



## Letter to Editor

# Ex Situ Sumatran Rhinoceros Conservation and the Agony of Choice. An Integration with the Management Strategy Proposed by Brandt et al. (2018)

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Editor’s Note: Dr Brandt and Dr Roca were contacted and indicated that they agree with the recommendation put forward in this letter.

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Brandt et al. (2018) offered a complete synthesis of the historical diversity in the genus *Dicerorhinus* and their results were consistent with 3 distinct subdivisions: *Dicerorhinus sumatrensis sumatrensis* (Sumatra and Peninsular Malaysia); *Dicerorhinus sumatrensis harrissoni* (Borneo) and *Dicerorhinus sumatrensis lasiotis* (mainland Asia, today probably extinct). These have been traditionally treated as subspecies of one polytypic species (reviewed, e.g., in Groves and Grubb 2011). Considering the grim status of the 2 extant taxa (about 30 live individuals including as few as 4 or 5 of the Borneo taxon), the authors propose a last-ditch effort to save the species through an ex situ breeding program, to reverse the alarming declining trajectory (Mays et al. 2018) of this evolutionary very distinct genus (e.g., Groves 2017).

Although we agree with most of the arguments and proposals made in the article, we propose that further discussion is needed to address the question of possible negative consequences following introgression of the 2 surviving distinct evolutionary significant units. Considering that the nominal *sumatrensis* is apparently still represented by a potentially viable number of founders, while the situation with *harrissoni* is desperate, we suggest that the breeding program should maintain separately the pure *sumatrensis* lineage from a *harrissoni* × *sumatrensis* one. This technique was adopted about a century ago in the conservation program for the wisent *Bos bonasus*, when a separate breeding line (lowland-Caucasian line) was established to include the contribution of the last Caucasian wisent bull *Bos (bonasus) caucasicus* (Pucek et al. 2004; Groves and Grubb 2011). Surprisingly, the lowland line derived from a lower number of founders ( $n = 7$ ) does not show inbreeding depression symptoms, in contrast to the lowland-Caucasian line that had more founders ( $n = 12$ ), yet shows negative effects such as neurocranium shortening and elongation and narrowing of the splanchnocranium, and lower survival of calves (Tokarska et al. 2011). Whether these

were chance effects or were due to outbreeding depression is not clear (but for genetic similarities between lowland and Caucasian wisents cf. Massilani et al. 2016). This prudent approach to ex situ conservation has long been also applied with other taxa, for example, Przewalski horse *Equus ferus przewalskii* (Groves 2009), and more recently with the pheasants *Lophura hatinhensis* and *Lophura edwardsi* (Hennache et al. 2012), and it has been considered for others, for example, dama gazelles *Nanger dama* complex (cf. Senn et al. 2014) and for the white rhinoceroses *Ceratotherium* spp. (but see below).

Our proposed approach to Sumatran rhino management will help to elucidate the potential effects of introgression on some elements of fitness such as health and breeding. Therefore, it would allow a more sound decision to be taken when more reliable data on possible outbreeding depression is available. It would also be sensitive to current discussions about the pros and cons of genetic rescue (e.g., Hedrick and Wehausen 2014; Frankham 2015; Waller 2015; Groves et al. 2017; Gippoliti et al. 2018a, 2018b; Ralls et al. 2018). This cautious approach is necessary considering that the only hybrid between the northern white rhinoceros *Ceratotherium simum cottoni* and the southern subspecies *Ceratotherium simum simum* (sometimes considered 2 different species) was atypical in several parameters. She was the largest female in Dvůr Králové Zoo, weighing 2203 kg, whereas 2 *simum* females weighed 1750–1930 kg; and 6 *cottoni* females were 1718–2016 kg (Holečková 2009); and some of her skull measurements were extremely large, with a basal skull length of 697 mm, and an occipitonasal length of 744 mm (see comparative measurements in Groves et al. 2010). She exhibited very poor health considering her age, in contrast to older *cottoni* individuals, and she did not produce offspring (but many of the pure *cottoni* and *simum* in captivity also do not reproduce). Although

it is difficult to generalize from a single hybrid animal, we think it likely that at least some of these unusual features in the individual were due to her hybrid status (Groves et al. 2017). The case of this hybrid could be important in this context, because subspecies of the Sumatran rhinoceros exhibit differences in body size (see Groves and Grubb 2011 and references therein). Therefore, even if crosses between *Dicerorhinus* subspecies do produce offspring, it is unknown to what extent they may suffer outbreeding depression. Finally, there exist strong ecological differences between Borneo and Sumatran forests (Wich et al. 2011) that may have led to different adaptations and may have potentially significant consequences for future reintroductions. We have no alternative now for Borneo—the agony of choice—but should try our best to maintain a nominotypical taxon in Sumatra, with one part of the Sumatra rhinoceros lineage maintained without admixture from Borneo.

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