MANAGEMENT

The last chance for the Sumatran rhinoceros?

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Abstract

The Sumatran rhino (*Dicerorhinus sumatrensis*) is very close to extinction in Indonesia. Three major ad hoc meetings, not two as generally reported, to discuss ways to save the Sumatran rhino were held in 1984, 1993 and 2013. Their targets have never been achieved. Despite the great efforts of the participants and other parties, the world population of *D. sumatrensis* has collapsed during the last 30 years from over 800 to fewer than 100. Besides worldwide phenomena like habitat loss and poaching, other specific causes lie behind this tragedy. The status of the Sumatran rhino has been optimistically overestimated. Precious time is being wasted in finding theoretical solutions rather than implementing the recommendations of these meetings. Political will to save the habitat and protect the species is lacking. After carefully evaluating the present Sumatran rhino conservation status, a breeding project greater than those so far managed has to go ahead as soon as possible to support the ongoing in situ programme and form a viable population in controlled environments for future reintroductions into the wild.

Résumé

Le rhinocéros de Sumatra (*Dicerorhinus sumatrensis*) est très proche de l'extinction en Indonésie. Il y a eu trois grandes réunions ad hoc et pas deux comme on l'a généralement signalé, organisées en 1984, 1993 et 2013 afin de discuter les voies et moyens pour sauver le rhinocéros de Sumatra. Leurs objectifs n'ont jamais été atteints. Malgré les efforts des participants et d'autres parties, la population mondiale de *D. sumatrensis* s'est effondrée à partir de plus de 800 rhinocéros à moins de 100 rhinocéros au cours des 30 dernières années. Outre les phénomènes à travers le monde comme la perte de l'habitat et le braconnage, il existe d'autres causes spécifiques derrière cette tragédie. La situation du rhinocéros de Sumatra a été surestimée avec optimisme. On gaspille un temps précieux dans la recherche des solutions théoriques plutôt que dans la mise en œuvre des recommandations de ces réunions. La volonté politique de sauver l'habitat et de protéger l'espèce fait défaut. Après avoir soigneusement évalué l'état actuel de la conservation du rhinocéros de Sumatra, un projet de reproduction plus grand que ceux gérés jusqu'ici doit être mis en place dès que possible pour soutenir le programme in situ déjà en cours et former une population viable dans des environnements contrôlés en vue des réintroductions futures dans la nature.

Introduction

This paper focuses on the plight of the Sumatran rhinoceros (*Dicerorhinus sumatrensis*) in Indonesia. I hope to show that only immediate action will save this rhino species from extinction, and that a large-scale capture operation of isolated animals is feasible with existing expertise, and presently is the only course of action with a chance of success.

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Andalas, the first-ever conceived and captive-bred Sumatran rhino, Cincinnati Zoo, 13 September 2001.

The importance of ex situ conservation next to in situ preservation continues to be controversial: a number of conservationists completely oppose the former, while others concede that removing animals from their habitat should be the 'last resource'. Some NGOs affirm that the animals need massive in situ investments and that if you take them into captivity (ex situ) you lose the argument for habitat protection. Their concern is correct but remains unsubstantiated. As far as the Sumatran rhino is concerned, much funding was made available for in situ conservation during the period 1984–1993 of the first project aimed to establish an ex situ metapopulation (Rabinowitz 1995), and more funding continues to be raised especially for in situ projects (rhino protection units, patrolling vehicles and boats, etc.). New ex situ programmes have to be funded by new specific subscriptions.

What happens in 'emergency situations' when the decline of a species is so rapid as to require final decisions and immediate action? Dalton (2000) suggested that rapid responses, 'emergency rooms', in many cases need to be the policy norm rather than the exception. The last 30 years witnessed the extinction of several Sumatran rhino populations. In Indonesia, the situation is rapidly declining, and more advanced field technologies demonstrate that both wild and captive populations have reached a deep crisis and call for major interventions (Ahmad et al. 2013; Pusparini et al. 2013).

In the course of the last 30 years I have personally experienced the tragic decline of the Sumatran rhino. I believe that the only remaining chance for the species is to promptly move all isolated in situ survivors into ex situ environments. This process should be considered as the best available (possibly temporary) solution, rather than risking to end up with no Sumatran rhino at all. Ex situ promoters are not to be blamed, though someone could say that there is a risk that the result would be to end up with Sumatran rhinos in captivity only and none in the wild. Ongoing in situ protective measures have to be continued and reinforced.

Only nine Sumatran rhinos are kept ex situ in large, natural fenced areas—five in Indonesia, three in Sabah and one in an appropriate enclosure in the USA (Cincinnati Zoo)—where they can be carefully monitored and protected. Three offspring have been born (2001, 2004, 2007) so far in Cincinnati Zoo and one (2012) at Way Kambas Rhino Sanctuary (Roth 2013), improving the skill of both Indonesian and American personnel involved.

Extinction is imminent. According to Martin et al. (2012): '1) informed, empowered, and responsive governance and leadership is essential, 2) processes that ensure institutional accountability must be in place, and 3) decisions must be made while there is an opportunity to act. The bottom line is that unless responsive and accountable institutional processes are in place, decisions will be delayed and extinction will occur.' It is a matter of months, because it may simply become too costly to locate and collect remaining individuals. Time is running out fast and time has come for all committed parties to take full responsibility, not to avoid it, if not for mere future liability (Brechin et al. 2002).

Status of *D. sumatrensis* in Indonesia

The present small Sumatran rhino population in Indonesia is fragmented in pockets found throughout Sumatra with a total estimate of 90–100 individuals, and possibly in Kalimantan, the Indonesian part of Borneo. (For safety reasons these data are not disclosed further.) Estimates on the number of *D. sumatrensis* vary *considerably* and this *uncertainty* is of great concern.

The total number of Sumatran rhinos in Bukit Barisan Selatan National Park (150,000 ha, MoF 2007) was estimated to be 250–390 in 1993 (Pusparini

et al. 2013), which had dwindled to 147–220 in 2007 (MoF 2007) or even 60–70 (Rubianto et al. 2008; Talukdar et al. 2010). Using the Royle/Nichols heterogeneity model, Pusparini et al. (2013) estimated the presence of 21 rhinoceros, fragmented in three distinct populations: Sukaraja, Way Ngaras and Kubu Perahu areas—just 32% of suitable rhino habitat. Despite the government's good intention to achieve a 30% rhino population growth (MoF 2007), the development of an asphalt road crossing rhino core areas is likley to bring in human disturbance and jeopardize the target.

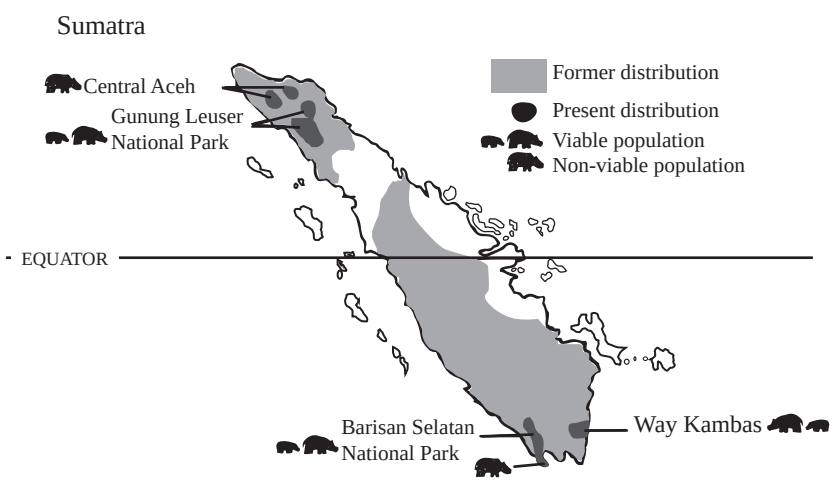

Figure 1. Sumatran rhino *Dicerorhinus sumatrensis* distribution (Nardelli 2014).

The population of rhinos in Way Kambas NP (50,000 ha) was 15–25 rhinos (MoF 2007). A current figure indicates 30–35 animals (Widodo, pers. comm. at the 2013 Singapore Summit) .

There were 60–80 rhinos in Gunung Leuser NP (80,000 ha) in 2007 (MoF 2007). Hopes are that a good number of *D. sumatrensis* not isolated remain in Gunung Leuser NP, but lack of information and even hostility by local people have not made it possible to ascertain their actual number (Widodo 2012, pers. comm.). However, Hadiansyah Putra (2013) states that 50 rhinos thrive in the core area and 10–20 in the surrounding forest. Once verified, this information would change the general in situ status considerably, and hence a field survey is valuable now.

These figures suggest that there are about 50–55 Sumatran rhinos left in Bukit Barasan Selatan NP and Way Kambas NP, while the population in Gunung Leuser needs further verification (Figure 1). Delegates at the Sumatran Rhino Summit in Singapore in 2013 suggested a total of 100 Sumatran rhinos on the island. I suggest that it is realistic to consider that 75 rhinos are available for in situ conservation in Sumatra. This number represents the two distinct, identified viable populations in Bukit Barisan Selatan and Way Kambas, let's say at 25 animals each. The status in Gunung Leuser is too poorly known to suppose that more than 25 animals would be available for in situ conservation. Other rhinos living in tiny groups or isolated circumstances could be 'ghosts' or doomed if not ascertained, and abandoned to their fate. The addition of such rhinos can only make sense once they are physically transferred into the viable populations or to ex situ facilities via operative conservation programmes.

First meeting on Sumatran rhino conservation in 1984

Three major meetings in 1984, 1993 and 2013 have marked the recent history of the Sumatran rhino; all were convened by the International Union for Conservation of Nature and Natural Resources (IUCN). The first was an ad hoc Sumatran rhinoceros meeting held 3–4 October 1984 in Singapore. At this convention, aptly termed 'ad hoc', 20 participants gathered to evaluate the already complex status of *D. sumatrensis*. In situ conservation was the primary objective and proposals for improvements were presented and discussed among government representatives of Indonesia, Malaysia and Sabah as well as committed NGOs and specialists. The option of ex situ breeding was debated for the first time in depth. The majority decided in favour of a coordinated ex situ breeding project (Foose 1984; Nardelli 1984). Two surveys to locate isolated (doomed) individuals in Sumatra preceded the meeting: one carried out by WWF field specialist Raleigh Blouch in the Torgamba area, Riau Province, and the other by Perlindungan Hutan dan Pelestarian Alam (PHPA) official, Widodo Ramono, in the Gunung Patah area, Bengkulu Province. Since

Base camp of the first Sumatran Rhino Project in Torgamba. On the left are the rhino shelters. The paddocks in the foreground were constructed under trees to keep the animals shaded and cool.

Blouch stressed the urgency to rescue the rhinos in Torgamba, literally surrounded by palm oil plantations, it was determined to start the capture in that locality (Strien 1985a).

As a direct outcome of the meeting, two agreements were signed: the first in 1985 between the Indonesian government and Howletts & Port Lympne Wildlife Parks (H&PL), UK, and the second in 1986 between the Indonesian government and the Sumatran Rhino Trust, USA, the latter a consortium of four major American zoological institutions (New York Zoo, San Diego Zoo, Los Angeles Zoo and Cincinnati Zoo). For various (undisclosed) reasons, Malaysia and Sabah started separate programmes for capturing rhinos within their territories. Hence the first ever captive breeding projects were set in motion. At the same time, substantial funding was made available to the Indonesian government for in situ protection of the viable *D. sumatrensis* populations identified in Gunung Leuser NP, Kerinci-Seblat NP and Bukit Barisan Selatan NP, to accommodate 400–500 Sumatran rhinos (Nardelli 1986a,b; Khan 1989).

Subsequent to the Singapore meeting of 1984, between 1984 and 1986, I was involved as negotiator of both agreements between the various parties, acting as executive director of H&PL and the Sumatran Rhino Trust until 1992 (Nardelli 1984, 1985). While the outcome of the project has been assessed by Rabinowitz (1995), Zafir et al. (2010), Ahmad et al. (2013) and others, their analyses have been somehow one-sided. A more balanced view was given in a short note by Sumardja (1995). Therefore, it is useful to present a short description of that operation in this paper.

Data about the ecology and conservation of *D. sumatrensis* were found in two theses by Markus Borner (1979) and by Nico van Strien (1985b). These authors presented much information on feeding habits and other ecological parameters, even though direct observations of individuals, most no longer than a few seconds, could be counted on the fingers of one hand due to the well-known elusiveness of the species. There was little or no information about procedures that would assist in ex situ breeding. Rookmaaker (1998) made available a list of all instances in which Sumatran rhinos were kept in captivity.

Due to the scarcity of data, the Sumatran rhino was considered to be a browser and treated accordingly by all the people involved in ex situ projects (author included) both in the field and in zoos, regrettably for several years (Dierenfeld et al. 1994). However, this rhino is a megafolivore that, like langurs and colugo, belongs among those species feeding almost exclusively on foliage, with approximate percentages of leaves and twigs at 90%, and fruit and grasses at 10% (Nardelli 2013).

The capture of doomed rhinos in Torgamba forest in Riau Province, Sumatra, was carefully planned in cooperation with Tony Parkinson, world renowned expert in catching wildlife, who directed the field operations, and Raleigh Blouch, WWF representative. During my stay in Indonesia from 1985 to 1992, we managed to capture 18 *D. sumatrensis* safely. All arrived at their destinations in perfect condition, already used to a browser diet.

The continuous presence of a qualified veterinarian, either from the USA or the UK, at the base camp in Torgamba proved particularly useful as four of the captured rhinos had infected lesions from wire snares deeply embedded in their legs. These animals were literally saved 'at the very last moment' by the well-equipped and experienced veterinarians on duty. At the base camp six trained people were collecting fresh leaves for the animals, watering them and properly cleaning the paddocks daily.

The experience gained during these operations provided much-needed expertise on the transfer, care and breeding of *D. sumatrensis*. In fact, through ex situ breeding it has been ascertained that, unlike other rhino species, Sumatran rhino females ovulate only if and when induced by males (Roth et al. 1998; Roth 1999).


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Holding pen in the forest, attached to the trap, for rhino adaptation lasting 15–20 days.

My experiences while with the project convinced me that two missteps were made in the absence of data. Both revealed critical consequences after the rhinos looked well adapted to their diet and settled in their final accommodations.

First, as a megafolivorous mammal, *D. sumatrensis* is strictly linked to rainforest food supply (Nardelli 2013), with a digestive system comparable to that of other leaf-eating mammals. As it was unanimously considered to be an undemanding browser in 1985, the animals were fed an unsuitable diet similar to the one fed to the black rhino, *Diceros bicornis*, a typical browser. Although Radcliffe et al. (2004) were close to a complete solution on the optimum diet for *D. sumatrensis*, it was the staff in charge of Cincinnati Zoo who solved this vital crisis, supplying ad libitum fresh ficus leaves acquired from San Diego (Romo 2011)—just in time for three *D. sumatrensis* to breed successfully (Roth 2013)!

This problem is solved.

Second, the Sumatran rhino suffers from an anthropogenic Allee effect (AAE), which was not properly recognized at the time. In many animal and plant species, individual reproduction and survival are diminished in small populations through various mechanisms including mate shortage, failure to optimize the environment, or lack of conspecific cooperation. When populations are enduring human exploitation, this can be called anthropogenic Allee effect (Courchamp et al. 2006). AEE may exhibit negative population growth rates at low densities, which drives them to even lower densities and ultimately precipitate into an extinction vortex. A typical example of a species sensitive to AAE is an obligate cooperative breeding species like *D. sumatrensis*. This rhino species is an induced ovulator; reproduction fails to be efficient when their numbers drop to such a low level that males and females simply don't meet each other anymore, leading to tumours of the uterus and probable too-low activity of the sperm (Hermes et al. 2006; Agil et al. 2008).

The AAE problem remains unsolved and it is likely to become the major threat to wild and captive populations of *D. sumatrensis.* No doubt a number of both males and females were already infertile at the time of their capture due to those pathologies, as autopsy revealed. Although today we could assess the medium-term probable survival of species using population viability analysis, we will never determine the consequences of stochastic phenomena like AAE (Lee 2013).

Second meeting on Sumatran Rhino Conservation, 1993

A Sumatran rhino population and habitat viability analysis workshop was held 11–13 November 1993 in Bandar Lampung, Indonesia, attended by about 50 delegates. Considering the high mortality rate of the captured Sumatran rhinos in some of the zoos, it was decided to discontinue the capture of isolated (or doomed) rhinos (Tilson 1993). Hence, we need to understand why capture of doomed animals was never resumed for 21 years (1993–2014). Have we allowed too much time to waste?

However, two major achievements were implemented as a direct result of the workshop. First, the Sumatran Rhino Sanctuary was constructed within Way Kambas NP, in Lampung Province, Sumatra, for semi-ex situ breeding *D. sumatrensis* in very large enclosures (Foose et al. 1995). Second, in situ protection was much strengthened with the institution of special Rhino Protection Units , formed by dedicated armed guards to control rhino areas (Foose et al. 1997). The management was handed over to the Indonesian Government.

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D. sumatrensis mother Ratu with male Andatu, born in Way Kambas on 23 June 2012, the first birth ever in Indonesia,the seventh in captivity.

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Male *D. sumatrensis* Rokan, in the pit trap.

Third meeting on Sumatran Rhino Conservation, 2013

The Sumatran Rhino Crisis Summit (SRCS) was convened 31 March–4 April 2013, again in Singapore, gathering over 100 specialists from different governments, NGOs, institutions and independent conservationists. Among various topics, managed breeding was examined in depth.

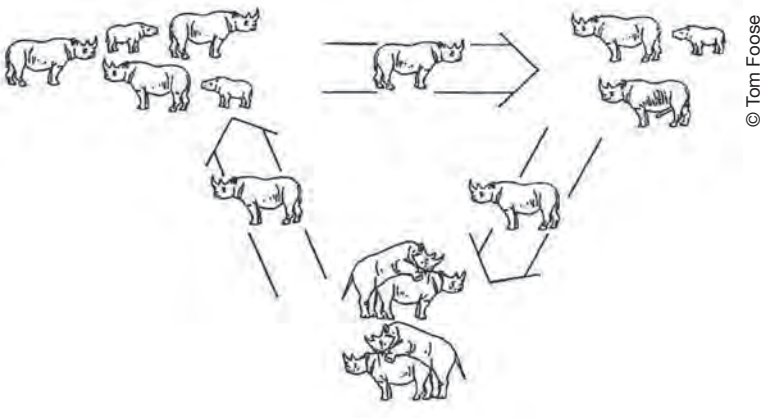
Summarizing the discussions on population modelling, Putnam (2013) showed that 'the best scenario would be with two groups; bring in 2.2 animals within 10 years per group, breeding every three years, and the probability of extinction drops to 7%. If things go on as they are, the captive population will be extinct within 50 years—100% probability.' This conclusion is similar to one reached in 1984 at the first Sumatran rhino meeting (Strien 1985a).

Action followed the first and second meetings, more pondering the third (Crosbie 2013; Ellis 2013; Goossens et al. 2013; Hegener 2013; Payne 2013; Roth 2013; Brook et al. 2014; Hance 2014b,c; Ip 2014; Kolbert 2014; McDonnell 2014; Vaz 2014; among others). Since its conclusion, two outcomes were publicized: the female Iman falling into a pit trap in Sabah on 20 March 2014 and safely moved to facilities in the Borneo Rhino Sanctuary (Hance 2014a), and the signing of the Bandar Lampung Declaration in October 2013 (IUCN 2013) by the respective ministers of Bhutan, India, Indonesia, Malaysia and Nepal at the First Asian Rhino Range States meeting. This event was marked by its promising goal: The populations of the Indian, Javan, and Sumatran rhinos will each be managed for an annual growth rate of at least 3%.

Discussion

It's time to go by phases and priorities. The three meetings of 1984, 1993 and 2013, in my opinion, should have taken place in a reverse order to justify the quantity of recommendations: in 1984, with population figures around 800 rhinos, there would have been time to put into practice several of the actions proposed in 2013 at the SRCS. In 2013, or today, with a population of 75 viable animals, we have time only to execute a few rapid schemes (e.g. listed in the 1984 ad hoc meeting). We cannot afford to implement all conservation methods efficiently as we all would like, unless all resources increase 10-fold.

We still have before our eyes the saga of the Nile rhino or northern white rhino (*Ceratotherium cottoni* or *Ceratotherium simum cottoni*): common just a century ago, down to a few dozen in the 1980s, four in 2006, extinct today in the wild despite millions spent for their protection. Seven, likely not reproductive individuals, can still be seen in captivity or in similar condition—four in Ol Pejeta Conservancy in Kenya, one in Dvur Kralove Zoo in Czech Republic and two in San Diego Zoo in the USA—and most of these are candidates to hybridize with southern white rhinos (Ol Pejeta Conservancy 2014). As rightly stated by Hermes et al. (2006): 'Intensive efforts to propagate specifically the northern white rhinoceros have been very limited. The dismal outlook for this subspecies in the wild makes successful ex situ breeding programmes paramount.'



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Managed migration among populations of rhino.

We may have personal ideas as far as conservation problems are concerned, with possible inaccuracies arising when a specific action is considered the only possible one. The results of 'unfortunate' initiatives have made today's governments (not only the Indonesian) reluctant to take decisions. The 1984 project was declared a failure by major NGOs. In 1995, with a population of a little more than 300 individuals left, Rabinowitz (1995) wrote that 'captive breeding would have led to extinction.' Which government will take the initiative after such statements by prominent NGOs and outstanding specialists?

Recommendations

Today with, in my opinion, a total population of only 75 viable *D. sumatrensis* left, there are action plans, proceedings, papers, etc., concluding that the species can still be saved. However, in my estimation such a goal cannot be achieved unless a new rescue project starts off immediately. Simply, in situ control has proved to be inadequate on its own. A programme giving priority to artificial propagation to save *D. sumatrensis* would be to keep our eyes 'wide shut', ignoring the scarce successes this practice has so far achieved, although it should be kept high in consideration to support natural breeding. In Sabah, for example, where Sumatran rhino numbers are so low—three in captivity and a few more in the wild—artificial insemination is the best option to increase their number.

I propose a strategy of seven practical steps to achieve a major objective: save the Sumatran rhino. Based on my experience, I suggest we restrict our aim, at present, to the following undertakings and in this progression:

1. Negotiate and sign long-term bi- or multilateral agreement(s) between the Indonesian government and conservation institution(s). This is to call a halt to meetings and transform their existing relevant conclusions into action.

2. Capture isolated rhinos, following the successful 1984 protocol and logistics, to enhance semi-ex situ breeding programmes, first in Way Kambas. Semi-ex situ breeding, sometime wrongly termed in situ breeding, is proving to be the optimal solution, not only for *D. sumatrensis*. For instance, the Javan rhino or the Saola could benefit too. The advantages are evident: food, temperature, humidity are natural and low workforce costs.

3. Allow regular movements between closely monitored managed populations, as the need is urgent to expand present facilities and construct new ones in Bukit Barisan Selatan NP. At the meeting in Singapore in 2013, Indonesian representatives declared that a facility similar to Way Kambas Sanctuary is in their progress schedule to be realized in the southern part of Bukit Barisan Selatan (now almost cut off from the northern part), where a few isolated Sumatran rhinos still exist. Most participants supported the plan.

4. Complete—preferably within 10 years—two facilities in Indonesia, one in Sabah and one in the USA, holding between them possibly 20 viable pairs (Foose in Khan 1989) or at least 26 viable individuals (Putnam 2013).

5. Move part of future progeny, in unrelated pairs, to selected zoos that can afford a new management and breeding protocol to fulfil requirements specific for *D. sumatrensis* (Dierenfeld et al. 2000; Radcliffe et al. 2004; McNeely 2005; Nardelli 2013).

6. Create large fenced areas (> 1000 hectares) in well-protected rainforest. Such pre-reintroduction areas would allow the rhinos to breed in complete natural conditions, prior to their release in well-protected national parks.

7. Fence Way Kambas NP to keep people outside and rhinos inside. This is not relevant for ex situ breeding but it is essential to preserve the integrity of at least one national park for in situ medium- to long-term conservation of one viable rhino population.

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Which is going to be the final result? Sumatran rhino birthday party (above)…or more photos like: The last known Javan rhino poached in Vietnam (right).

Managing this species requires a significant amount of time. Pairing individuals, pregnancies and inter-calving periods are just some of the long-time processes. Whichever the approach, breeding Sumatran rhinos is a lengthy course of action, so time is of the essence (Martin et al. 2012). To emphasize the positive effects to manage the rhinos as a single population (Ellis et al. 2011), it is necessary to ensure the possibility of fast cross-border movement of rhinos with existing international protocols, to achieve a truly fluid captive metapopulation. Indispensable arrangements and agreements between governments related to ownership of adults or offspring and their transfer should be agreed upon now to ensure future population flexibility. It is essential that the efficiency of the whole process is enhanced by political will, know-how and experience.

The specific status that the Sumatran rhino suffers today warns that only a collaborative and resolute ex situ conservation programme will keep the species from extinction. Brook et al.'s (2014) paper on the last days of *Rhinoceros sondaicus annamiticus* spells out clear deficiencies of management, and there is a disappointing similitude to *D. sumatrensis* state of affairs: 'The failure at the site level to protect the rhinoceros population ultimately resulted in its demise. Low political will to take decisions required to recover the species and inadequate focus from the conservation and donor community further contributed to the subspecies's extinction, in part due to a lack of knowledge on population status. Lessons from this example should inform the conservation of other very threatened large vertebrates, particularly in Southeast Asia.'

And NOW? We do risk saying farewell forever to the Sumatran rhino!

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