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Identifying rhinoceroses in museum collections

Miguel Prôa

Rhinoceroses are a greatly endangered group of animals. No less than three subspecies of the recognised six species (Groves *et al.* 2010; Groves & Grubb 2011) are thought to have disappeared in the 20th century (Groves & Grubb 2011; Rookmaaker 1997; Rookmaaker & Groves 1978), and one already in the 21st century (Brook *et al.* 2011, 2012). Three species are today critically endangered (IUCN 2021): the Black Rhino, *Diceros bicornis* Linnaeus, 1758; the Sumatran Rhino, *Dicerorhinus sumatrensis* G. Fischer [von Waldheim], 1814; and the Javan Rhino, *Rhinoceros sondaicus* Desmarest, 1822. The Northern White Rhino, *Ceratotherium cottoni* (Lydekker, 1908), often considered a subspecies of White Rhino, *Ceratotherium simum* (Burchell, 1817), is left with only two living individuals at the time of publication of this letter (San Diego Zoo Global 2021). Their scarcity makes research into many aspects of their biology difficult due to the near impossibility of collecting wild specimens. It follows that rhinoceros material already stored away in museum reserves, or present in lesser-known collections is irreplaceable and invaluable (Gippoliti *et al.* 2013; Groves & Chakraborty 1983; Groves & Leslie 2011; Prôa & Donini 2019). In particular, small museums and private collections may house specimens of considerable importance, with specimen and its documentation often separated (Casas-Marce *et al.* 2012; De Francesco *et al.* 2020; Prôa 2017; Prôa *et al.* 2017; Watson & Werb 2013). Nevertheless, even when full documentation has been retained, the importance of finding and correctly identifying unknown rhinoceros material in already existing museum collections cannot be overemphasised.

It is therefore of great importance that a simple procedure is put in place for aiding un-specialised museum staff in the identification of extant rhinoceros material, reviewed from the literature. It should consider solely taxonomic distinctions that can be made among taxa according to modern comparative anatomy, and it should not have a phylogenetic intention. Documentation often being lost, it should aim at identification beyond characters such as ge-

ographic provenance, life history traits, behaviour, or other traits external to bony anatomy. Skull and teeth being the most common rhinoceros materials found in collections, it should be based on cranial, mandibular and dental anatomy to start with.

Rhinoceros skulls are easy to distinguish from other mammalian skulls, not only for their sheer large size, but also for their shape and characteristic horn. The horn or, more specifically, the number of horns, is perhaps the most distinctive feature among rhinoceroses. Of the six extant species of rhinoceros, two have only one horn (*Rhinoceros unicornis* Linnaeus, 1758 and *R. sondaicus*), while the four others have two. Female horns are generally smaller than those of males (Groves 1971), but it is only totally absent in females of the species *D. sumatrensis* (Groves & Kurt 1972). An abnormal three-horn condition seems to occur rarely in *D. bicornis* (Hillman-Smith & Groves 1994). Horns consist on keratin, not bone, and are not attached to the skull, so they are often found isolated in museum reserves. They are too variable among themselves and among different species to be convincingly identifiable by themselves when no other information is available (but see Groves 1971). In the absence of horns *in situ* on the skull, the number of horns can be ascertained by looking at the rugose regions of the nasals and frontal; the frontal bone being smooth in species that have only the nasal horn (Groves & Leslie 2011; Laurie *et al.* 1983).

Apart from the number of horns, another distinction may be readily achieved: African species can be straightforwardly separated from Asian species by a number of anatomical characters. For example, no rhinoceros has canine teeth, but the three Asian species have tusk-like anterior mandibular teeth that look like canines but are in fact incisors (Groves 1967b). However, in museum specimens the cranium or the mandible is sometimes found without some of the teeth, which fall off during museum preparations (Groves & Leslie 2011). Many differences among rhinoceroses can be found on the cranium alone, the most apparent ones being related to the shape of the nasal bones, the occipital plane, the foramen magnum or the dorsal outline of the cranium. Dental traits, very distinct among species, can perhaps be too technical and require specialist reading and training.

The existing literature is relatively abundant in descriptions of the anatomy of *Rhinoceros* (Chakraborty 1972; Flower 1876; Groves 1967b, 1982; Groves & Chakraborty 1983; Groves & Guérin 1980; Groves & Leslie 2011; Guérin 1980; Laurie *et al.* 1983; Pocock 1945; Rookmaaker 1980, 1983, 1997; Yan *et al.* 2014), *Dicerorhinus* (Amato *et al.* 1995; Chakraborty 1972; Flower 1876; Groves 1967b; Groves & Chakraborty 1983; Guérin 1980; Pocock 1945; Yan *et al.* 2014; Zainuddin *et al.* 1990), *Diceros* (Groves 1967a; Harley *et al.* 2005; Hillman-Smith & Groves 1994; Rookmaaker 1995; Rookmaaker & Groves 1978), and *Ceratotherium* (Groves 1975; Groves *et al.* 2010; Robinson *et al.* 2005). Surveys of all Asian species exist (Chakraborty 1972; Groves 1982; Groves & Chakraborty 1983), and broad surveys of several

aspects of all rhinoceroses are also available (Amin *et al.* 2006; Groves 1971, 1983, 1997; Willerslev *et al.* 2009).

Museums and other collections often find themselves at odds with old specimens; rarely do these specimens retain any trustworthy information regarding classification, age at death, sex, provenance, etc. (Beucher & Prôa 2019; Pouit *et al.* 2019). Since museums do not always have expert zoologists available or the means to engage them, a simple procedure for the identification of extant rhinoceros material would be of great importance. It can be achieved by making use of apparent anatomical trait differences to correctly identify species of rhinoceroses among unlabelled or mislabelled specimens, with a minimum of time and effort. Of course, consultation of the original literature on apomorphic characters would always be advised for a more detailed study of each rhinoceros taxon. Furthering the scientific knowledge of these animals, using material already present in museum collections as a resource, will assuredly contribute to prevent their irreversible disappearance.

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