

Taxonomic Review of Deer Species in Victoria

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Executive Summary

This report aims to clarify the taxonomy of deer species established, or with the potential to establish, in Victoria. All species relevant to this report are related in the tribe Cervini:subfamily Cervinae:family Cervidae. The report recommends the use of names *Axis axis* (Chital deer), *Axis porcinus* (Hog deer), *Cervus elaphus* (Western Red deer), *Cervus canadensis* (Wapiti deer (Elk)), *Cervus nippon* (Sika deer), *Cervus timorensis* (Rusa deer), *Cervus unicolor* (Sambar deer), and *Dama dama* (Common Fallow deer). The report identified potential for hybridisation between species both within and outside Australia that may require understanding the taxonomic status of additional species of deer in the tribe Cervini that are not established in Australia.

Methodology

Museums Victoria conducted a comprehensive review of all taxonomic literature related to deer taxa established, or with the potential to establish, in Victoria. Museums Victoria also reviewed and compared taxonomic authorities maintained by the Australian Mammal Society (Australasian Mammal Taxonomy Consortium; AMTC, 2021), Australian Biological Resources Study (Australian Faunal Directory; ABRS, 2020), and the American Society of Mammalogists (Mammal Diversity Database; MDD, 2022). Finally, Museums Victoria reviewed all literature relevant to hybridisation among deer taxa.

Specifically, this report considered the following...

- a) The relationships between sub-species, strains and populations of established and not yet established deer in Victoria
- b) The taxonomic levels that should be applied in each instance, i.e. to genus, species or sub-species level. Including, specifically...
 - The recommended scientific name for Chital, Hog, Red, Wapiti (Elk), Sika, Fallow, Rusa, and Sambar deer
 - The generic name that should applied to Sambar deer; i.e. *Cervus* or *Rusa*
 - The taxonomic status of Wapiti deer (Elk) as a sub-species of red deer or a species in their own right
- c) Evidence for Hybridisation between species including
 - Hog and Chital deer
 - Red and Sika deer
 - Red and Wapiti deer
 - Rusa and Sambar deer

Taxonomic Classification – Family Cervidae

Deer of the family Cervidae are a diverse group of ruminant mammals natively distributed in the Americas, Europe, and Asia (Heckeberg, 2020). Despite decades of efforts and recent advances with molecular phylogenetic studies, the taxonomy of the Cervidae remains incompletely resolved. Controversy and contradictory taxonomies exist with respect to species limits, subspecies, generic names and higher taxonomies (e.g. tribes). There is consensus that cervids can be split into two

subfamilies the Capreolinae and Cervinae, reflecting the earliest phylogenetic divergence in Cervidae. The latter, Cervinae, contains all taxa known to occur in Australia or otherwise considered in detail for this report.

The subfamily Capreolinae are comprised of “New World Deer”, which are primarily native to the Americas. However, a few taxa have native distributions ranging into Europe and Asia (i.e. Moose, *Alces alces*; Reindeer, *Rangifer tarandus*; and Roe Deer, genus *Capreolus*). Odocoileinae has been applied to members of this group, but phylogenetic studies do not support the use of this name (Heckeberg, 2020). The Capreolinae are comprised of tribes Alceini, Capreolini, and Odocoileini. Some taxonomies also recognise tribe Rangiferini for the genus *Rangifer*, but most phylogenetic studies support sinking Rangiferini into Odocoileini (Heckeberg, 2020). The Odocoileini include an extensive radiation in South America where considerable taxonomic uncertainties remain (González & Duarte, 2020). No species in the subfamily Capreolinae are present in Australia and none are capable of hybridization with any deer taxa in Australia.

The subfamily Cervinae are comprised of “Old World Deer”, which are primarily native to Europe and Asia. However, the genus *Cervus*, including the Wapiti (Elk), *C. canadensis*, has a native distribution ranging into North America. The Cervinae are consistently split into two tribes the Muntiacini and Cervini. The former is comprised of two genera, *Muntiacus* (the Muntjacs) and *Elaphodus* (Tufted Deer), neither of which are present in Australia nor considered in detail for this report.

All taxa considered for this report are members of the tribe Cervini. The Cervini are comprised of species in the genera *Axis*, *Cervus*, *Dama*, *Rucervus*, and *Elaphurus*. However, there remains controversy over the number of genera in the Cervini (Heckeberg, 2020). Most notably, the genus *Rusa*, which has applied previously to *Rusa* (*C. timorensis*) and Sambar (*C. unicolor*) deer in Australia. Some phylogenetic studies suggest that *Rusa* belongs within *Cervus* and therefore *Rusa* would be an unnatural group if recognized as a distinct genus (Gilbert et al., 2006; Groves & Grubb, 2011). While some international taxonomic authorities continue to recognize the genus *Rusa* (e.g. MDD, 2022), and further phylogenetic analyses are needed to resolve the issue (Heckeberg, 2020), the sinking of *Rusa* into *Cervus* is the current consensus among Australian taxonomic authorities (Jackson & Groves, 2015; ABRS, 2020; AMTC, 2021). Thus, *Cervus* is currently the most appropriate genus to apply to *Rusa* and Sambar deer in Australia including Victoria.

The genera *Axis*, *Cervus* and *Dama* are each present in Victoria. Their recommended scientific names and those of other species in these genera are provided in Table 1. These recommendations are justified in detail following.

Axis

Four species of deer are currently recognized worldwide for this genus (ABRS, 2020; AMTC, 2021; MDD, 2022). Both distinction of *Axis* as a genus, separate from *Cervus*, and the number of species assigned to *Axis* have been stable for several decades (Groves & Grubb, 1987; Wilson & Reeder, 2005). Phylogenetic analyses support a close relationship among all four *Axis* species to the exclusion of other species in tribe Cervini. The closest relative to genus *Axis* is not clearly resolved. They appear to be most closely related to at least some species of the genus *Rucervus* based on molecular phylogenetic and morphological traits (Groves & Grubb, 2011; Heckeberg, 2020). However, some studies have placed *Rucervus eldii* closer to *Cervus* or *Elaphurus* (Heckeberg, 2020) suggesting that *R. eldii* may belong in one of those two genera or in a separate genus *Panolia* (Groves & Grubb, 2011). Regardless, *Axis* is distinct and possibly the most divergent genus from all other genera of Cervini, including all taxa in Australia. Within genus *Axis*, *A. axis* is well-supported as the earliest diverging from the other three species including *A. porcinus*, which is more closely related to *A. kuhlii* and *A. calamianensis* (Heckeberg, 2020).

Dama

The phylogenetic and morphological distinctiveness of *Dama* from other genera of Cervini is widely supported by most recent studies (Randi et al., 2001; Lister et al., 2005; Hughes et al., 2006; Hassanin

et al., 2012; Heckeberg et al., 2016; Zurano et al., 2019). Their precise relationship within Cervini varies among phylogenetic studies, but the most recent studies place them sister to the clade comprising *Cervus*, *Elaphurus*, and *Rucervus eldii* (Heckeberg, 2020). Two species of deer are currently recognized worldwide for this genus; *D. dama*, Common Fallow Deer and *D. mesopotamica*, Persian Fallow Deer (Groves & Grubb, 2011; MDD, 2022). Earlier taxonomies that included both as subspecies of *D. dama* (Wilson & Reeder, 2005), have largely been eclipsed by molecular and phylogenetic studies (Masseti et al., 2008; Groves & Grubb, 2011; Heckeberg, 2020), but their treatment as subspecies persists in some studies (Fernández-García, 2012; Baker et al., 2017). Both species were once considered extinct in the wild leading to some confusion about the origins of introduced populations (Webley et al., 2007; Fernández-García, 2012). Despite their long association with humans and numerous translocations, distinct genetic signatures persist in European (*D. dama*) and Iranian (*D. mesopotamica*) populations (Baker et al., 2017). Given the origin of Fallow deer in Australia from European sources, they are almost certainly derived from *D. dama*, even if a formal genetic assessment has not been completed (see also hybridization section below).

Cervus

The genus *Cervus* is the most diverse and complicated of genera within Cervini. Their taxonomy is incompletely resolved, with both recent revisions and conflicting opinions among taxonomic authorities (summarised in Table 2). As already discussed, the inclusion of *Rusa* within *Cervus* is supported by a consensus of Australian authorities (ABRS, 2020; AMTC, 2021), and included here in *Cervus*. The number of species recognised in *Cervus* (including *Rusa*) varies substantially from 9 (MDD, 2022) to 27 species (Groves & Grubb, 2011). There is consensus for at least 9 species in genus *Cervus*, based on elevation of *C. canadensis* and *C. hanglu* to species, both of which were previously included as subspecies of *C. elaphus* (Wilson & Reeder, 2005). These 9 species are presented in Table 1 and compared to the 27 species of Groves & Grubb in Table 2. Given that most of the 27 species *sensu* Groves & Grubb, 2011, are not known to occur in Australia there is no clear consensus among Australian taxonomic authorities on their validity (ABRS, 2020; AMTC, 2021). Fortunately, the taxa present in Australia are assignable to a species name shared between these disparate taxonomies. For example, *C. elaphus sensu* MDD, 2022 includes four species recognised by Groves & Grubb, 2011 (Table 2), but *C. elaphus sensu* Groves & Grubb, 2011 is the taxon present in Australia. Thus, both taxonomies would recognize the same name in Australia. The same is true for *C. nippon*, *C. timorensis* and *C. unicolor* where additional names in Groves & Grubb, 2011 are not present in Australia. The most parsimonious solution is to maintain the available species names for *C. elaphus*, *C. nippon*, *C. timorensis*, and *C. unicolor* to apply to species established in Victoria. However, any importation of these species from outside Australia should consider the additional names of Groves & Grubb, 2011 and their potential to establish new species and or genetic lineages in Australia.

Table 1: Recommended scientific names of deer species relevant and/or closely related to species established in Victoria

Genus (Species Group)	Recommended Common name	Recommended Scientific Name	Recommended subspecies in Victoria	Scientific name (as currently listed in CaLP Act declarations)	Other Common Names	Notes	Synonyms In Use (see appendix for full list of synonyms)
Axis	Chital deer	<i>Axis axis</i>	None	<i>Axis axis</i>	Chital, Axis Deer, Spotted Deer, Indian Spotted Deer	Hybrids with <i>A. porcinus</i> are common and much of Victorian <i>A. porcinus</i> are the result of hybrids with <i>A. axis</i> .	
Axis	Hog deer	<i>Axis porcinus</i>	None	<i>Axis porcinus</i>	Para, Indian Hog Deer	Hybrids with <i>A. axis</i> are common and much of Victorian <i>A. porcinus</i> are the result of hybrids with <i>A. axis</i>	
Axis	Calamian Deer	<i>Axis calamianensis</i>	None	N/A		Not known to be present in wild or captive populations of Australia but closely related to <i>A. porcinus</i> and <i>A. axis</i> with which it could likely form hybrids. Endemic to Calamian Island, Philippines and unlikely to present in Australia.	
Axis	Bawean Deer	<i>Axis kuhlii</i>	None	N/A		Not known to be present in wild or captive populations of Australia but closely related to <i>A. porcinus</i> and <i>A. axis</i> with which it could likely form hybrids. Endemic to Bawean Island, Indonesia and unlikely to present in Australia.	

Genus (Species Group)	Recommended Common name	Recommended Scientific Name	Recommended subspecies in Victoria	Scientific name (as currently listed in CaLP Act declarations)	Other Common Names	Notes	Synonyms In Use (see appendix for full list of synonyms)
Cervus (elaphus group)	Western Red deer	<i>Cervus elaphus</i>	<i>scoticus</i>	<i>Cervus elaphus</i> (incl. <i>C. elaphus elaphus</i> and <i>C. elaphus montanus</i>)	Red deer	Nominate subspecies <i>C. e. elaphus</i> does not occur in the wild in Australia and presence in captive populations unknown. Subspecies <i>C. e. montanus</i> is not valid [preoccupied]. Groves & Grubb, 2011 recognise an additional 3 species in this taxon (see synonyms in next column) but none are known to be present in wild or captive populations of Australia. <i>C. elaphus sensu</i> Groves & Grubb, 2011 present in Australia.	<i>C. corsicanus</i> <i>C. maral</i> <i>C. pannoniensis</i>
Cervus (elaphus group)	Wapiti deer (Elk)	<i>Cervus canadensis</i>	None	<i>Cervus elaphus canadensis</i>		Not known to be present in wild or captive populations of Australia. Now widely recognised as a distinct species from <i>C. elaphus</i> . Rare hybrids with <i>C. elaphus</i> in Europe and little evidence of gene flow between species even when co-occurring. Groves & Grubb, 2011 recognise an additional four species in this taxon but none are known to be present in wild or captive populations of Australia (see synonyms in next column).	<i>C. alashnicus</i> <i>C. macneilli</i> <i>C. wallichii</i> <i>C. xanthopygus</i>

Genus (Species Group)	Recommended Common name	Recommended Scientific Name	Recommended subspecies in Victoria	Scientific name (as currently listed in CaLP Act declarations)	Other Common Names	Notes	Synonyms In Use (see appendix for full list of synonyms)
Cervus (elaphus group)	Sika deer	<i>Cervus nippon</i>	<i>nippon</i>	<i>Cervus nippon</i>		Not known to be present in the wild in Australia, but present in captive farmed settings in Australia (Forsyth et al., 2015). Hybrids with <i>C. elaphus</i> in Europe are common. Uncertain if these impact on genetic variation of Australian <i>C. elaphus</i> populations (wild or captive). Groves & Grubb, 2011 recognise an additional six species in this taxon but none are known to be present in wild or captive populations of Australia (see synonyms in next column).	<i>C. aplodontus</i> <i>C. hortulorum</i> <i>C. pseudaxis</i> <i>C. pulchellus</i> <i>C. sichuanicus</i> <i>C. taiouanus</i>
Cervus (elaphus group)	White-lipped Deer	<i>Cervus albirostris</i>	None	N/A		Not known to be present in wild or captive populations of Australia. Possibly most closely related to <i>C. nippon</i> which can hybridize with <i>C. elaphus</i> .	
Cervus (elaphus group)	Central Asian Red deer	<i>Cervus hanglu</i>	None	N/A	Kashmir stag, Kashmir Red deer, Hangul	Not known to be present in wild or captive populations of Australia, but closely related to <i>C. elaphus</i> with which it may be able to hybridize. Groves & Grubb, 2011 recognise an additional two species in this taxon but neither is known to be	<i>C. bactrianus</i> <i>C. yarkandensis</i>

Genus (Species Group)	Recommended Common name	Recommended Scientific Name	Recommended subspecies in Victoria	Scientific name (as currently listed in CaLP Act declarations)	Other Common Names	Notes	Synonyms In Use (see appendix for full list of synonyms)
Cervus (rusa group)	Rusa deer	<i>Cervus timorensis</i>	<i>rusa</i>	<i>Rusa timorensis</i>	Rusa, Javan Deer, Timor Deer	present in wild or captive populations of Australia (see synonyms in next column). Nominate subspecies <i>C. t. timorensis</i> is not known to occur in wild or captive populations in Australia; Subspecies <i>C.t. moluccensis</i> introduced to QLD but not reported in Victoria; <i>C.t.moluccensis</i> subspecies status is also suspect due to numerous introductions of <i>C.t. rusa</i> to Moluccas from Java.	<i>Rusa timorensis</i>
Cervus (rusa group)	Sambar deer	<i>Cervus unicolor</i>	<i>unicolor</i>	<i>Rusa unicolor</i>	Sambar, Ceylon Elk	Groves & Grubb, 2011 recognise an additional species in this taxon that are not known to occur in wild or captive populations in Australia (see synonyms in next column). <i>C. unicolor sensu</i> Groves & Grubb, 2011 is only species known to be present in Australia.	<i>Rusa unicolor</i> <i>Cervus equinus</i>
Cervus (rusa group)	Philippine Spotted deer	<i>Cervus alfredi</i>	None	N/A	Prince Alfred's deer	Not known to occur in wild or captive populations in Australia but closely related to <i>C. timorensis</i> , <i>C. unicolor</i> and other <i>Cervus</i> with uncertain	

Genus (Species Group)	Recommended Common name	Recommended Scientific Name	Recommended subspecies in Victoria	Scientific name (as currently listed in CaLP Act declarations)	Other Common Names	Notes	Synonyms In Use (see appendix for full list of synonyms)
Cervus (rusa group)	Philippine Brown deer	<i>Cervus marianna</i>	None	N/A	Philippine deer	potential for hybridisation outside Australia. Not known to occur in wild or captive populations in Australia but closely related to <i>C. timorensis</i> , <i>C. unicolor</i> and other <i>Cervus</i> with uncertain potential for hybridisation outside Australia. Groves & Grubb, 2011 recognise an additional two species in this taxon but that are not known to be present in Australia (see synonyms in next column).	<i>C. mariannus</i> <i>C. barandanus</i> <i>C. nigellus</i>
Dama	Common Fallow deer	<i>Dama dama</i>		<i>Dama dama</i>	European Fallow deer	<i>D. Dama</i> from Europe are the likely source of Fallow deer in Australia, but fertile hybrids between <i>D. dama</i> and <i>D. mesopotamica</i> produced in captivity in Europe and translocated as far as Iran.	
Dama	Persian Fallow deer	<i>Dama mesopotamica</i>		N/A		Presumed not present in Australia, but fertile hybrids between <i>D. dama</i> and <i>D. mesopotamica</i> produced in captivity in Europe and translocated as far as Iran.	

Table 2: Comparison of taxonomies of the genus *Cervus* (including *Rusa sensu MDD 2022*) from Wilson & Reeder, 2005; Groves and Grubb, 2011; and MDD, 2022. Names marked with asterisks are those from Groves and Grubb, 2011 that are believed to be present in Australia.

Recommended Scientific Names	Wilson & Reeder, 2005	Groves & Grubb, 2011	MDD, 2022
Cervus spp. (including Rusa)	n=7	n=27	n=9
elaphus group spp.	n=3	n=20	n=5
<i>C. albirostris</i>	<i>Przewalskium albirostris</i>	<i>C. albirostris</i>	<i>C. albirostris</i>
<i>C. elaphus</i>	<i>C. elaphus</i>	<i>C. elaphus*</i>	<i>C. elaphus</i>
	<i>C. elaphus</i>	<i>C. corsicanus</i>	<i>C. elaphus</i>
	<i>C. elaphus</i>	<i>C. maral</i>	<i>C. elaphus</i>
	<i>C. elaphus</i>	<i>C. pannoniensis</i>	<i>C. elaphus</i>
<i>C. canadensis</i>	<i>C. elaphus</i>	<i>C. canadensis</i>	<i>C. canadensis</i>
	<i>C. elaphus</i>	<i>C. alashnicus</i>	<i>C. canadensis</i>
	<i>C. elaphus</i>	<i>C. macneilli</i>	<i>C. canadensis</i>
	<i>C. elaphus</i>	<i>C. wallichii</i>	<i>C. canadensis</i>
	<i>C. elaphus</i>	<i>C. xanthopygus</i>	<i>C. canadensis</i>
<i>C. hanglu</i>	<i>C. elaphus</i>	<i>C. hanglu</i>	<i>C. hanglu</i>
	<i>C. elaphus</i>	<i>C. bactrianus</i>	<i>C. hanglu</i>
	<i>C. elaphus</i>	<i>C. yarkandensis</i>	<i>C. hanglu</i>
<i>C. nippon</i>	<i>C. nippon</i>	<i>C. nippon</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. aplodontus</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. hortulorum</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. pseudaxis</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. pulchellus</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. sichuanicus</i>	<i>C. nippon</i>
	<i>C. nippon</i>	<i>C. taiouanus</i>	<i>C. nippon</i>
unicolor (rusa) group spp.	n=4	n=7	n=4
<i>C. alfredi</i>	<i>R. alfredi</i>	<i>C. alfredi</i>	<i>R. alfredi</i>
<i>C. marianna</i>	<i>R. marianna</i>	<i>C. mariannus</i>	<i>R. marianna</i>
	<i>R. marianna</i>	<i>C. barandanus</i>	<i>R. marianna</i>
	<i>R. marianna</i>	<i>C. nigellus</i>	<i>R. marianna</i>
<i>C. timorensis</i>	<i>R. timorensis</i>	<i>C. timorensis*</i>	<i>R. timorensis</i>
<i>C. unicolor</i>	<i>R. unicolor</i>	<i>C. unicolor*</i>	<i>R. unicolor</i>
	<i>R. unicolor</i>	<i>C. equinus</i>	<i>R. unicolor</i>

Hybridisation Cervidae

Hybridization is common between species within the family Cervidae, particularly in the genus *Cervus* (Lowe & Gardiner, 1975; McDevitt et al., 2009; Moore & Littlejohn, 1989; Senn & Pemberton, 2009). Hybrids between genera of subfamily Cervinae are rare and not likely to produce fertile offspring (Asher et al., 1999; Willard et al., 2005)

Hybrids between Axis species

Hybrids between *A. axis* and *A. porcinus* are known and the Victorian population of *A. porcinus* appear to carry genetic variation resulting from past hybridisation with *A. axis* (Hill et al., 2019). Given that *A. porcinus* is more closely related to *A. kuhlii* and *A. calamaniensis* than *A. axis* (Heckeberg, 2020), *A. porcinus* are likely to hybridise with these two species if they were to come into contact. However, *Axis kuhlii* is only known from Bawean island, Indonesia and *A. calamaniensis* is only known from Calamian Island, Philippines so the potential for contact and hybridisation with *A. porcinus* is minimal.

Hybrids between Dama species

The two species of *Dama* are known to produce viable hybrids in captivity (Jantschke, 1990; Chapman, 2008; Fernández-García, 2012). While the two species do not co-occur in the wild and captive hybrids are now avoided due to the conservation status of *D. mesopotamica*, hybrid animals were translocated from Germany to the native range of *D. mesopotamica* in Iran in 1973 (Fernández-García, 2012). There is no evidence that hybrids are present in European populations which are the source of Australian animals, but a thorough assessment of the genetic identity of Australian populations has not been conducted.

Hybrids between Cervus species

C. elaphus/C. nippon Hybrids

Although phylogenetic analyses suggest that *C. elaphus* and *C. nippon* are not each other's closest relatives (Heckeberg, 2020), hybrids between them are fairly common where they co-occur especially in Europe (McDevitt et al. 2009, Senn & Pemberton 2009, Senn et al. 2010, Smith et al., 2014; Iacolina et al., 2019). These studies indicate that *C. elaphus* populations in Europe can carry genetic variation derived from hybridisation with *C. nippon*.

C. elaphus/C. canadensis Hybrids

Hybrids between *C. elaphus* and *C. canadensis* are rare (Pérez-Espona et al. 2011, 2013) and lead to reduced reproductive fitness (Asher et al. 2005). Despite numerous introductions of *C. canadensis* with intent to improve body mass of *C. elaphus* in their native range, the introgression of genes from *C. canadensis* into *C. elaphus* is minimal (Smith et al., 2014; Iacolina et al., 2019). These studies indicate that *C. elaphus* populations in Europe or Australia are unlikely to contain any genetic variation derived from hybridisation with *C. canadensis*.

C. unicolor/C. timorensis Hybrids

Hybrids between *C. unicolor* and *C. timorensis* have been reported among contemporary populations (van Mourik and Schurig 1985; Muir et al. 1997; New Zealand Department of Conservation 2005; Idris and Moin 2009; Leslie, 2011) and the two species may carry evidence of ancient hybridization (Martins et al., 2018). Male hybrids crossed with *C. timorensis* females are fertile as are female hybrids crossed with *C. unicolor* males (Slee 1984; Leslie, 2011). These studies suggest that hybridisation between *C. timorensis* and *C. unicolor* in Australia is possible if the two species come into contact. They also indicate that genetic variation within Australian populations of *C. timorensis* and *C. unicolor* may contain genetic variation derived from past hybridisation events between the species. Within their native range, all *C. timorensis* sampled east of Bali, Indonesia (e.g. Sulawesi, Lombok, Timor, and Maluku Islands), carry genetic variation derived from *C. unicolor*. A thorough

assessment of the genetic identity of Australian populations of *C. timorensis* and *C. unicolor* is needed.

Other Cervus Hybrids

Hybrids between *C. unicolor* and *C. elaphus* also have been reported but appear to be limited (Idris and Moin 2009; Muir et al. 1997; New Zealand Department of Conservation 2005; Takagi et al., 2020). Their significance to Australian populations of *C. elaphus* are unknown.

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Appendix 1 – Taxonomic authorities, nominal names, common names geographic distributions, threat status and species-specific notes for species of deer in the genera *Axis*, *Cervus* and *Dama*.

***Axis axis* (Erxleben, 1777)**

Chital

Authority citation: Erxleben ICP. 1777. Systema regni animalis per classes, ordines, genera, species, varietates, cum synonymia et hystoria animalium, Lipsiae [Lipzig]: Impensis Weygandianis.

Original name as described: Name is as originally described.

Nominal names: axis (Erxleben, 1777)|maculatus (Kerr, 1792)|ceylonensis (J. B. Fischer, 1829)|indicus (J. B. Fischer, 1829)|nudipalpebra (Ogilby, 1831)|major Hodgson, 1842|minor Hodgson, 1842|zeylanicus (Lydekker, 1905)

Other common names: Axis Deer|Indian Spotted Deer

Type locality: Banks of Ganges, Bihar (India).

Geographic distribution: India|Nepal|Bhutan|Bangladesh|Sri Lanka

IUCN Red List of Threatened Species status: Least concern

***Axis calamianensis* (Heude, 1888)**

Calamian Deer

Nominal names: calamianensis (Heude, 1888)|culionensis (D. G. Elliot, 1897)

Other common names:

Type locality: Calamian Islands.

Geographic distribution: Philippines

IUCN Red List of Threatened Species status: Endangered

***Axis kuhlii* (Temminck, 1836)**

Bawean Deer

Nominal names: kuhlii (Temminck, 1836)

Other common names:

Type locality: Bawean Island.

Geographic distribution: Indonesia

IUCN Red List of Threatened Species status: Critically endangered

***Axis porcinus* (E. A. W. Zimmermann, 1780)**

Hog Deer

Nominal names: porcinus (E. A. W. Zimmermann, 1777) [unavailable name]|porcinus (E. A. W. Zimmermann, 1780)|pumilio (C. H. Smith, 1827)|dodur (Royle, 1834) [nomen dubium]|oryzus Kelaart, 1852|annamiticus (Heude, 1888)|hecki (Lydekker, 1908)

Other common names:

Type locality: West Bengal (India).

Geographic

distribution: China|Pakistan|India|Nepal|Bhutan|Bangladesh|Myanmar|Thailand|Cambodia

IUCN Red List of Threatened Species status: Endangered

Species-specific notes: includes annamiticus, which was listed as distinct by Groves & Grubb 2011.

***Cervus albirostris* Przewalski, 1883**

White-lipped Deer

Nominal names: albirostris Przewalski, 1883|sellatus Przewalski, 1883|dybowskii P. L. Sclater, 1889 [preoccupied]|thoroldi Blanford, 1893

Other common names: Thorold's Deer

Type locality: Nan Shan, Humboldt's Mountains, Gansu (China).

Geographic distribution: China

IUCN Red List of Threatened Species status: Vulnerable

Species-specific notes: moved from *Przewalskium* to *Cervus*.

***Cervus alfredi* (P. L. Sclater, 1870)**

Philippine Spotted Deer

Nominal names: alfredi P. L. Sclater, 1870|breviceps (Heude, 1888)|masbatensis (Heude, 1888)|cinerea (Heude, 1899)

Other common names: Prince Alfred's Sambar|Visayan Spotted Deer

Type locality: Philippines.

Geographic distribution: Philippines

IUCN Red List of Threatened Species status: Endangered

Species-specific notes: moved to *Cervus*, then back to *Rusa*, and consensus among Australian taxonomic authorities is to return to *Cervus* (Groves & Grubb 2011; Jackson & Groves, 2015; ABRS, 2020; AMTC, 2021).

***Cervus canadensis* Erxleben, 1777**

Wapiti

Authority citation: Erxleben ICP. 1777. Systema regni animalis per classes, ordines, genera, species, varietates, cum synonymia et hystoria animalium, Lipsiae [Lipzig]: Impensis Weygandianis.

Nominal names: canadensis Erxleben, 1777|strongyloceros von Schreber, 1784|wapiti Barton, 1808|major Ord, 1815|wallichii G. Cuvier, 1823|occidentalis C. H. Smith, 1827|affinis Hodgson, 1841|tibetanus Hodgson, 1850|nariyanus Hodgson, 1851|xanthopygus Milne-Edwards, 1867|sibiricus Severtzov, 1873|songaricus Severtzov, 1873|eustephanus Blanford, 1876|luehdorfi Bolau, 1880|isubra Noack, 1889|ussuricus (Heude, 1892)|bedfordianus Lydekker, 1897|roosevelti Merriam, 1897|asiaticus Lydekker, 1898|typicus de Pousargues, 1898|merriami E. W. Nelson, 1902|wachei Noack, 1902|nannodes Merriam, 1905|biedermanni Matschie, 1907|macneilli Lydekker, 1909|wardi Lydekker, 1910|kansuensis Pocock, 1913|baicalensis Lydekker, 1915|manitobensis Millais, 1915|alashanicus Bobrinski & Flerov, 1935|nelsoni V. O. Bailey, 1935

Other common names: Elk|Alashan Wapiti (Elk)|Izubra|Manchurian Wapiti (Elk)|Merriam's Wapiti (Elk)|Tule Elk|Sichuan Shou|Macneill's Red Deer|Tibetan Shou|Rocky Mountain Wapiti (Elk)|Roosevelt's Wapiti (Elk)|Altai Wapiti (Elk)

Type locality: E Canada.

Geographic distribution: Kazakhstan|Kyrgyzstan|Russia|Mongolia|China|Bhutan|Canada|United States

IUCN Red List of Threatened Species status: Least concern

Species-specific notes: split from *C. elaphus*, includes alashanicus, macneilli, wallichii, xanthopygus, which were considered distinct by Groves & Grubb 2011.

***Cervus elaphus* Linnaeus, 1758**

Western Red Deer

Authority citation: Linnaeus, C von. 1758. Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis. (10th Ed.). Stockholm: Laurentius Salvius.

Nominal names: elaphus Linnaeus, 1758|corsicanus Erxleben, 1777|hippelaphus Erxleben, 1777|albus Desmarest, 1822|germanicus Desmarest, 1822|mediterraneus de Blainville, 1822|barbarus E. T. Bennett, 1833|maral Ogilby, 1840 [nomen nudum]|albifrons Reichenbach, 1845|corsiniacus P. Gervais, 1848|maral J. E. Gray, 1850|minor J. A. Wagner, 1855|varius Fitzinger, 1874|caspius Radde, 1886|typicus Lydekker, 1898|campestris Botezat, 1903 [nomen nudum, preoccupied]|montanus Botezat, 1903 [preoccupied]|vulgaris Botezat, 1903|atlanticus Lönnberg, 1906|scoticus Lönnberg,

1906|albicus Matschie, 1907|bajovaricus Matschie, 1907|balticus Matschie, 1907|rhenanus Matschie, 1907|hispanicus Hilzheimer, 1909|bolivari Cabrera, 1911|debilis Matschie, 1912|neglectus Matschie, 1912|saxonicus Matschie, 1912|visurgensis Matschie, 1912|caucasicus Winans, 1914 [nomen nudum]|brauneri Charlemagne, 1920|tauricus Fortunatov, 1925|carpathicus Tatarinov, 1956 [nomen nudum]|pannoniensis Banwell, 1997|italicus Zachos, Mattioli, Ferretti, & Lorenzini, 2014

Other common names: Stag|Barbary Red Deer|Bukhara Red Deer|Caspian Red Deer|Maral|Thyrranian Red Deer|Persian Red Deer|Turkish Red Deer|Mesola Red Deer|Barbary Stag|Central European Red Deer|Common Red Deer|Norwegian Red Deer|Scottish Red Deer|Spanish Red Deer|Corsican Red Deer|Crimean Red Deer

Type locality: Sweden.

Geographic distribution: Ireland|United

Kingdom|Norway|Sweden|Portugal|Spain|France|Belgium|Netherlands|Germany|Denmark|Luxembourg|Switzerland|Liechtenstein|Italy|Austria|Czech

Republic|Poland|Slovakia|Hungary|Croatia|Slovenia|Bosnia & Herzegovina|Serbia|Montenegro|North Macedonia|Greece|Bulgaria|Romania|Moldova|Ukraine|Belarus|Lithuania|Latvia|Estonia|Russia|Georgia|Armenia|Azerbaijan|Turkey|Iran|Iraq|Morocco|Algeria|Tunisia

IUCN Red List of Threatened Species status: Least concern

Species-specific notes: includes maral, corsicanus, pannoniensis which were considered distinct by Groves & Grubb 2011; previously included *C. hanglu* and *C. canadensis*;

***Cervus hanglu* J. A. Wagner, 1844**

Central Asian Red Deer

Nominal names: hanglu J. A. Wagner, 1844|casperianus J. E. Gray, 1847|cashmeriensis A. L. Adams, 1859|cashmeerianus Falconer, 1868|cashmirianus Fitzinger, 1874|yarkandensis Blandford, 1892|bactrianus Lydekker, 1900|hagenbeckii Shitkov, 1904

Other common names: Hangul|Tarim Red Deer|Bactrian Red Deer|Bukhara Red Deer|Kashmir Stag|Yarkand Stag|Bactrian Stag

Type locality: Lake Mansarovar (S Tibet).

Geographic distribution: Turkmenistan|Kazakhstan|Uzbekistan|Tajikistan|Afghanistan|India|China

IUCN Red List of Threatened Species status: Least concern

Species-specific notes: split from *C. elaphus*, includes bactrianus and yarkandensis, which were considered distinct by Groves & Grubb 2011.

***Cervus marianna* (Desmarest, 1822)**

Philippine Brown Deer

Authority citation: Desmarest, A. G. (1822). Mammalogie, ou, Description des espèces de mammifères. Chez Mme. Veuve Agasse, imprimeur-libraire, 1820-1822, Paris, 2, 436.

Original name as described: *Cervus mariannus*

Nominal names: marianna (Desmarest, 1822)|philippina (C. H. Smith, 1827)|nigricans (Brooke, 1876)|ambrosiana (Heude, 1888)|barandana (Heude, 1888)|basilanensis (Heude, 1888)|brachyceros (Heude, 1888)|chrysotrichos (Heude, 1888)|corteana (Heude, 1888)|crassicornis (Heude, 1888)|dailiardiana (Heude, 1888)|elegans (Heude, 1888)|elorzana (Heude, 1888)|franciana (Heude, 1888)|garciana (Heude, 1888)|gonzalina (Heude, 1888)|gorrichana (Heude, 1888)|guevarana (Heude, 1888)|guidoteana (Heude, 1888)|hippolitiana (Heude, 1888)|longicuspis (Heude, 1888)|macariana (Heude, 1888)|maraisiana (Heude, 1888)|marzanina (Heude, 1888)|michaelina (Heude, 1888)|microdontus (Heude, 1888)|nublana (Heude, 1888)|ramosiana (Heude, 1888)|rosariana (Heude, 1888)|roxasiana (Heude, 1888)|rubiginosa (Heude, 1888)|spatharia (Heude, 1888)|telesforiana (Heude, 1888)|tuasonina (Heude, 1888)|verzosana (Heude, 1888)|steerii (D. G. Elliot, 1896)|vidalina (Heude, 1899)|villemariana (Heude, 1899)|atheneensis (Heude, 1899)|baryceros (Heude, 1899)|boninensis (Lydekker, 1905)|nigella Hollister, 1913|apoensis Sanborn, 1952

Other common names: Philippine Deer|Philippine Sambar

Type locality: Mariana Islands (introduced).

Geographic distribution: Philippines

IUCN Red List of Threatened Species status: Vulnerable

Species-specific notes: moved to *Cervus*, then back to *Rusa*, and consensus among Australian taxonomic authorities is to return to *Cervus* (Groves & Grubb 2011; Jackson & Groves, 2015; ABRIS, 2020; AMTC, 2021); includes *barandanus* and *nigellus*, which were considered distinct by Groves & Grubb 2011.

***Cervus nippon* Temminck, 1838**

Sika Deer

Nominal names: *nippon* Temminck, 1838|*pseudaxis* P. Gervais, 1841|*sika* Temminck, 1844|*japonicus* Sundevall, 1846|*taiouanus* Blyth, 1860|*taevanus* P. L. Sclater, 1862|*hortulorum* Swinhoe, 1864|*mantchuricus* Swinhoe, 1864|*mandarinus* Milne-Edwards, 1871|*taivanus* J. E. Gray, 1872|*kopschi* Swinhoe, 1873|*euopsis* P. L. Sclater, 1874|*dybowskii* Taczanowski, 1876|*minor* Brooke, 1878|*andreas* Heude, 1882|*cyclorhinus* Heude, 1882|*devilleanus* Heude, 1882|*frinianus* Heude, 1882|*gracilis* Heude, 1882|*hyemalis* Heude, 1882|*ignotus* Heude, 1882|*joretianus* Heude, 1882|*lacrymosus* Heude, 1882|*taioranus* Heude, 1882|*aplodontus* (Heude, 1884)|*blakistoninus* (Heude, 1884)|*brachypus* (Heude, 1884)|*brachyrhinus* (Heude, 1884)|*cycloceros* (Heude, 1884)|*dolichorhinus* (Heude, 1884)|*dominicanus* (Heude, 1884)|*fuscus* (Heude, 1884)|*grassianus* (Heude, 1884)|*grilloanus* (Heude, 1884)|*hollandianus* (Heude, 1884)|*infelix* (Heude, 1884)|*legrandianus* (Heude, 1884)|*mitratus* (Heude, 1884)|*microdontus* (Heude, 1884)|*microspilus* (Heude, 1884)|*morrisianus* (Heude, 1884)|*novioninus* (Heude, 1884)|*orthopus* (Heude, 1884)|*oxycephalus* (Heude, 1884)|*pouvrelanus* (Heude, 1884)|*schlegeli* (Heude, 1884)|*schulzianus* (Heude, 1884)|*sylvanus* (Heude, 1884)|*xendaiensis* (Heude, 1884)|*yesoensis* (Heude, 1884)|*yuanus* (Heude, 1884)|*aceros* (Heude, 1888)|*dejardinus* (Heude, 1888)|*granulosus* (Heude, 1888)|*kematoceros* (Heude, 1888)|*marmandianus* (Heude, 1888)|*minutus* (Heude, 1888)|*modestus* (Heude, 1888)|*paschalis* (Heude, 1888)|*rex* (Heude, 1888)|*soloensis* (Heude, 1888)|*surdescens* (Heude, 1888)|*major* Noack, 1889|*sica* Lydekker, 1893|*arietinus* (Heude, 1894)|*dugennianus* (Heude, 1894)|*dybovskii* (Heude, 1894)|*imperialis* (Heude, 1894)|*riverianus* (Heude, 1894)|*aplodonticus* (Heude, 1897)|*elegans* (Heude, 1897)|*ellipticus* (Heude, 1897)|*minoensis* (Heude, 1897)|*orthopodicus* (Heude, 1897)|*rutilus* (Heude, 1897)|*schizodonticus* (Heude, 1897)|*sendaiensis* (Heude, 1897)|*typicus* Lydekker, 1897|*consobrinus* (Heude, 1898)|*daimius* (Heude, 1898)|*latidens* (Heude, 1898)|*regulus* (Heude, 1898)|*sicarius* (Heude, 1898)|*sika* (Heude, 1898)|*typicus* R. Ward, 1910|*keramae* (Kuroda, 1924)|*matsumotei* Kishida, 1924|*centralis* Kishida, 1936|*mageshimae* Kuroda & Okada, 1950|*yakushimae* Kuroda & Okada, 1950|*swinhoei* Glover, 1956 [preoccupied]|*pulchellus* Imaizumi, 1970|*sichuanicus* Guo Zhuopu, Chen Entu & Wang Youzhi, 1978

Other common names: Spotted Deer|Japanese Deer

Type locality: Japan.

Geographic distribution: Russia|China|North Korea?|Taiwan|Japan|Vietnam

IUCN Red List of Threatened Species status: Least concern

Species-specific notes: includes *aplodontus*, *sichuanicus*, *taiouanus*, *pseudaxis*, *pulchellus*, *hortulorum*, which were considered distinct by Groves & Grubb 2011.

***Cervus timorensis* (de Blainville, 1822)**

Javan Deer

Nominal names: *timorensis* (de Blainville, 1822)|*hippelaphus* (G. Cuvier, 1825) [preoccupied]|*peronii* (G. Cuvier, 1825)|*moluccensis* (Quoy & Gaimard, 1830)|*tunjuc* (Horsfield, 1830) [nomen nudum]|*hippolaphus* (Schinz, 1945)|*javanica* (S. Müller & Schlegel, 1845)|*rusa* (S. Müller & Schlegel, 1845)|*timoriensis* (S. Müller & Schlegel, 1845)|*lepida* (Sundevall, 1846)|*paradoxa* Brehm, 1865|*buruensis* (Heude, 1896)|*celebensis* (Rörig, 1896)|*floresiensis* (Heude, 1896)|*hoevelliana* (Heude, 1896)|*macassaricus* (Heude, 1896)|*menadensis* (Heude, 1896)|*sumbavana* (Heude, 1896)|*tavistocki* (Lydekker, 1900)|*renschii* (Sody, 1932)|*djonga* Van Bemmelen, 1949|*laronesiotes* Van Bemmelen, 1949

Other common names: Maned Sambar|Rusa Deer|Sunda Sambar|Timor Deer

Type locality: Timor Island.

Geographic distribution: Indonesia|East Timor

IUCN Red List of Threatened Species status: Vulnerable

Species-specific notes: moved to *Cervus*, then back to *Rusa*, and consensus among Australian taxonomic authorities is to return to *Cervus* (Groves & Grubb 2011; Jackson & Groves, 2015; ABRS, 2020; AMTC, 2021).

***Cervus unicolor* (Kerr, 1792)**

Sambar

Authority citation:

Authority publication link:

Nominal names: unicolor (Kerr, 1792)|major (Kerr, 1792)|albicornis (Bechstein, 1799)|nigra (de Blainville, 1816)|hippelaphus (de Blainville, 1822)|maxima (de Blainville, 1822)|aristotelis (G. Cuvier, 1823)|equina (G. Cuvier, 1823)|leschenauldii (G. Cuvier, 1823)|malaccensis (F. Cuvier, 1824)|jarai (Hodgson, 1831)|heterocerus (Hodgson, 1841)|nepalensis (Hodgson, 1841)|pennantii (J. E. Gray, 1843)|bengalensis (Schinz, 1845)|cambojensis (J. E. Gray, 1861)|swinhoii (P. L. Sclater, 1862)|saumur (Jerdon, 1874)|brachyrhina (Heude, 1888)|colombertina (Heude, 1888)|combalbertina (Heude, 1888)|curvicornis (Heude, 1888)|errardiana (Heude, 1888)|joubertiana (Heude, 1888)|latidens (Heude, 1888)|lemeana (Heude, 1888)|lignaria (Heude, 1888)|longicornis (Heude, 1888)|officialis (Heude, 1888)|outreyana (Heude, 1888)|planiceps (Heude, 1888)|planidens (Heude, 1888)|simoniana (Heude, 1888)|veruta (Heude, 1888)|brookei (Hose, 1893)|dejeani de Pousargues, 1896|hamiltoniana (Heude, 1896)|typica (Lydekker, 1898)|spatulata (O. Thomas, 1901)|oceanica (Chasen & Kloss, 1928)|hainana (Xu Longhui in Xu Longhui, Liu Zhenhe, Liao Weiping, Li Xiaohui, Yu Simian, Qiu Jinchang, Zhou Yuyuan, Deng Juxie, Guan Guanxun, Lu Jizhen, Yan Kun, 1983)

Type locality: Sri Lanka.

Geographic distribution: India|Nepal|Bhutan|Bangladesh|Sri

Lanka|China|Taiwan|Myanmar|Thailand|Laos|Vietnam|Cambodia|Malaysia|Indonesia|Brunei

IUCN Red List of Threatened Species status: Vulnerable l

Species-specific notes: moved to *Cervus*, then back to *Rusa*, and consensus among Australian taxonomic authorities is to return to *Cervus* (Groves & Grubb 2011; Jackson & Groves, 2015; ABRS, 2020; AMTC, 2021); includes *equinus*, which was considered distinct by Groves & Grubb 2011.

***Dama dama* (Linnaeus, 1758)**

Common Fallow Deer

Authority citation: Linnaeus, C von. 1758. *Systema naturae per regna tria naturae: secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymis, locis.* (10th Ed.). Stockholm: Laurentius Salvius.

Nominal names: dama (Linnaeus, 1758)|plinii (E. A. W. Zimmermann, 1780)|platyceros (G. Cuvier, 1798)|mauricus (F. Cuvier, 1816)|leucaethiops (J. B. Fischer, 1829)|maura (J. B. Fischer, 1829)|vulgaris (J. B. Fischer, 1829)|albus Fitzinger, 1874|niger Fitzinger, 1874|varius Fitzinger, 1874|schaeferi Hilzheimer, 1926

Other common names: European Fallow Deer

Type locality: Sweden.

Geographic distribution: Ireland|United

Kingdom|Portugal|Spain|France|Belgium|Netherlands|Germany|Denmark|Switzerland|Luxembourg|Liechtenstein|Austria|Italy|Hungary|Slovenia|Slovakia|Czech

Republic|Poland|Sweden|Norway|Croatia|Bosnia &

Herzegovina|Montenegro|Albania|Serbia|Kosovo|Greece|Turkey|Bulgaria|Romania|Moldova|Ukraine|Belarus|Lithuania|Latvia|Estonia|Finland|Russia

IUCN Red List of Threatened Species status: Least concern

***Dama mesopotamica* (Brooke, 1875)**

Persian Fallow Deer

Nominal names: mesopotamica (Brooke, 1875)|mesopotamiae (Trouessart, 1905)

Other common names: Mesopotamian Fallow Deer

Type locality: Iran.

Geographic distribution: Iran|Israel

IUCN Red List of Threatened Species status: Endangered