

Short Communication

Will current conservation responses save the Critically Endangered Sumatran rhinoceros *Dicerorhinus sumatrensis*?

RASMUS GREN HAVMØLLER, JUNAIDI PAYNE, WIDODO RAMONO, SUSIE ELLIS
K. YOGANAND, BARNEY LONG, ERIC DINERSTEIN, A. CHRISTY WILLIAMS
RUDI H. PUTRA, JAMAL GAWI, BIBHAB KUMAR TALUKDAR and NEIL BURGESS

Abstract The Critically Endangered Sumatran rhinoceros *Dicerorhinus sumatrensis* formerly ranged across South-east Asia. Hunting and habitat loss have made it one of the rarest large mammals and the species faces extinction despite decades of conservation efforts. The number of individuals remaining is unknown as a consequence of inadequate methods and lack of funds for the intensive field work required to estimate the population size of this rare and solitary species. However, all information indicates that numbers are low and declining. A few individuals persist in Borneo, and three tiny populations remain on the Indonesian island of Sumatra and show evidence of breeding. Rhino Protection Units are deployed at all known breeding sites but poaching and a presumed low breeding rate remain major threats. Protected areas have been created for the rhinoceros and other in situ conservation efforts have increased but the species has continued to go locally extinct across its range. Conventional captive breeding has also proven difficult; from a total of 45 Sumatran rhinoceros taken from the wild since 1984 there were no captive births

until 2001. Since then only two pairs have been actively bred in captivity, resulting in four births, three by the same pair at the Cincinnati Zoo and one at the Sumatran Rhino Sanctuary in Sumatra, with the sex ratio skewed towards males. To avoid extinction it will be necessary to implement intensive management zones, manage the metapopulation as a single unit, and develop advanced reproductive techniques as a matter of urgency. Intensive census efforts are ongoing in Bukit Barisan Selatan but elsewhere similar efforts remain at the planning stage.

Keywords Conservation planning, Critically Endangered, extinction, advanced reproductive technology, intensive management zones, metapopulation management, Sumatran rhino, South-east Asia

The Sumatran rhinoceros *Dicerorhinus sumatrensis* is categorized as Critically Endangered on the IUCN Red List (van Strien et al., 2008). It has been extirpated from > 99% of its former range, is threatened by poaching for its horn and has proven difficult to breed in captivity (Dinerstein, 2011). Poaching of rhinoceroses has soared in recent years (Emslie, 2013) and was the primary cause of extinction of the western black rhinoceros *Diceros bicornis longipes* and wild northern white rhinoceros *Ceratotherium simum cottoni* in Africa (Emslie, 2011a, b), and the Javan rhinoceros *Rhinoceros sondaicus annamiticus* in mainland South-east Asia (Brook et al., 2012). It has also been a causal factor in the decline of the Sumatran rhinoceros, which has also been affected by habitat loss and isolation (Ahmad et al., 2013). Here we outline the population status of the Sumatran rhinoceros, summarize the threats to its survival and highlight the main components and progress of the emergency plan developed during the April 2013 Sumatran Rhino Crisis Summit in Singapore and later agreed upon in the Bandar Lampung Declaration in October 2013.

Reliable population estimates for Sumatran rhinoceros have always been difficult to obtain. After years of suspected decline, the population was assessed in 2009 to comprise 200–216 individuals (Zafir et al., 2011). We provide an updated estimate (Fig. 1) but it should be noted that robust

RASMUS GREN HAVMØLLER Natural History Museum of Denmark, Centre for Macroecology, Evolution & Climate, Copenhagen, Denmark

JUNAIDI PAYNE Borneo Rhino Alliance (BORA), Kota Kinabalu, Sabah, Malaysia

WIDODO RAMONO Yayasan Badak Indonesia, Bogor, Java, Indonesia

SUSIE ELLIS International Rhino Foundation, Strasburg, Virginia, USA

K. YOGANAND WWF–Malaysia, Kota Kinabalu, Sabah, Malaysia

BARNEY LONG and ERIC DINERSTEIN WWF, Washington, DC, USA

A. CHRISTY WILLIAMS WWF–International, Gland, Switzerland

RUDI H. PUTRA* Leuser Conservation Forum, Banda Aceh, Aceh, Indonesia

JAMAL GAWI Leuser International Foundation, Banda Aceh, Aceh, Indonesia

BIBHAB KUMAR TALUKDAR† IUCN Species Survival Commission Asian Rhino Specialist Group, Guwahati, Assam, India

NEIL BURGESS‡ United Nations Environment Programme World Conservation Monitoring Centre, Cambridge, UK

*Also at: Tropical Biodiversity Conservation, Bogor Agricultural University, Bogor, Indonesia

†Also at: International Rhino Foundation, Strasburg, Virginia, USA

‡Also at: Natural History Museum of Denmark, Centre for Macroecology, Evolution & Climate, Copenhagen, Denmark

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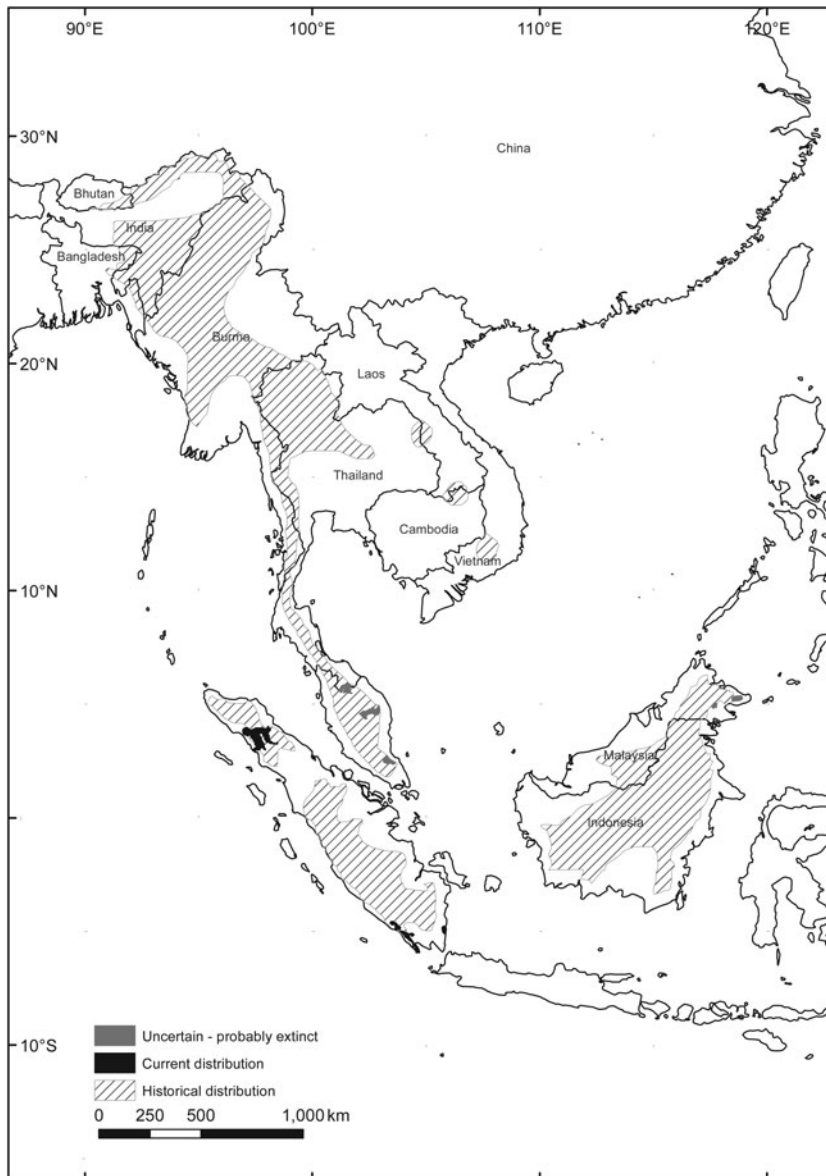


FIG. 1 Historical and present distribution of the Sumatran rhinoceros *Dicerorhinus sumatrensis* in South-east Asia. The historical distribution is derived from range maps in Foose & van Strien (1997), and the current distribution from IUCN (2012).

population data are lacking in most areas and these numbers represent best estimates.

In Indonesia the population in Way Kambas National Park was estimated to be c. 35 individuals in 2012 (Talukdar et al., 2012), indicating a strong recovery after being declared extinct in the Park in 1961 but rediscovered in the 1980s (Reilly et al., 1997). Immediately after the 1997–1998 El Niño drought a study using camera-trapping data (P. Wells, unpubl. data) estimated there were 7–16 individuals remaining in the Park, a decline of 50% of the population estimated to have been present in 1996. If these estimates are accurate, the implication is that the population may have doubled between 1996 and 2012.

In Bukit Barisan Selatan National Park a study conducted during 2007–2008 estimated there were 21 ± 7.1 rhinoceroses in the Park (Pusparini & Wibisono, 2013) but the methods

were not optimized for surveys of Sumatran rhinoceros. Based on patrol data, the distribution of rhinoceros signs had decreased by 70% during 2007–2012 (Talukdar et al., 2012).

To date only c. 10% of the 2,600 km² Leuser Ecosystem has been surveyed for Sumatran rhinoceros, and a minimum of 17 individuals were confirmed in a 250 km² area in 2012 (Leuser International Foundation, 2012). The species has also been recorded in other parts of the Leuser Ecosystem, including observation of a mother and calf in 2012 (Leuser Ecosystem Management Authority, unpubl. data). Camera-trap footage of a Sumatran rhinoceros was obtained from East Kalimantan, Indonesian Borneo (WWF–Indonesia, 2013), but the evidence suggests the population consists of very few individuals.

The most recent record of a Sumatran rhinoceros in Peninsular Malaysia was in 2007 (Magintan et al., 2010) and there is no evidence to support previous population

estimates of 69–94 individuals (Zafir et al., 2011; Talukdar et al., 2012; WWF–Malaysia, 2012). Tabin Wildlife Reserve in Sabah, Malaysia, was believed to contain as many as 20 rhinoceroses in the 1980s but records of fresh footprints declined thereafter. Since 2007 there have been no definite signs of the presence of wild rhinoceroses in the Reserve other than those of a female that was captured in 2011. This was despite an effort by Borneo Rhino Alliance of 11,600 trap-days at 52 trap stations covering $> 300 \text{ km}^2$ in a $2.5 \times 2.5 \text{ km}^2$ grid during July 2012–July 2013, overlapping the entire area where footprints had been recorded during 1995–2005.

In Danum Valley WWF–Malaysia conducted camera-trap surveys within a $2 \times 2 \text{ km}$ grid from October 2012. By March 2013, after surveying 25 grids over 11,235 trap-days, only one rhinoceros had been photographed, which was subsequently caught in March 2014. This is presumed to have been the last individual in Danum Valley and the Sumatran rhinoceros may now be extinct in Malaysia, echoing the concern raised by Rabinowitz (1995). As of June 2015 no further signs of the species have been found in Sabah, and it is safe to consider the species extinct in the wild in Malaysia.

Currently the two main threats to the Sumatran rhinoceros are poaching and low densities (leading to a likely negative population growth rate). With the high demand for rhinoceros horns in black markets in Asia, poaching remains a significant threat. The last confirmed record of poaching in the Malaysian state of Sabah was of a young adult female with severe reproductive tract pathology, near the border with East Kalimantan, in March 2001 (Sen Nathan, pers. comm.; Talukdar et al., 2009). In Indonesia the Sumatran rhinoceros was extirpated by poaching in Kerinci Seblat National Park by 2007 (Zafir et al., 2011); in Way Kambas National Park the last known rhinoceros poaching event was in 2006 (Talukdar et al., 2009). In Bukit Barisan Selatan National Park three individuals were poached during 2001–2002 but there have been no recorded poaching events since then (Talukdar et al., 2009; Arief Rubianto, pers. comm.).

In Gunung Leuser National Park poaching was almost eliminated during the 5-year study of van Strien in the early 1980s, however by the late 1980s poaching was rife and as few as 13 individuals were thought to remain in 1991 (Griffiths, 1991). No direct evidence of rhinoceros poaching has been detected recently, although signs of poaching of other species are found regularly throughout the area.

Female Sumatran rhinoceros with severe reproductive pathology are well documented in Malaysia, with $> 50\%$ of captured females being affected, including the two currently held in captivity in Sabah. This condition results from a lack of pregnancy and eventually renders the female infertile. The frequency of the problem provides direct evidence that females rarely mate and become pregnant (Schaffer et al., 2002). This phenomenon could also become a problem in Indonesia when populations decline such that

breeding events become rare. These problems have implications for natural breeding efforts in captivity and in situ, including the effectiveness of efforts within the proposed intensive management zones. We recommend that all females in these zones not known to be breeding are checked for reproductive pathology before a decision on their utilization in recovery efforts is made.

One of the key actions identified at the Sumatran Rhino Crisis Summit and in the Bandar Lampung Declaration is a unifying global strategy to manage the global population (both wild and captive) as a single metapopulation across national and international borders. The best example of success of a single metapopulation strategy is that of the greater one-horned rhinoceros *Rhinoceros unicornis* in Nepal and India (Talukdar, 2006; Martin et al., 2013). This management strategy has yet to be implemented for the Sumatran rhinoceros. The national government of Malaysia and state government of Sabah are ready to collaborate in this way.

The second agreed action is the continued deployment of Rhino Protection Units at sites with remaining breeding populations. This has been achieved in all breeding areas but requires strengthening, especially in northern Sumatra.

The third proposed action is the creation of intensive management zones, with increased protection and monitoring in areas where the Sumatran rhinoceros breeds naturally. It was also proposed that rhinoceroses outside intensive management zones would be consolidated into these areas to achieve the highest probability of population growth. Actions to implement this proposal are still in the planning stages.

The fourth action of the conservation strategy is captive breeding. Only c. one-third of all individuals captured were subjected to systematic breeding efforts, and some of those on only a few occasions. The development of advanced reproductive technology for captive breeding is being pursued in Sabah, in collaboration with the Leibniz Institute for Zoo and Wildlife Research, Agro-biotechnology Institute Malaysia, Universiti Putra Malaysia and others. After the techniques for removing oocytes from females and producing embryos in vitro have been ascertained it should be possible for every female in managed conditions to produce several progeny. This option may take many years to develop, however, and we may lose the species before it becomes a reliable technique. Exchange of gametes between individuals in all captive facilities, where it provides a genetic advantage, must be facilitated to boost potential success of the managed breeding programme (Goossens et al., 2013). However, such a programme has yet to be agreed upon.

In Indonesia the emphasis remains on natural breeding, although preliminary attempts are being made to inseminate Sumatran rhinoceros artificially. Artificial insemination has resulted in the births of five white rhinoceros calves in European zoos and three greater one-horned rhinoceros calves (Terri Roth, pers. comm.), but has not yet yielded any results for the Sumatran rhinoceros.

In conclusion, with only three small wild populations of Sumatran rhinoceros, albeit with some records of breeding, and nine individuals in captivity (one in Cincinnati Zoo, three in Sabah and five in the Sumatran Rhino Sanctuary, with three individuals being closely related), and no overall indication of recovery of the wild populations, we can say that despite great efforts the current conservation actions for the Sumatran rhinoceros may not be adequate to prevent the species' extinction. In contrast, conservation efforts, particularly consolidation and protection of small populations, have resulted in significant population increases for other rhinoceros species. Plans to save the Sumatran rhinoceros are in place at the conceptual level and there is broad consensus and commitment to work in partnership amongst the organizations involved, but the pace of development and implementation of such plans needs to be increased. Although a significant increase in funding for Sumatran rhinoceros conservation has become available since the Sumatran Rhino Crisis Summit, most of this has focused on habitat protection. Thus, new funding streams for metapopulation management and conservation breeding, including expanding the conservation breeding facilities and development of advanced reproductive technology, need to be identified. Political will is needed to make the bold decisions to facilitate implementation of these far-reaching conservation plans. A rapidly implementable and fully integrated metapopulation management model incorporating all the above strategies is critical if the Sumatran rhinoceros is to survive.

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Biographical sketches

RASMUS GREN HAVMØLLER researches the ecology, genetics and conservation of large mammals. JUNAIDI PAYNE works on captive breeding and surveys of the Sumatran rhinoceros in Sabah, Malaysia. WIDODO

RAMONO's focus is on captive breeding and in situ conservation of Sumatran and Javan rhinoceroses. SUSIE ELLIS focuses on the conservation of all rhinoceros species. K. YOGANAND leads terrestrial conservation work for WWF–Malaysia in Sabah, Malaysia. BARNEY LONG focuses on conservation programmes for rare and threatened species in South-east Asia. ERIC DINERSTEIN focuses on international conservation projects for large mammals. A. CHRISTY WILLIAMS is coordinator for WWF–International AREAS programme. RUDI PUTRA works on the conservation of Sumatran rhinoceros and other large mammals in Aceh, Indonesia. JAMAL GAWI is a biodiversity governance specialist. BIBHAB TALUKDAR focuses on conservation and management of rhinoceroses in India and South-east Asia. NEIL BURGESS has worked on biodiversity conservation, predominantly in Africa, for the last 25 years.