The Sumatran rhino is one-of-a-kind

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The six living species of rhinoceros all belong to the family Rhinocerotidae, which is divided into three subfamilies:

Rhinocerotinae: There is a single genus, *Rhinoceros*, with two species, the Indian or greater one-horned rhinoceros *Rhinoceros unicornis*, and the Javan or lesser one-horned rhinoceros *Rhinoceros sondaicus*.

Dicerorhininae: There is again a single genus, *Dicerorhinus*, which contains a single living species, the Sumatran or Asian two-horned rhinoceros *Dicerorhinus sumatrensis*.

Dicerotinae: There are two genera, both African: *Diceros* with a single species the black rhinoceros *Diceros bicornis*, and *Ceratotherium* with two species, the southern white rhinoceros *Ceratotherium simum* and the northern white or Nile rhinoceros *Ceratotherium cottoni.*

African rhinos have elongated skulls with short snouts with the front teeth rudimentary or absent. Asian rhinos have short, deep skulls with large front teeth, including long tusks in the lower jaw. The Sumatran rhino is in some respects intermediate between the One-horned and the African rhinos: it has lower tusks like the One-horned rhinos, but two horns like the African rhinos. It has more extensive skin folds than the African rhinos, but they are not nearly as extensive and elaborate as in the One-horned rhinos. The body of the Sumatran rhino is covered with hair (this abrades to some degree with age, but is always conspicuous); short, sparse hairs can be felt along the bodies of One-horned rhinos and the Southern White rhino, but the Black and Nile rhinos appear to lack even hair follicles except on the rims of the ears and the end of the tail.

The genetic data of Willerslev et al. (2009) put the separation of the three subfamilies at between 30.4 and 32 million years ago. The median dates calculated by the Time Tree of Life (http://www.timetree.org/) are 27.15Ma (*Rhinoceros-Diceros*), 26.6 (*Rhinoceros-Dicerorhinus*) and 27.15 (*Diceros-Dicerorhinus*). There is, in other words, no doubt that the three subfamilies are very different indeed, each with a very long evolutionary history.

The earliest fossil indication of separation between the modern subfamilies may be the Early Miocene (16.5-20.0Ma) *Rusingaceros leakeyi* from East Africa, which Geraads (2010) suggested was antecedent to the slightly later (13.5-13.0Ma) *Paradiceros mukirii*, a clear representative of the *Dicerotinae*. If one of the three subfamilies existed 20 million years ago, the other two must have done so as well. The Sumatran rhinoceros, therefore, was already separate from other rhinos by more than 20 million years ago, so agreeing with the genetic data.

Fossils related to the Sumatran rhino are known from the Late Miocene, Pliocene and Pleistocene of northern Eurasia (they include the famous Woolly Rhino *Coelodonta antiquitatis*). Oddly, fossil remains of the Sumatran rhinoceros itself are not known prior to the (Early) Pleistocene of Liucheng Cave, southernmost China; they occur sporadically through the Pleistocene in mainland Southeast Asia (Antoine 2012). A related species, *Dicerorhinus gwebinensis*, is known from the Early Pleistocene of Burma. (The fossil rhinos of Java are all *Rhinoceros sondaicus* or *Rhinoceros unicornis*: no *Dicerorhinus* is known from there).

The consequences of the long, long separation between the Sumatran rhino and other rhinos are severe. Whereas Indian, Black and Southern White rhinos breed relatively freely in captivity (as long as White rhinos are not fed with alfalfa: see Tubbs et al. 2012), the Sumatran rhinos captured in the 1980s and '90s stubbornly refused to do so, until Terri Roth in Cincinnati Zoo cracked the problem (Roth 2003). For example, the female is an induced ovulator, unlike other rhinos, and its hormonal requirements are different. One cannot predict much about the species' biology from knowing that of other rhino species.

A further consequence must be borne in mind: the species must rely on its own resources as far as its

future is concerned. It has been proposed that the Nile rhinoceros might be saved from extinction by assisted reproduction, including IVF or stem cell technology, followed by implantation of the resultant embryo into a Southern White rhino (Saragusty et al. 2016), and it might be possible to do this also in the case of the Javan rhino, whose embryo might be successfully implanted into an Indian rhino. But successful implantation of a Sumatran rhino embryo into any other species is highly improbable.

In sum, the Sumatran rhino is one-of-a-kind: the unique living representative of a long-separated lineage. We have before us the shocking example of the Baiji or White-flag dolphin *Lipotes vexillifer* (Turvey 2008): we must not again let 25 million years of evolution be snuffed out.

References

Antoine PO. 2012. Pleistocene and Holocene rhinocerotids (Mammalia, Perissodactyla) from the Indochinese Peninsula. *Comptes Rendus Palevol* 11:159–168.

Geraads D. 2010. Rhinocerotidae. In Werdelin L, Sanders WJ. (eds.), *Cenozoic Mammals of Africa*, University of California Press, pp.669–683.

Rookmaaker LC. 1980. The distribution of the rhinoceros in eastern India, Bangladesh, China, and the Indochinese region. *Zoologische Anzeiger* 205:253–268.

Roth TL. 2003. Breeding the Sumatran rhinoceros (Dicerorhinus sumatrensis) in captivity: behavioral challenges, hormonal solutions. *Hormones and Behavior* 44:31.

Saragusty J, Diecke S, Drukker M, Durrant B, Friedrich Ben-Nun I, Galli C, Göritz F, Hayashi K, Hermes R, Holtze S, Johnson S, Lazzari G, Loi P, Loring JF, Okita K, Renfree MB, Seet S, Voracek T, Stejskal J, Ryder OA, Hildebrandt TB. 2016. Rewinding the process of mammalian extinction. *Zoo Biology* 35:280–292.

Tubbs C, Hartig P, Cardon M, Varga N, Milnes M. 2012. Activation of Southern White Rhinoceros (Ceratotherium simum simum) estrogen receptors by phytoestrogens: potential role in the reproductive failure of captive-born females? *Endocrinology* 153:1444–1452.

Turvey S. 2008. *Witness to Extinction: How we Failed to Save the Yangtze River Dolphin*. Oxford University Press.

Willerslev E, Gilbert M, Binladen J, Ho S. 2009. Analysis of complete mitochondrial genomes from extinct and extant rhinoceroses reveals lack of phylogenetic resolution. *BMC Evolutionary Biology* 9:1–30.