

# The naming of wild animal species and their domestic derivatives

Anthea Gentry<sup>a\*</sup>, Juliet Clutton-Brock<sup>b</sup>, Colin P. Groves<sup>c</sup>

<sup>a</sup>Littlewood, Copyhold Lane, Cuckfield, Haywards Heath, West Sussex RH17 5EB, UK

<sup>b</sup>South Barn, High Street, Fen Ditton, Cambridgeshire CB5 8ST, UK

<sup>c</sup>School of Archaeology and Anthropology, The Australian National University, Canberra, ACT 0200, Australia

Received 5 June 2003; accepted 15 October 2003

## Abstract

Several systems have been devised for the naming of domestic animals but none has gained universal acceptance. Where Latin names of the Linnaean system are used, the majority of wild progenitor species and their domestic derivatives share the same name but in 19 cases there is a tradition of separate names for the wild and domestic forms. Many taxa first described and named by Linnaeus (*Systema Naturae*, 1758, 1766) and other authors were either based on domestic animals or encompassed both the wild and domestic forms. Among these are 16 mammals for which the name for the domestic form antedates or is contemporary with that of the wild ancestor and the former has been applied by a few authors to the wild species, creating confusion in the literature. A recent ruling (Opinion 2027, March 2003) by the International Commission on Zoological Nomenclature has fixed the first available specific name based on a wild population for 17 wild progenitor species (15 mammals, a fish and a moth). It is now recommended that names based on domestic forms be adopted for the corresponding domestic derivatives.

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**Keywords:** Nomenclature; Taxonomy; Mammalia; Osteichthyes; Lepidoptera; Wild progenitor species; Domestic animals

## 1. Domestication

The first osteological evidence for the domestication of a wild animal, that of the wolf, is dated to at least 15,000 years ago, and the earliest known domestic food animals were probably goats and sheep at least 9000 years ago. Domestication of cattle and pigs followed, and by 7000 years ago these four constituted the main food items. The horse was the last of the five common livestock animals to be domesticated [9]. There is evidence that the cultivation of plants began about 10,500 years ago, shortly before the end of the last European glacial period [31].

A domestic animal, in its most developed form, shows four main characteristics: (1) its breeding is under human control; (2) it provides a product or service useful to humans; (3) it is tame; (4) it has been selected

away from the wild type. Domestication was defined by Gautier [22] as “a microevolutionary process and a form of cultural control over animals, implying that these creatures are forced to live and multiply in captivity; as a result they acquire domestic traits” (see also various papers in Clutton-Brock [7] and see [9]). Not all animals considered to be “domestic” qualify under all the criteria, and archaeozoologists and anthropologists have demonstrated many different stages intermediate between wild species and their domestic derivatives (see, for example, [71] and references cited in her paper). Van Gelder [65, p. 151] also drew a distinction between modern “domestic” animals (populations that have come to differ from their ancestral stocks through selection by humans) and “domesticates” (individuals of otherwise wild species that are tame and “of the home”). Recent research has accepted a combination of features in animal remains, particularly ungulates, at archaeological sites as indicating the early stages of domestication: dominance of one species at any one time; dominance of young adult males; presence of all skeletal parts of a given species; reduction in size; morphological

\* Corresponding author. Tel.: +44-1444-413678

E-mail addresses: [alantgentry@aol.com](mailto:alantgentry@aol.com) (A. Gentry), [julietcb@btinternet.com](mailto:julietcb@btinternet.com) (J. Clutton-Brock), [colin.groves@anu.edu.au](mailto:colin.groves@anu.edu.au) (C.P. Groves).

change in horn cores; increase in the number of pathologies; and presence in an archaeological site outside the natural wild range ([68]; a number of detailed analyses of Near and Middle Eastern sites using these criteria appear in the same volume).

Recent genetic analyses have demonstrated that there are two or more lineages represented in several domestic animals (including cattle, water buffalo, sheep, goat, pig, horse, llama and alpaca), derived from two or more wild ancestral species or subspecies (Hiendleder et al. [35], for example, on sheep; MacHugh and Bradley [45], on goats; and Kadwell et al. [37] on the llama and alpaca). There is also genetic evidence of hybridisation of domestic animals with wild species and other domestic forms during domestication. Many distinct wild species can interbreed with normal fertility rates and all domestic forms retain the genetic ability to breed with the wild species if that is extant (see, for example, Stains [60] for dog/wolf; Novoa and Wheeler [52] for llama and alpaca/guanaco and Morris [50] for ferret/polecat and domestic cat/wildcat).

## 2. Naming domestic forms

Domestic animals do not fall into a recognised and consistent system of taxonomy (see [6,9,23,30]) and zoologists and archaeozoologists have been discussing their naming for many years. Many taxa first described and named by Linnaeus [42,43] and a few other authors were either based on domestic animals or encompassed both the wild species and domestic forms. The great majority of wild species and their domestic derivatives share the same name (e.g. *Oryctolagus cuniculus* (Linnaeus, 1758) for the wild and the domestic rabbit, *Myocastor coypus* Molina, 1782 for the wild coypu and the domestic nutria, *Anas platyrhynchos* Linnaeus, 1758 for the mallard and the domestic duck, and *Columba livia* Gmelin, 1789 for the rock dove and the domestic pigeon; [9,13]), but some 19 domestic forms (17 mammals, a fish and a moth) have names which are traditionally distinct from those applied to their wild ancestors ([30]; the names are here set out in Table 1). Of these, 16 domestic mammals have names that antedate or are contemporary with those for the wild species and a few authors have applied these names to the wild species. This has caused problems and confusion in zoology and especially in archaeozoology where the distinction between wild species, domestic forms and intermediate stages is crucial.

The creation of Latin names for domestic animals was fashionable for many decades in the 19th and early 20th centuries and a plethora of names in the literature resulted. The nomenclatural treatment of these names (as species, subspecies, races or breeds) was inconsistent, both between authors and within the works of the same author. Ellerman and Morrison-Scott [19], for example,

treated the wild and domestic forms of the gaur as separate species, *Bos gaurus* and *B. frontalis*; the wild yak as a subspecies, *B. grunniens mutus*, of the domestic; and the wild and domestic forms of the water buffalo as conspecific, *Bubalus bubalis*. More recently, attempts have been made to achieve consistency in the naming of domestic animals and several nomenclatural systems have been devised. These were summarised and discussed by Gautier [23]; the two most notable are mentioned here. Bohlken [3,4] proposed that priority should be suspended for the nomenclature of domestic animals; he labelled them with the specific name of the wild ancestor followed by the name of the domestic form where this had been separately named. In order to indicate that domestic animals were not “natural” subspecies he added the word “forma” and treated the trinomial as infrasubspecific (e.g. “*Bos primigenius* forma *taurus*”). This system was adopted by Herre and Röhrs [34] and a number of other archaeozoologists worldwide. Dennler de la Tour [17,18] also considered that priority should not apply to the names of domestic animals and proposed that they be labelled with the name of the wild ancestor followed by “familiaris” to denote their status (e.g. *Bos primigenius* “familiaris”).

In response to the inconsistency of treatment in the two systems proposed by Bohlken [3,4] and Dennler de la Tour [17,18], neither of which was in accord with the International Code of Zoological Nomenclature, and to avoid the danger of a proliferation of such systems, one of us (C.P.G.) submitted an application [27, pp. 269–272] to the International Commission on Zoological Nomenclature (ICZN) which sought to exclude from the Code names based on domestic animals. Groves proposed that wild species should be referred to by the first available name based on a wild population, whilst vernacular names only would be used for domestic animals (e.g. “*Bos* (domestic cattle)”). Comments on the application were received from eight authors; those from five were published in the Commission’s publication, the *Bulletin of Zoological Nomenclature* (BZN). All the commentators opposed the proposal on practical grounds: (a) there are difficulties in interpreting the meaning and boundaries of the word “domestic” and it would be difficult to decide which names were to be treated as outside the scope of zoological nomenclature; (b) as noted above, relatively few names based on domestic forms (19 in all) are distinct from those applicable to their wild ancestors. The majority of wild species and their domestic derivatives share the same name, which may well have been based on domestic forms. If “domestic” names were excluded from nomenclature under the Code all these names would be affected. Additionally, if excluded from the Code, the “domestic” names could, formally, be re-used for different taxa, leading to considerable confusion. The application eventually lapsed. Nearly all the commentators,

Table 1  
Wild species and their domestic derivatives which traditionally have separate names

Wild species	Domestic form
<b>Perissodactyla</b>	
<i>Equus africanus</i> Heuglin and Fitzinger, 1866 [66, p. 588] North African wild ass	<i>Equus asinus</i> Linnaeus, 1758 [42, p. 73] Donkey
<i>Equus ferus</i> Boddaert, 1785 [2, p. 159] Russian wild horse, tarpan	<i>Equus caballus</i> Linnaeus, 1758 [42, p. 73] Domestic horse
<b>Artiodactyla</b>	
<i>Camelus ferus</i> Przewalski, 1878 [56, pp. 20, 43] Wild Bactrian camel, now restricted to the western Gobi desert	<i>Camelus bactrianus</i> Linnaeus, 1758 [42, p. 65] Domestic Bactrian camel
<i>Lama guanicoe</i> (Müller, 1776) [51, p. 50] South American guanaco	<i>Lama glama</i> (Linnaeus, 1758) [42, p. 65] Llama
<i>Vicugna vicugna</i> (Molina, 1782) [47, p. 313] South American vicuña	<i>Vicugna pacos</i> (Linnaeus, 1758) [42, p. 66] Alpaca
<i>Bos primigenius</i> Bojanus, 1827 [5, p. 477, pl. 24] Aurochs of Europe, Asia and North Africa, extinct since 1627	<i>Bos taurus</i> Linnaeus, 1758 [42, p. 71] Common cattle
<i>Bos namadicus</i> <sup>a</sup> Falconer, 1859 [21, p. 230] Indian aurochs, extinct	<i>Bos indicus</i> Linnaeus, 1758 [42, p. 72] Indian humped cattle or zebu
<i>Bos gaurus</i> H. Smith, 1827 [59, p. 399] Gaur of India, Burma and Malaya	<i>Bos frontalis</i> Lambert, 1804 [41, p. 57] Gaur, mithan
<i>Bubalus arnee</i> (Kerr, 1792) [38, p. 336, figs. opposite pp. 295, 336] Indian water buffalo, arni	<i>Bubalus bubalis</i> (Linnaeus, 1758) [42, p. 72] Domestic water buffalo
<i>Bos mutus</i> (Przewalski, 1883) [57, p. 191, pl. opposite p. 190] Yak of mountains of Tibet, Nepal and the Himalayas	<i>Bos grunniens</i> Linnaeus, 1766 [43, p. 99] Domestic yak
<i>Capra aegagrus</i> Erxleben, 1777 [20, p. 260] Bezoar of the Middle East	<i>Capra hircus</i> Linnaeus, 1758 [42, p. 68] Domestic goat
<i>Ovis orientalis</i> Gmelin, 1774 [25, pp. 432, 486, pl. 15] Mouflon of Western Asia	<i>Ovis aries</i> Linnaeus, 1758 [42, p. 70] Domestic sheep (including European mouflon; [62])
<i>Sus scrofa</i> <sup>b</sup> Linnaeus, 1758 [42, p. 49] Wild boar of Europe, Asia and North Africa	<i>Sus domesticus</i> Erxleben, 1777 [20, p. 179] Domestic pig
<b>Rodentia</b>	
<i>Cavia aperea</i> Erxleben, 1777 [20, p. 348] South American cavy	<i>Cavia porcellus</i> (Linnaeus, 1758) [42, p. 59] Domestic guinea pig
<b>Carnivora</b>	
<i>Canis lupus</i> Linnaeus, 1758 [42, p. 39] Wolf of the Palaearctic, India and North America	<i>Canis familiaris</i> Linnaeus, 1758 [42, p. 38] Dog (including dingo)
<i>Mustela putorius</i> Linnaeus, 1758 [42, p. 46] Polecat of Europe, Middle East and Morocco	<i>Mustelo furo</i> Linnaeus, 1758 [42, p. 46] Ferret
<i>Felis silvestris</i> Schreber, 1777 [67, p. 39] Wildcat of Western Europe to Western China and Central India, much of Africa	<i>Felis catus</i> Linnaeus, 1758 [42, p. 42] Domestic cat
<b>Osteichthyes</b>	
<i>Carassius gibelio</i> (Bloch, 1782) [1, p. 71] Prussian or gibel carp of Central Europe to East Asia	<i>Carassius auratus</i> (Linnaeus, 1758) [42, p. 322] Goldfish
<b>Lepidoptera</b>	
<i>Bombyx mandarina</i> (Moore, 1872) [48, p. 576] Mulberry silk moth of China, Korea and Japan	<i>Bombyx mori</i> (Linnaeus, 1758) [42, p. 499] Silkworm

<sup>a</sup>The name *Bos namadicus* Falconer, 1859, the Indian aurochs, and that for its domestic derivative, *B. indicus* Linnaeus, 1758, the Indian humped cattle or zebu, have been added to the Table since publication of Opinion 2027 in March 2003 [36]. In our application to the ICZN *B. indicus* was included as a synonym of *B. taurus*, the name for common cattle. Archaeological and recent genetic studies strongly suggest that non-humped cattle of Europe and Western Asia and the zebu were independent domestications from different subspecies of the aurochs, *Bos primigenius primigenius* and *B. p. namadicus* respectively [39,44].

<sup>b</sup>The name *Sus scrofa* Linnaeus, 1758 for the wild boar predates that for the domestic form, *S. domesticus* Erxleben, 1777, and *S. scrofa* was therefore not included in the application to the ICZN.

and also Richard Melville (former Secretary to the Commission) in his summing-up in the *BZN* of November 1977, advocated bringing an application to the Commission to deal individually with the names for wild species which are distinct from and are contem-

porary with or postdate those for domestic animals. However, it was not until 1996 that a revised application was made (see below).

Following Groves's [27] application the inconsistent treatment of the names for domestic animals continued.

A number of authors [10,11,15] urged that names for domestic forms should be vernacular only. Odening [54], however, treating domestic animals and their wild ancestors as conspecific, proposed that the earliest available name for the two components should be adopted, domestic animals being indicated by the notation “hemerotype” and wild species by “agriotype” (e.g. “*Felis catus*” would denote both wild and domestic cats, “*F. catus* agriot.” all wildcats, and “*F. catus* hemerot.” all domestic cats). Where the ancestor of the domestic form was not known separate names would be used for the wild species and domestic form. Corbet and Clutton-Brock [13] recommended that Linnaean names be used for domestic animals as if separate from the wild species but in quotation marks to indicate their status (e.g. *Canis* “*familiaris*”). Clutton-Brock [6,9] subsequently used names based on domestic animals as valid for domestic forms, and applied the first available names based on wild species to the wild taxa. Gautier [23] proposed that domestic animals be treated as subspecies of wild species and named accordingly, whilst in the same volume Uerpman [64] proposed that domestic animals should be denoted by a single Latin word printed in capitals and italics (e.g. *ALPACA*, *BOS*, *BANTENG*, *CABALLUS*, *LAMA*).

### 3. Naming wild ancestral species

Notwithstanding the continuing discussions on what should be the approved nomenclature of domestic animals, for those with distinct Latin names of their own the naming of their wild ancestors has been relatively stable in recent years. Most authors have adopted the first available name based on the wild species as valid for the taxon (see Table 1, left side). The names have appeared in current checklists and reference works (see, for example, [12,14,15,53]) and numerous publications on biology, ecology, behaviour and conservation, as well as taxonomy. Recent representative works in which the names have been used include Groves [28,29], Kingdon [40], Stuart [61], Martin and Klein [46], Uerpman [63], Skinner and Smithers [58], Harrison and Bates [32], Morey [49] and Wheeler [69]. The first available name based on the wild species was adopted for endangered taxa in the 1994 IUCN Red List of Threatened Animals [26], and in legal documentation relating to the conservation and management of protected species (for example, in 1996, Appendices of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) [72]).

The 1993 edition of the influential *Mammals of the World*, edited by D.E Wilson and D.A.M. Reeder [70], was an unfortunate exception to the majority usage of the first available Latin name based on a wild population for wild progenitor species. In the chapters on the Perissodactyla and the Artiodactyla names were used for

wild species irrespective of whether they were first described on a wild or a domestic form. Thus the Linnaean names *Equus asinus* and *E. caballus* were used for both the wild and domestic forms of ass and horse respectively, and *Bos taurus* was used for the aurochs, with *B. primigenius* Bojanus, 1827 included as a synonym. Similarly, *Ovis aries* and *Capra hircus* were given as the valid names for the wild progenitors of sheep and goats, which usually appear as *Ovis orientalis* Gmelin, 1774 and *Capra aegagrus* Erxleben, 1777 in archaeozoological publications and current checklists (such as [14]). Editorial policy was to adopt the earliest name (see the Introduction, p. 9) but this was not used for taxa in other chapters of the Wilson and Reeder volume [70] where, for example, the Linnaean name for the domestic cat, *Felis catus*, was cited as a synonym of *F. silvestris* Schreber, 1777, the wild cat, and the Linnaean name *Cavia porcellus* was restricted to the domestic form of the guinea pig.

### 4. ICZN ruling on the names for wild ancestral species

The three of us saw any continuing use for wild species of names that were first based on domestic forms as a retrograde step that would confuse not only biologists, palaeontologists, archaeologists and those in applied fields (ecology, conservation, behaviour studies and physiological research) but also customs officials who had the job of sorting out illegal imports of endangered species (they would find it difficult to impound a trophy head of a wild sheep if it carried the name of *Ovis aries*). We took note of the review of the Wilson and Reeder volume [70] by Corbet and Hill [16] in which they criticised both the unaccustomed inclusion for these taxa of the domestic form and the inconsistency of treatment in different groups (they wrote that “the ambiguities ... could easily be avoided by excluding the domestic forms from the wild species”). In 1995 we submitted an application to the ICZN [24] which, in accord with prevailing usage for 15 mammal taxa listed in Table 1 (left side), proposed that the usage for wild taxa of the first available names based on wild species should be stabilised. Before publication our proposals were discussed and endorsed by the Executive Committee of the International Council of Archaeozoology at a meeting (July 1995) in Cambridge, UK, and by a meeting (September 1995) of the ICAZ in Basle. Two non-mammalian taxa, *Carassius gibelio* (Bloch, 1782), the Prussian or gibel carp, and *Bombyx mandarina* Moore, 1872, the mulberry silk moth, also traditionally have distinct names which postdate those of the derived domestic forms, *C. auratus* (Linnaeus, 1758), the goldfish, and *B. mori* (Linnaeus, 1758), the silkworm. To our knowledge there has been no confusion in the use of these names but for the sake of consistency the names

for the wild species of carp and silkworm were eventually included in the application.

Over the next six years our application received many comments, which were published in the *BZN*. Most were in favour of our proposals and there was considerable support from workers in zoology, archaeozoology, palaeontology, conservation, ecology, ethology and endangered species management. A few commentators were not in favour but this seemed to be because they had misunderstood the intention of the application: they assumed that we were either proposing that the earlier names based on domestic forms should be discarded or that two alternative names should be adopted as valid for the wild species. We noted in published replies to these commentators that neither assumption was correct.

In March 2003 the Commission approved the proposal and the ruling (Opinion 2027) was published [36]. Approval of the application has ratified the current majority usage and ensured the stability of 17 specific names for wild species (Table 1, left side) which are traditionally distinct from those of their domestic derivatives. Implementation of the ruling means that names based on wild populations will continue to be used for wild species and will include those for domestic forms if these are considered conspecific. It allows workers the freedom to decide the taxonomic limits of the names based on wild species, giving them the taxonomic judgement as to what degree of domestication can be encompassed in the species-concept employed. This is particularly important in many archaeological studies where the ancestral wild species is usually not in doubt while the evidence of domestication is debatable.

Use of the now-approved specific name for a wild species, based on a wild population, will not affect or be affected by future changes in ideas about the ancestry of the domestic form. For example, traditionally both the domestic llama and alpaca were considered to have been derived from the wild South American guanaco, *Lama guanicoe* (Müller, 1776), while the vicuña, *Vicugna vicugna* (Molina, 1782), was thought not to have been domesticated ([33] and others). Recent genetic research has suggested that only the llama derives from the guanaco and that the alpaca is descended mainly from the vicuña, domestication having begun 6000–7000 years ago in the Peruvian Andes [37]. Whatever the final outcome on the ancestry of the alpaca the specific name *vicugna* has now been fixed for the vicuña. Similarly, it has not yet been conclusively demonstrated that *Cavia aperea* Erxleben, 1777 is the ancestor of the domestic form of the guinea pig, but the use of the names *C. aperea* and *C. porcellus* (Linnaeus, 1758) for the wild widespread South American species and the domestic form is the best solution in the present understanding.

Greater sophistication in a number of methods of genetic analysis is allowing the ancestry of domestic

animals to be investigated. Analysis of mitochondrial DNA has indicated that in the domesticates so far studied there is one main lineage but also evidence of a second, and in goats a third, additional lineage. These lineages are derived from two or more ancestral sources from different geographical areas. In sheep the main ancestor is the western Asian mouflon, *Ovis orientalis*, and the additional wild ancestor has yet to be identified. It may well be eventually demonstrated that most, if not all, domestic forms have been derived from more than one wild progenitor. Studies of nuclear DNA have indicated that hybridisation of the domestic form with wild species and other domesticates has taken place during domestication. For example, there is evidence in both the llama and alpaca, and particularly the latter, for reciprocal hybridisation and introgression with both wild ancestors.

## 5. Recommendation for the names of domestic forms

The Commission ruling allows workers the freedom to decide whether or not to include domesticates in the wild species concept, in accordance with the stated aims of taxonomic freedom in the Code of Zoological Nomenclature. In practice, since wild species and their derivatives are recognisable entities, it is desirable to separate them nomenclaturally when distinct names exist. Fixation in the ruling of the names for wild progenitor species has ensured their stability and has settled part of the long-standing problem in the naming of wild and domestic forms where the names are traditionally separate. We now recommend that names based on domestic forms (Table 1, right side) be adopted for the corresponding domestic derivatives. These were established by Linnaeus [42,43] with the exceptions of the names for the domestic gaur (*Bos frontalis* Lambert, 1804) and the domestic pig (*Sus domesticus* Erxleben, 1777). The names have been in use for over 200 years and are internationally recognised. Moreover, in his compilation of mammalian genera and families, Palmer [55] recorded the type species designations made by earlier authors and in a number of cases the types are domestic animals. Several of the names for genera and their type species have been included in the Official Lists of Names in Zoology compiled by the ICZN. The generic names *Bos* and *Ovis* were placed on the Official List in Opinion 75 (January 1922), *Canis*, *Capra* and *Felis* in Opinion 91 (October 1926). The type species of these genera (*Bos taurus*, *Ovis aries*, *Canis familiaris*, *Capra hircus* and *Felis catus* respectively, in accord with Palmer's [55] citations), were placed on the Official List in Direction 22 (November 1955). *Equus* and its type species, *E. caballus*, were placed on Official Lists in Opinion 271 (September 1954). The silkworm *Phalaena mori* Linnaeus, 1758 was designated the type of *Bombyx*

Linnaeus, 1758 and placed on the Official List in Opinion 450 (March 1957).

Under Article 17.2 of the Code of Zoological Nomenclature the availability of specific names for domestic animals is not affected even if they are known, or later found, to be of hybrid origin. Article 23.8 further states that a specific name for an animal later found to be hybrid must not be transferred to either of the parental species, even if it is older than all other available names for them. This is particularly relevant in the case of domestic animals because many of their names predate those of the wild species.

Names based on domestic forms apply also to feral populations (i.e. animals living in a self-sustained population after a history of domestication; [8, p. 19]). For example, the feral Bactrian camels in Australia retain the name *Camelus bactrianus* established by Linnaeus (1758) for the two-humped domestic Bactrian camel.

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