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Redetermination of the skeleton of the Asian rhinoceros in the Zoological Museum of the University Federico II, Naples (Italy)

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Abstract

An Asian rhinoceros skeleton is preserved in the Zoological Museum of the University Federico II of Naples (Italy). The study of the diagnostic characters of the skull has allowed to identify it as Javan rhinoceros, *Rhinoceros sondaicus* Desmarest, 1822. This specimen is one of the only two skeletons of Javan rhinoceros housed in Italian museums of natural history. This study also provides further morphometric data of the skull.

Keywords: Mammals, Javan rhinoceros, Paolo Panceri, Zoological Museum of Naples

Riassunto

Uno scheletro di rinoceronte asiatico è conservato nel Museo Zoologico dell'Università Federico II di Napoli (Italia). Lo studio dei caratteri diagnostici del cranio ha permesso di indentificarlo come rinoceronte di Java, *Rhinoceros sondaicus* Desmarest, 1822. L'esemplare è uno dei due soli scheletri di rinoceronte di Java presenti in un museo italiano di storia naturale. Questo studio fornisce inoltre dati morfometrici del cranio.

Parole chiave: Mammiferi, Rinoceronte di Java, Paolo Panceri, Museo Zoologico di Napoli

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Introduction

Three extant species of rhinoceros are recognised in Southeastern Asia, subdivided in two genera: the genus Rhinoceros with the two species *Rhinoceros unicornis* Linnaeus, 1758 and *Rhinoceros sondaicus* Desmarest, 1822 and the genus Dicerorhinus with the single species *Dicerorhinus sumatrensis* (Fischer, 1814) (Groves and Grubb, 2011). All three species are considered highly threatened by IUCN. Their rarity in nature means that the specimens now kept in museums are of enormous scientific value.

During a recent revision of the Mammals collection in the Zoological Museum of the University Federico II of Naples, our attention was attracted by a poorly documented skeleton of an Asian rhinoceros whose label indicates simply "*Rhinoceros unicornis*". Unfortunately, the vicissitudes of the museum, and significant damages to collections during World War II (Botte & Scillitani, 1999) have caused the loss of a large part of the records, thus preventing us from recovering exhaustive documentation about this specimen.

Materials and Methods

Documents kept at the museum were consulted, mainly those written during the headships of Achille Costa and Saverio Monticelli, as well as Paolo Panceri. They consist of short acquisition lists, generic inventories (Costa, 1862, 1864, 1866), and lists of specimens divided by taxonomic groups, although Paolo Panceri, director of the Gabinetto di Anatomia Comparata, listed the specimens by type of apparatus, omitting any indication of the geographical origin (Panceri, 1862; 1872; 1878). Unfortunately searches did not produce relevant informations about the history of the specimen find object of this article.

The rhino skeleton find guarded in the Zoological Museum of Naples currently has catalog number Z0685. An incomplete label affixed to the front almost certainly indicates that the specimen belongs to the collection of the GAC with original number 3791.

It is a complete skeleton in good conditions, with the third right rib replaced by a wooden replica, and the last caudal vertebrae missing; the nasal horn is a recent replica, although its size

is excessive compared to that of the species (see Groves, 1971). Furthermore, photos of the Javan rhinoceros skull preserved at the Natural History Museum Giacomo Doria of Genoa (Italy) were useful for comparing and recognizing our specimen.

A morphological analysis was performed on the skull with the recognition of the bone segments present and verifying the presence of all the parts, also through the comparison with reference skulls reported on specific texts and catalogs (Gray, 1869; Lydekker, 1916; Groves & Leslie, 2011).

The sample was subjected to classical craniometric measurements. The following morphometric indices were used: BL basal length; ON occipito-nasal length; TL upper toothrow length; ZB zygomatic breadth; NA nasal breadth; OB occipital breadth; OH occipital height; IA interorbital anterior, IP interorbital posterior; ML mandible length; ML mandible height.

Two different types of measuring tape were used to carry out the measurements: a rigid folding one, a tape one, and a caliper gauge, alternating their use based on the nature of the measurement to be made. To accurately determine the amplitude of smaller measurements, a digital caliper was also used for greater accuracy.

Finally, the smartphone proved to be an extremely useful accessory which, in addition to acting as a room for carrying out the related documentation, allowed constant access to information relating to biometric data, taxonomies, reference catalogs.

Results and Discussion

The skull of Z0685 (Fig. 1), is moderately elongated in lateral view, with the dorsal profile almost straight and a supraoccipital crest quite arched upwards; the occipital surface is inclined forward from the baseline plan. The zygomatic arches rise slightly, reaching only the orbital plane. The front edge of the orbit corresponds approximately to Pm3; The nasal is tight and light; premaxillae are narrow, unfused to the maxillae and freely movable, although the specimen is an adult. The mandible has a short ascending branch, with pronounced angular process; the mandibular body is slender, tapering towards the tip of the symphysis, with a large diastema between the incisors and first premolars. The dentition is complete, except for both lower Pm2.

The diagnostic features that help us to identify with absolute certainty the species and to clearly distinguish it from the *R. unicornis* Linneus, 1758, are: premaxillary not fused with maxillary (Fig. 2A), the dorsal profile not distinctly concave, the occiput not overly high, the lightest nasal and the shorter ascending branch of the mandible. These

Figure 1: Left lateral view of the skull of the Z0685 specimen.

morphological characteristics and measures indicate the belonging of the specimen to the Javan rhinoceros, *R. sondaicus* Desmarest, 1822 (Groves & Leslie, 2011).Groves (1967) identifies six growth stages in *R. sondaicus* in relation to teeth eruption; therefore, in relation to specimens used for comparison, the skull appears to belong to a fully grown animal, with M3 completely erupted (Fig. 2B). The absolute main dimensions of the skull under examination (Tab. 1), compared with those in literature (Gray, 1869), fall fully within the range of the *R. sondaicus*. The basal length makes it a specimen of considerable size, although within the maximum size range of the species (Groves and Leslie, 2011). About dimorphism, only males exhibit a nasal horn, although some female specimens are known to sport a modestly sized hump (Groves, 1971; Groves and Leslie, 2011), A distinctive dimorphic character is therefore the size and shape of the nasal reflecting the horn size, so that in males the size and thickness of the nasal bones is greater than in females. From the characteristics described it is clear that our specimen is male. Groves and Guerin (1980) deal with the differences of craniodental and skeletal characters among extant and historical populations of Java, Sumatra, Malaysia, Indochina and India, which correspond to distinct morphotypes. At the moment, in the absence of exhaustive morphometric data from other museum specimens and on the geographical origin of the Z0685, it is not possible to clarify the subspecies to which it belongs.

Table 1: Main absolute dimensions (in mm) of the skull. Abbrevations: BL basal lenght; ON occipito-nasal lenght; TL upper toothrow lenght; ZB zygomatic breadth; NA nasal breadth; OB occipital breadth; OH occipital height; FB facial breadth; FH facial height; IB interorbital breadth; ML mandible length; ML mandible height.

Specimen	Biometric parameters											
Z 0685	BL	ON	TL	ZB	NA	OB	OH	FB	FH	IB	ML	MH
	595	565	250	340	93	250	185	190	170	90	515	245

However, the morphology of the skull of the rhinoceros present at the Zoological Museum and the measured morphometric data (Tab. 1), compared with the skull of the Javan rhinoceros preserved at the Giacomo Doria Natural History Museum in Genoa (Italy), as well as with the reference indicators relating to the species *R. sondaicus* Desmarest, 1822, collected from the specimens in the collection of rhinos of the Natural History Museum in London (Gray, 1869), lead to re-determine the species of rhinoceros present in the Zoological Museum of Naples as belonging to *R. sondaicus*, where the typical conformation of the premaxillaries is already in itself an exclusive diagnostic character.

Conclusions

There are only two specimens certainly attributed to *R. sondaicus* in Italian museums. Menchinelli (1970) lists a skull from Gulang Mountain, District of Bantam, Java, housed in the Natural History Museum Giacomo Doria of Genoa; a complete skeleton, as well as a

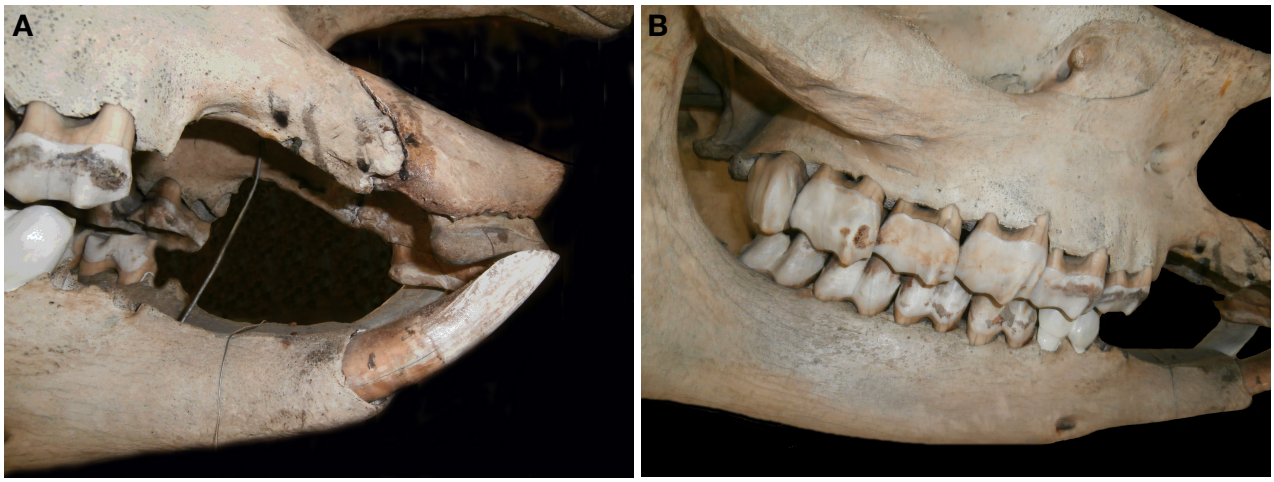

Figure 2: Detail of **A)** the unfused premaxillae in right lateral view and **B)** the right toothrows of the Z0685 specimen.

mounted skin are kept in the Regional Museum of Natural Sciences of Turin (Passerin D'Entreves, 2003). Therefore, the skeleton of Javan rhinoceros of the Zoological Museum of the University Federico II of Naples is undoubtedly a valuable specimen, both for the integrity and good state of conservation, and because in European natural history museums there are no more than twenty rhinoceroses skeletons, according to acquired data (Groves, pers. comm., 2017).

To date, the amount of findings attributed to this very rare species of rhinoceros in other Italian natural history museums is almost entirely unknown, both because there is no modern revision of the specimens, and because most of the catalogs and historical information sometimes shows serious gaps which therefore do not allow having quantitative and qualitative data. Therefore, it is important to remember that some findings have a remarkable value as much as the rarity of the species itself in nature, being a source of data both for understanding the historical distribution and the morphometric and genetic variability of populations (Gippoliti, et al, 2014).

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Author contributions

Roberta Improta and Tommaso De Francesco cured all steps for the composition of the manuscript.

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