

## A note on the systematic position of the Muntjac (*Artiodactyla*, *Cervidae*)

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The Muntjac and its relatives the Tufted deer (genera *Muntiacus* and *Elaphodus*) have always been assigned an isolated position among the Cervidae. It is true that they bear a fairly close resemblance to certain Miocene genera such as *Euprox*, but at the same time their relatively primitive features should not be allowed to obscure any similarities they may have with more specialised, recent groups.

Because of their supposed isolation, generally resulting in the muntjac being assigned a separate subfamily (Muntiacinae or Cervulinae), a consideration of their relationship may help to clarify the systematics of the living Cervidae as a whole. A brief summary of the history of the classification of this group will therefore be given.

The earliest attempt to split up the Cervidae into groups was by BROOKE (1878), who proposed a basic division into Plesiometacarpi (deer in which the rudiments of metacarpals II and V are retained at the proximal end of the cannons) and Telemetacarpi (in which it is the distal ends which are retained). To the first group belonged the muntjac and the Red Deer group, to the second, all the other deer. BROOKE also pointed out certain other features which help to divide up the Cervidae: division of the choanae, position of the metatarsal tuft, and premaxillary-nasal articulation. These subsidiary features did not, however, entirely agree in their distribution with the metacarpal characters, as BROOKE himself noted.

LYDEKKER (1915) did not divide up the Cervidae beyond putting the Musk deer (*Moschus*) into a subfamily of its own: but these latter are today not considered true deer in any case and are placed in a family, Moschidae, of their own (FLEROV 1952).

POCOCK (1923) proposed a division into eight subfamilies of the Cervidae; his prime division being between the Plesiometacarpal and Telemetacarpal groups. Within the Telemetacarpal group, he used the character of the vomer mentioned by BROOKE to separate the Pudinae, Odocoileinae and Rangiferinae from the Hydroptinae, Capreolinae and Alcinae; with the Plesiometacarpal group he distinguished two subfamilies, Cervinae and Muntiacinae, on the grounds that 1. in the latter the naviculo-cuboid and external and median cuneiforms are all fused together, 2. the male muntjac has a long, daggerlike canine whereas cervine stags have the upper canine absent or minute, 3. the antler pedicels are very long in Muntiacinae, short in Cervinae.

SIMPSON (1945) also makes the Plesio- vs. Telemetacarpal division the primary one in his classification, recognising two large subfamilies, Cervinae for the Plesio- and Odocoileinae for the telemetacarpal groups, and two small ones, Moschinae (now removed from the Cervidae altogether: see above) and Muntiacinae. The theoretical standpoint therefore seems to be that BROOKE's divisions are of prime importance,

except that the muntjac group is too primitive to be allowed to take its place in its respective group (which would be the plesiometacarpal group, the Cervinae of SIMPSON).

The system adopted by FLEROV (1952) is totally different from any of these. Roundly criticising SIMPSON for in effect making a division of the Cervidae on the basis of a single character, he uses skull-characters to reshuffle the various genera while retaining two subfamilies with the same nuclei as SIMPSON. Basically, *Alces* and *Capreolus* are now transferred to the Cervinae and *Hydropotes* is made the type of a special subfamily, Hydropotinae; the residue of the New World deer plus *Rangifer* are retained in a subfamily Neocervinae (basically, SIMPSON's Odocoileinae).

We thus have now two large subfamilies, distinguished by the presence or absence of a vomerine septum in the nasal cavity (and other skull characters) instead of by the metacarpal rudiments, and two "primitive" subfamilies instead of one. The main contribution in this scheme was to show that *Alces* and — more especially — *Capreolus* are really quite closely related to the *Cervus* group in spite of their metacarpal types. But still the muntjac is excluded because of its claimed primitive status, and indeed a second subfamily has now been erected on a similar basis.

The arrangement of HALTENORTH (1963) returns to a scheme like that of POCKOCK, with a number of subfamilies rather than a basic division. Although *Capreolus* is retained in the Odocoileinae, both *Alces* and *Hydropotes* have been raised to subfamily rank, in addition to *Rangifer*; a curious move, as both SIMPSON and FLEROV agreed that this genus is close to *Odocoileus* and the true New World deer.

Two other studies that need to be mentioned, as they provide further bases for systematic conclusions without however, themselves making new subfamilial arrangements, are those of POCKOCK (1935) and MEUNIER (1963). The former is a survey of incisor forms in Cervidae, and has been subsequently extended by HALTENORTH (1963); the latter is a study of skull angles, especially the basicranial angulation.

If we take the results of all these studies together, character by character, we find very definite indications as to the relationships of the muntjac group:

1. Like the Cervinae (*Cervus*, *Elaphurus* etc.), muntjac are plesiometacarpal; they are, moreover, the only other deer which are. As this implies a virtually non-functional role for the lateral digits — since these do not articulate with the lateral metacarpal rudiments — it seems likely that this is a strong specialisation. Indeed in *Muntiacus*, though not in the closely allied *Elaphodus*, the lateral digits are more or less absent and have no skeletal elements.
2. Again like the Cervinae, the choanal opening is undivided. In this case we have probably a resemblance due to retention of a primitive (symplesiomorph) condition; it is shared with *Alces*, *Capreolus* and *Hydropotes*, while the Odocoileinae have a specialised condition in which the vomer extends dorsally to fuse with the palatines, making a septum for the nasal cavity.
3. The basicranial axis is straight as in the Cervinae, *Alces*, *Capreolus* and *Hydropotes*, and contrasts with the typical Odocoileine condition which shows lordosis.
4. The anterior ends of the premaxillae are rounded as in the Cervinae and in the three genera listed above, not notched as in the Odocoileinae. This, like (2), may well be a primitive character.
5. The angle between the palatal plane and the pharyngeal skull-base plane (MEUNIER 1963) is below  $165^\circ$  in *Muntiacus* as in the Cervinae. In this case, some of the Odocoileinae show values also under  $165^\circ$ , but the three other Old World genera mentioned above have values above this.
6. The choanal height angle lies between  $10^\circ$  and  $15^\circ$  as in the Cervinae and most of the Odocoileinae; *Alces* has an angle in this range, but in *Hydropotes* and certain Odocoileines it is lower, while in *Capreolus* alone in the family it is above  $15^\circ$ .

7. The rhinarium is large, enclosing the nostrils, in *Muntiacus*; this is likely to be a primitive character as only cold-adapted deer (*Alces*, *Rangifer*, *Pudu*) have smaller rhinaria.
8. The incisors show a characteristic size relationship in various deer. In muntjac, as in *Axis* and *Dama* (two of the cervine group), the breadth of  $I_1$  is greater than the combined breadth of the other two incisors and the canine. In the other cervines, as well as in *Hydropotes*,  $I_1$  breadth is about equal to the combined breadth of  $I_2$  and  $I_3$ , or equal to these plus the canine. *Capreolus* falls into this group as well. But in the *Odocoileinae* and in *Alces*, the size discrepancy is far less,  $I_1$  being only half the combined breadth of the other incisors plus the canine, and in some cases not much broader than  $I_2$  alone.
9. The pedal glands of the hindfoot are long and deep in muntjac, as in *Dama* and *Axis*, *Hydropotes*, and some *odocoileines* (*Pudu* and *Mazama*). In other deer they are simple and pocket-like, but in other cervines (*Cervus*, *Rusa* etc.) lacking altogether.
10. The special features of muntjac are in most cases only exaggerations of tendencies already present in other deer, especially the *Cervinae*:
  - a. The nasal bones are very short, and fail to reach back to the level of the orbits. This character is less marked in *Elaphodus*, and foreshadowed in some individuals of other genera, e.g. *Axis*.
  - b. The orbits are not tubular like those of most deer. This seems to be partly dependant on size; in *Hydropotes*, *Pudu* and *Mazama* there are also non-tubular orbits, and those of *Axis porcinus* and some of the small Philippine *Rusa* are less so than most.
  - c. The long, dagger-like upper canines of males are shared only with *Hydropotes* among the *Cervidae*, and in the latter they are much more strikingly developed. Some deer have lost the upper canines entirely, which is why those of muntjac are so conspicuous, but small ones are regularly present in the *Cervinae* (except *Dama*) and in some *Odocoileinae*.
  - d. The facial "ribs" of *Muntiacus* — downward prolongations of the antler pedicels — and the great length of the pedicels themselves are only the extreme development of tendencies common among the smaller *Cervinae* (e.g. *Axis porcinus*, *Cervus nippon*), and are seen much more exaggerated in *Muntiacus* than in *Elaphodus*.
  - e. The extensive fusion of tarsal bones is not seen in any other deer except *Pudu*, in which the medial cuneiform is still free, and in which, in any case, it is likely to be convergent. This is therefore a real special feature of muntjac.

An examination of a number of features has, therefore, shown that there is no reason to exclude *Muntiacus* from the *Cervinae*; it is indeed probably closer to the central group of cervina genera — *Cervus*, *Axis*, *Dama*, *Elaphurus* — than *Alces*, probably even than *Capreolus*. It is probable that *Hydropotes* is another member of this subfamily, though an aberrant one owing to its total lack of antlers: the question of this remarkable genus is more difficult it being uncertain whether its resemblance to the *Cervinae* are due to common retention of primitive features or not. But in the case of *Muntiacus* there is no doubt.

### Summary

A survey of the features used to divide the subfamilies of *Cervidae* shows that the muntjac, *Muntiacus* and *Elaphodus*, are true cervines, and rather closely related to *Cervus* and its allies. There is no reason to refer them to a separate subfamily as has been done by almost all authors up to now.

## Zusammenfassung

*Eine Notiz über die systematische Stellung der Muntjacs (Artiodactyla, Cervidae)*

Ein Merkmalsüberblick beschäftigt sich mit den Unterschieden der Unterfamilien innerhalb der Cervidae. Dabei zeigt sich, daß die Muntjacs *Muntiacus* und *Elaphodus* mit *Cervus* und dessen Verwandten eng verbunden sind und somit echte Cervinae darstellen. Es gibt keinen Grund, eine eigene Unterfamilie Muntiaginae aufzustellen, was bislang fast jeder Verfasser tat.

## Résumé

*Une note sur la position systématique du Muntjac (Artiodactyla, Cervidae)*

Un aperçu sur les caractères employés à diviser les sous-familles des Cervidae a montré que les muntjac, *Muntiacus* et *Elaphodus*, sont des vrais cervinés, étroitement affinis à *Cervus* et ses parentés. Il n'y a pas de raison pour les séparer en une sous-famille spéciale, comme a été fait par presque tous les auteurs jusqu'à maintenant.

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Artikel/Article: [A note on the systematic position of the Muntjac \(Artiodactyla, Cervidae\) 369-372](#)