

Genetics and the last stand of the Sumatran rhinoceros *Dicerorhinus sumatrensis*

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Abstract The Sumatran rhinoceros *Dicerorhinus sumatrensis* is on the brink of extinction. Although habitat loss and poaching were the reasons of the decline, today's reproductive isolation is the main threat to the survival of the species. Genetic studies have played an important role in identifying conservation priorities, including for rhinoceroses. However, for a species such as the Sumatran rhinoceros, where time is of the essence in preventing extinction, to what extent should genetic and geographical distances be taken into account in deciding the most urgently needed conservation interventions? We propose that the populations of Sumatra and Borneo be considered as a single management unit.

Keywords *Dicerorhinus sumatrensis*, extinction, genetics, genome resource banking, Sumatran rhinoceros, threatened

The rhinos...are unaware of their precarious existence. Their fate depends wholly on us, on our commitment to protect them forever. E. Dinerstein (2003)

Introduction

With as few as 216 wild individuals worldwide (Ahmad Zafir et al., 2011), the Sumatran rhinoceros *Dicerorhinus sumatrensis* is on the brink of extinction. Following a recent report by WWF on the fate of the Javan

rhinoceros *Rhinoceros sondaicus* in Vietnam (Brook et al., 2011), are we to witness the loss of another rhinoceros species? Genetic studies have played an important role in identifying conservation priorities (Moritz, 1994, 2002; De Salle & Amato, 2004; Caballero et al., 2009; Frankham, 2009; Laikre, 2010), including for species of rhinoceros (Ashley et al., 1990; Dinerstein & McCracken, 1990; Amato et al., 1995; Morales et al., 1997; Harley et al., 2005; Fernando et al., 2006; Scott, 2008; Kim, 2009; Willerslev et al., 2009). However, for a species such as the Sumatran rhinoceros, where time is of the essence in preventing extinction, to what extent should genetic and geographical distances be taken into account in deciding the most urgently needed human interventions?

Since its appearance in the Eocene, the family Rhinocerotidae has comprised > 40 genera (Guerin, 1989; Cerdeño, 1998). Nowadays it includes only four genera, with a total of five species (but see Groves et al., 2010). Comparisons of mitochondrial (mt) DNA sequences (including whole mt genomes) of contemporary Asian, African and fossil rhinoceros DNA suggest that the Sumatran rhinoceros is the most primitive extant species of the family and the closest related living species to the ancient woolly rhinoceros *Coelodonta antiquitatis* (Morales & Melnick, 1994; Cerdeño, 1998; Tougard et al., 2001; Orlando et al., 2003; Willerslev et al., 2009). Formerly existing across South-east Asia, including Thailand and Myanmar, the Sumatran rhinoceros is now Critically Endangered, with a decreasing population trend (IUCN, 2011), and confined to a few disjunct populations in Indonesia (Sumatra) and Malaysia (Borneo). The situation has been described as a problem of political endemism (Moritz, 2002). In the mid 1980s the governments of Indonesia and Malaysia, and international conservation organizations, supported management plans that included greater protection of wild populations and habitats, a controversial captive-breeding programme, and research (Khan, 1989; Rabinowitz, 1995; Foose & van Strien, 1997; Dinerstein, 2003). Today, there are 10 individuals in captivity: one female in Cincinnati Zoo and one male in Los Angeles Zoo (USA), two males (including a calf) and three females in the Sumatran Rhino Sanctuary at Way Kambas (Sumatra, Indonesia) and one male and two females at the Borneo Rhino Sanctuary (Sabah, Malaysia).

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