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Annals and Magazine of Natural History: Series 9

Publication details, including
instructions for authors and
subscription information:

[http://www.tandfonline.com/loi/
tnah15](http://www.tandfonline.com/loi/tnah15)

LII.—The classification of the Mongooses (Mungotidæ)

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Published online: 02 Sep 2009.

To cite this article: R.I. Pocock F.R.S. (1919) LII.—The classification of
the Mongooses (Mungotidæ), *Annals and Magazine of Natural History*:
Series 9, 3:18, 515-524, DOI: [10.1080/00222931908673851](https://doi.org/10.1080/00222931908673851)

To link to this article: <http://dx.doi.org/10.1080/00222931908673851>

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ACANTHOCEPHALA.

Polymorphus minutus (Goeze), Lühe, 1911
[= *Echinorhynchus polymorphus*, Bremser].

Hosts: *Somateria mollissima*, Petschenga, 24. ix. 1917.
Uria grylle, Petschenga, 22. x. 1917.

The latter bird appears to be a new host for this species, which occurs chiefly in various species of ducks and in some other aquatic birds.

LII.—*The Classification of the Mongooses* (Mungotidæ).

By R. I. POCKOCK, F.R.S.

IN 1916 (Proc. Zool. Soc. 1916, pt. i. pp. 349-374) I published a comparative study of the principal external characters of the mongooses, granting this group the rank of a family Mungotidæ of the Æluroid, Herpestoid, or Mungotoid section of the Carnivora*.

In this paper I restored to use certain generic names, such as *Atilax*†, *Ichneumia*, and *Ariela*, which do not appear in their generic significance in modern treatises on the group, the two first being regarded as synonyms of *Mungos* (*Herpestes*) and the last as a synonym of *Crossarchus*. Since the justification for their resuscitation was not definitely stated in systematic form, and since the reason for thinking the mongooses should rank as a family of the Mungotidæ rather than as a subfamily of the Viverridæ, according to the generally adopted practice, was not declared at all, I propose in this paper to make good those defects.

* The term Herpestoidea was proposed by Winge to replace Æluroides on the grounds that the generic name *Ælurus* unfortunately stands for one of the Procyonidæ belonging to the Cynoid or Arctoid section of the order. But since *Herpestes*, being preoccupied, no longer stands for the typical mongooses, *Mungos* is used instead. Similarly, Mungotinæ has taken the place of Herpestinæ. Logically, therefore, Mungotoidea should be preferred to Herpestoidea if, in accordance with Weber, we follow Winge in discarding the title Æluroides.

† *Atilax*—or *Athylax*, as it should have been spelt—means pouchless, and was given by Cuvier to the marsh-mongoose, on the supposition that this animal has no anal sack. As I have shown, however (*op. cit.* p. 366), the sack is well developed in this genus.

Family Mungotidæ.

Mungotoid Carnivora distinguished by the combination of a number of positive and negative characters, of which the principal are:—

The secretion of the *anal glands*, the orifices of which are outside the anus, is discharged into a nearly naked, glandular, cutaneous sack capable of being closed by the juxtaposition of the upper and lower halves of its thickened rim.

Perineal scent-gland absent in both sexes.

Vulva close beneath lower rim of anal sack.

Prepuce close to scrotum.

Glans penis short, with orifice on its lower surface; baculum present.

Feet with fossorial, non-retractile, usually long claws, and pollex and hallux, when present, arising just above the plantar pad.

Ear rounded, small or moderate, without marginal bursa, and with antero-internal ridge (intratragus) curving abruptly backwards beneath the supratragus, and high above the intertragal notch.

Resembling the Hyænidæ and Cryptoproctidæ in the possession of an anal sack and the absence of preputial scent-gland, but differing from them in the smallness of the penis, the proximity of the prepuce to the scrotum, etc. The last character mentioned and the absence of the preputial gland distinguish them from the Viverridæ (*Viverra*, *Paradoxurus*, etc.). They approach the Galidictidæ in the structure of the feet and in cranial characters, but differ in the presence of the anal sack, the absence of the perineal gland and of the bursa in the ear, and in the presence of an alisphenoid canal or of a groove representing it.

Characters and Classification of the Genera of Mungotidæ.

In 1864, and in papers published after that date, Gray made use of the presence and absence of the naked area of skin cleaving the upper lip as a character of primary importance in classifying the mongooses. He even divided them into two families—the Herpestidæ and Rhinogalidæ—on that basis.

Thomas also chose this as the leading feature in grouping the genera of African mongooses, the number of toes coming next in order, then the premolar teeth, and, finally, the hairiness of the sole of the hind foot (P. Z. S. 1882, pp. 62-63). But whether the analytical key compiled on those lines

expressed his views regarding the true affinities of the genera, or whether the arrangement, in its entirety or in part, was merely a matter of convenience for the determination of the genera, I am not sure.

Mivart's classification was published in the same year as that of Thomas (P. Z. S. 1882, p. 185). He pointed out that the genera may be arranged in various ways, *i. e.*, according to the number of anal glands, the number of digits, the number of teeth, and the presence or absence of the subnasal groove; and it is quite clear, I think, that Mivart had no preference for one category over another. The use he made of the anal glands has already been discussed (P. Z. S. p. 366, 1916). With regard to the other groups, by the number of toes *Suricata* is ranged alongside *Bdeogale*, by the character of the upper lip it falls with *Rhinogale* and *Crossarchus*, by the number of premolar teeth it is associated with *Helogale* and *Crossarchus*.

Suricata has been selected here as a test of Mivart's proposed classification, because, in my opinion, the simple structure of the ear in that genus shows that it cannot be closely affiliated with any other genera of mongooses, all of which have complicated highly specialized ears; and this conclusion further suggests that the suppression of the divisional line of the upper lip may be an independently acquired resemblance between *Suricata* and *Crossarchus* or *Rhynchogale*.

From a comparison of the genera, admitted in my paper in 1916, both mutually and with those of the subfamilies of the Viverridæ, it may be assumed as a working hypothesis that the immediate ancestor of the mongooses possessed the following characters:—

1. The snout was of moderate length, and a naked grooved strip of skin (*philtrum*) extended from the rhinarium, which had a deep infranarial portion, to the edge of the upper lip.

2. The cheek-teeth, consisting of four premolars and two molars above and below on each side, were of a crushing and cuspidate rather than of a shearing and piercing type, with the upper carnassial (pm^4) set well in front of the posterior angle of the cheek where the inferior edge of the zygoma rises, thus leaving space behind for two well-developed molars, the last molar of the mandible being also well developed*.

* If it be claimed, as it may be claimed, that the ancestral form had the specialized carnivorous dentition of the kind seen in *Mungos*, then that genus, setting aside the ear, differs but little from the hypothetical progenitor of the group, and the more generalized omnivorous dentition of such forms as *Ichneumia* and *Crossarchus* has been secondarily acquired. A similar argument applied to the subfamilies of Viverridæ will involve

3. The ear had the external portion of the pinna small as compared with the depression containing the cartilages, and there was no marginal bursa. Of the cartilages, the supratragus was rod-like and the prominence of the antero-internal ridge (*intratragus*) ended high above the intertragal notch leading to the inferior auditory meatus.

4. The feet were semiplantigrade and pentadactyle, with the pollex and hallux inserted above the plantar pad, which was trilobate, not quadrilobate; the four main digits, armed with long fossorial claws, were united by interdigital webs extending to the proximal ends of the small digital pads; the fore feet were naked back to the carpal pad and the hind feet up to and possibly including the heel.

5. The orifices of the anal glands were outside the anus, and their secretion was discharged into a nearly naked glandular cutaneous sack with a thickened rim and capable of being closed by the juxtaposition of the upper and lower halves of this rim.

6. The vulva was only a short distance below the lower edge of the anal sack and the penis was short and situated close to the scrotum, there being no trace of a preputial gland between the penis and scrotum in the male or between the anal sack and the vulva in the female.

None of the existing genera conforms precisely to this type. Apart from *Suricata*, to be considered later, all of them have ears more complex in construction, owing to the formation of the two valvular laminae.

Of the genera with complex ears, *Mungos* (type *mungo*), in a broad sense, with its pentadactyle naked feet, well-webbed digits, and cleft upper lip and moderate snout, agrees with the primitive type, but it differs therefrom in its carnivorous dentition, the upper carnassial (pm^4) being large and set back

the conclusion that the specialized carnivorous dentition of *Genetta* and *Linsang* preceded in evolution the generalized omnivorous dentition of *Paradoxurus* and *Fossa* respectively. Also that the similarity between the teeth of *Genetta* and *Mungos* in number, position, and form is a character inherited almost unchanged from a common *Æluroid* ancestor. I believe, on the contrary, that it is a purely adaptive resemblance, and that the carnivorous type of dentition, attested more particularly by the retrogression of the upper carnassial (pm^4), accompanied by reduction in the size and importance of the two molars behind it and of the first premolar, has been independently acquired several times over within the limits of the *Æluroides*; and that the extraordinarily varied types of dentition met with in this group have been derived sometimes by elaboration, sometimes by degeneration from some such type as that of the typical *Canidæ*, in which the upper carnassial is set far forwards, leaving space for two fairly large molars behind it.

almost to the angle of the cheek, the two molars being reduced so as to fit into the short dental area behind it. The lower carnassial (m^1) is correspondingly large and the last molar quite small. The first premolar, always small and sometimes absent, is evidently a practically functionless tooth, but, when absent, its former position is marked by the persistence of the space between the canine and the second premolar.

Helogale (type *parvula*) may be regarded as a dwarfed *Mungos*, in which the diastema has closed up by the shortening of the jaw.

Atilax (type *paludinosus*) is related to *Mungos*, but has very specialized feet, as is testified by the suppression of the interdigital webs. The slightly more forward position of the upper carnassial and the larger size of the two molars suggest its being an offshoot from the *Mungos* + *Helogale* stem before the retrogression of the carnassial was completed. The exceptional massiveness of the teeth and jaws are probably an adaptation for crushing the shells of the river-crabs on which it feeds to a great extent.

Ichneumia (type *albicauda*) has teeth* of a more generalized type than *Mungos*, and in that particular comes nearer the hypothetical primitive form, but it differs therefrom at least in the hairiness of the hind feet and more digitigrade gait. The depth of the upper lip below the rhinarium is also no doubt a specialized feature.

Bdeogale (type *crassicauda*) shows many dental resemblances to *Ichneumia*, as Thomas pointed out †. Specialization of the feet, however, is carried a stage further than in that genus, as is shown by the shortening of the four main digits and the suppression of the hallux and pollex.

* Of the teeth of *Ichneumia albicauda* Thomas wrote in 1882:—“Teeth more rounded than in the members of the typical subgenus [*Mungos*]. Last molars above and below proportionately much larger . . . the lower one with a well-marked extra cusp between the usual ones, so that there are five cusps in all.” To this it may be added that the first molar of the upper jaw is nearly as large as the carnassial (pm^1), though lower crowned, and occupies the position of the carnassial in *Mungos*, being inserted well in front of the superjacent base of the zygomatic arch.

† He wrote, “Of all the mongooses *H. albicauda* [*Ichneumia*] seems to be most nearly allied to true *Bdeogale*, strongly resembling the species of that genus in . . . the proportionally large size of the last molar, and, most of all, in the presence of the median middle external cusp to the last molar, a character in which *Bdeogale* differs from all other mongooses except the present species and those of the very distinct genus *Crossarchus*.”

*Rhynchogale** (type *melleri*) was associated by Gray with *Crossarchus* and *Suricata*, and provisionally left in that category by Thomas. It appears to me to be more nearly related to *Ichneumia* and *Bdeogale*, despite the suppression of the groove on the upper lip.

In position and relative size the teeth are not at all unlike those of *Ichneumia* and *Bdeogale*, although the upper carnassial is a little more forward. Their chief peculiarity lies in the flatness of the crowns of the molars, probably an adaptation to a frugivorous diet †. The twist of the lower dental row is not much, if at all, more marked than in *Bdeogale*, and the same is true of the concavity of the palate. The mesopterygoid fossa is more forward than in *Ichneumia* and *Bdeogale*, but the bullæ, which are more inflated posteriorly than in *Bdeogale*, do not surpass those of *Ichneumonia* in that respect. The feet are pentadactyle and hairy as in *Ichneumia*. The absence of the groove below the rhinarium is a distinctive feature of *Rhynchogale*, which appears also to have a longish snout; but this latter feature seems to be foreshadowed by the long upper lip of *Ichneumia*. On the evidence I think the genus may be regarded as a specialized form of the *Ichneumia* + *Bdeogale* group of genera.

The exact position of *Cynictis* (type *penicillata*) and *Paracynictis* (type *selousi*) is doubtful, but there are indications perhaps of closer kinship with *Ichneumia* than with any other genus, although the relationship is not close. Nevertheless, the large ears of *Cynictis* are foreshadowed in *Ichneumia*, and, as in that genus, the fore foot is hairy down to the carpal pad and the hind foot down or almost down to the plantar pad; but the suppression of the hallux in *Cynictis* and of both pollex and hallux in *Paracynictis*, and the reduction in depth of the interdigital webs mark the feet as more specialized than in *Ichneumia*, though possibly in the greater length of the claws they are more primitive. Specialized features in the skull are its shortness, a character correlated, judging from *Suricata*, with stronger postorbital bars and

* I have seen no fresh or spirit-preserved material of this genus apart from a newly born kitten found by White at Zomba and preserved in the British Museum. The anal sack is well developed, but the most remarkable feature about the specimen is the enormous depth of the upper lip beneath the rhinarium, giving an unusually thick aspect to the muzzle. The rhinarium, moreover, is set upon the summit of the muzzle, and has an upward, not a forward aspect, almost as in *Cynogale*. Since I do not know the condition of the muzzle in the young of other genera of mongooses, a simple record of the facts must suffice.

† White found the stomachs of *Rhynchogale* filled with fruit (P. Z. S. 1894, p. 139).

more arched zygomata, and the inflation of the anterior chamber of the bulla, coupled with the large perforation close to the tympanic bone.

As in *Ichneumia*, *Mungos*, and others, the *foramen rotundum* opens into the alisphenoid canal, probably a primitive feature. The teeth of the upper jaw are somewhat more sectorial than in *Ichneumia*, as is shown more particularly by the narrower palatal portions of the two molars.

Ariela (type *fasciata*), with some points of resemblance to *Mungos* in its semiplantigrade pentadactyle feet, has nevertheless a more generalized dentition. The highly developed anal sack and absence of groove on the snout are specialized features. In one character connected with the skull it differs from all the genera hitherto considered (? *Rhynchogale*)—namely, in the opening of the *foramen rotundum* direct into the temporal fossa and not into the alisphenoid canal, the anterior aperture of the latter being situated alongside that orifice and separated therefrom by a narrow bony partition.

Crossarchus (type *obscurus*), resembling *Ariela* in the particular last mentioned, has a less specialized anal sack and a more specialized snout.

Suricata (type *suricata*) has always been admitted to hold an isolated position amongst the mongooses, and the now ascertained differences in the structure of its ear enhance the isolation.

Generically it may be distinguished from the rest of the family by a complex of associated characters, like the general form of the skull, the elongated snout, undivided upper lip, tetradactyle feet, and naked tarso-metatarsus. The shape of the skull, with its bowed zygomata and complete and stout postorbital bars, recalls in a measure that of *Cynictis*; but the great difference in the form of the bullæ, apart from other features, precludes the idea of near affinity between the two genera. The long snout and undivided upper lip, resembling those features in *Crossarchus*, are likely enough to be purely adaptive resemblances; but in the skull there is one significant similarity, namely, the situation of the *foramen rotundum* alongside the anterior orifice of the alisphenoid canal and close to the sphenoidal fissure—a character restricted to *Ariela*, *Crossarchus*, ? *Rhynchogale*, and *Suricata*, so far, at all events, as mongooses are concerned. I think it is a tenable hypothesis that *Suricata* is a highly specialized offshoot of the *Ariela* + *Crossarchus* stock of this family. In that case, the ear of *Suricata* may be regarded as secondarily simplified. Nevertheless, a comparison between this ear and that of the Mascarene Galidictine genera forcibly suggests

simplification from that type of organ found in the latter group. In the present state of our knowledge it seems to me that no satisfactory conclusion can be reached on this point. But even if kinship between *Suricata* and *Crossarchus* be admitted, it must be remembered that the former differs from the latter more than *Crossarchus* differs from other genera of mongooses.

The main characters peculiar to the skull of *Suricata* are the following :—

1. The plane of the base of the skull is inclined at an obtuse angle to the plane of the palate. In other genera these two planes are subparallel.
2. The bullæ are nearly as wide as long, very flat, and project only slightly below the occipital condyles, which are situated between their postero-superior portion. In other genera the bullæ are much longer than wide, inflated, and project some distance below the condyles.
3. The ridge of the mastoid extends on the outer side of the bulla below the inferior edge of the auditory meatus.

These characters, coupled with the difference in the structure of the ear, justify the erection of *Suricata* to the rank of a subfamily—the Suricatinæ,—the rest of the genera constituting the Mungotinæ.

Analytical Key to the Genera of Mungotidæ.

The construction of an analytical key to the genera of this family is simplified by giving a foremost place to the number of digits and to the structure of the upper lip; but since the adoption of that course leads, in my opinion, to artificial affiliation, I have attached a secondary importance to those characters :—

- | | |
|---|--|
| <p>A. Supratragus a simple ridge with no valvular flap above it; skull-characters as enumerated above</p> <p>Teeth as under <i>a'</i> below, pollex and hallux suppressed, upper lip uncleft by philtrum</p> | <p>Subfam. SURICATINÆ.</p> <p><i>Suricata.</i></p> |
| <p>B. Supratragus large and valvular, with a valvular flap just above it</p> <p><i>a.</i> Dentition sectorial, upper carnassial (<i>pm</i>⁴) dominant, set back so that its posterior angle is close to the base of the malar arch, its outer edge forming an obtuse angle with that of <i>m</i>¹, most of which is</p> | <p>Subfam. MUNGOTINÆ.</p> |

- behind that point; (upper lip shallow, cleft; digits 5—5).
- b. Digits 2 to 5 always united by a web which projects beyond the margin of the plantar pad.
- c. Either a space or pm^1 intervening between the upper canine and pm^2 . *Mungos* *.
- c'. No space between upper canine and pm^2 ; pm^1 suppressed *Helogale*.
- b'. Digits 2 to 5 separated down to plantar pad, owing to suppression of the webs present in other genera *Atilax*.
- a'. Dentition more generalized, rather crushing than sectorial, upper carnassial (pm^4) set forwards so that its posterior angle is well in advance of the root of the malar arch, the whole or practically the whole of m^1 being also in advance of that point, the line of the cheek-teeth forming a much more even curve at the junction of pm^4 and m^1 .
- d. Webs deeper as compared with length of digits; ears moderate or small, with no pocket behind the antitragal ridge; skull elongated, lower; inner portions of upper m^1 , m^2 thick and strong; last lower molar with median external cusp or flat-crowned.
- e. Legs short, semiplantigrade, fore paws broad, with very long claws; at most the heel of the hind foot hairy, ears small and rounded (no groove on upper lip).
- f. Snout short as in *Mungos*, infranarial portion of rhinarium shallow; anal sack complex. *Ariela*.
- f'. Snout long, infranarial portion of rhinarium deep; anal sack simple. *Crossarchus*.
- e'. Legs long, digitigrade, fore paws narrow, claws shorter, metatarsus covered with hair almost to the plantar pad, ears longer.
- g. Upper lip grooved, posterior cheek-teeth cuspidate; mesopterygoid fossa set further back.
- h. Pollex and hallux retained . . . *Ichneumia*.
- h'. Pollex and hallux suppressed . . *Bdeogale*.
- g'. Upper lip ungrooved, posterior cheek-teeth flat-crowned; mesopterygoid fossa set more forwards. *Rhynchogale*.
- d'. Webs very shallow as compared with length of digits, especially between digits 3 and 4, 4 and 5; ears very large for the group, with a small

* I suspect this genus will prove to be divisible into three or more genera when better known.

pocket behind the antitragal ridge * ; skull short and high ; inner portions of upper m^1 and m^2 slender and weak ; last lower molar without median external cusp ; (upper lip grooved ; metatarsus hairy down to plantar pad ; hallux absent).

- i. Pollex retained *Cynictis*.
 ii. Pollex suppressed *Paracynictis*.

LIII.—On Two new Parasitic Mites (*Myocoptes hintoni* and *Psoroptes natalensis*). By STANLEY HIRST.

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Myocoptes hintoni, sp. n.

♀. The minute little *scutum* (at the extreme anterior end of the *dorsum*) angular posteriorly in the middle, but not ending in a slender, median, spine-like process, as in *M. musculinus*, Koch, and *M. tenax*, Michael. The new species can also be readily recognized by the four very long hairs (a pair on each side) that are present (on the venter) at the posterior end of the body, instead of only two long hairs in this position (one on each side), as in *M. musculi*, *M. tenax*, etc.

Length of body 340 μ , its width 170 μ .

Host: English Squirrel (*Sciurus vulgaris*), Exeter, October 1918.

Psoroptes natalensis, sp. n.

♂. Second hair from each side on abdominal lobe fairly long and shaped like a very fine lance, the distal half being distinctly flattened (blade-like), instead of cylindrical as in *P. ovis*, *P. capræ*, *P. cuniculi*, *P. equi* (and also *P. bovis*, according to Berlese's description and figure). Middle hair on lobe long and fine. Outermost hair quite short. Innermost hair very fine and comparatively long.

Length of body (including capitulum and posterior lobes) 420 μ , its width 290 μ .

Material. A number of specimens found on cattle at Richmond, Natal, 1896 (C. D. Soar's collection).

Note.—In the genus *Chorioptes* (including *C. bovis*) the central hairs on the abdominal lobes of the male are modified in much the same way as in this new species, but the flattened portion is very much wider and the pedicles of the tarsi bearing the pulvilli are quite short instead of elongated and segmented, as in *Psoroptes natalensis*, etc.

* The characters of the feet and ear need verification in the case of *Paracynictis*, only dried skins of the genus being available for examination.