



## Perspective

# Lessons learned from the loss of a flagship: The extinction of the Javan rhinoceros *Rhinoceros sondaicus annamiticus* from Vietnam



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## ABSTRACT

The extinction of the Javan rhinoceros (*Rhinoceros sondaicus*) from Vietnam in 2010 was a conservation tragedy. Hunting has been the primary driver of the catastrophic decline of Javan rhinoceros throughout its range. The last individual from Vietnam was poached in 2010. To help avert repeating such outcomes with similarly imperiled species, this case study presents a state-pressure-response framework, considering the rhinoceros's historical and current status, the pressures it faced, and the adequacy of the conservation response. 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.

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## 1. Global state of Javan rhinoceros

The Javan rhinoceros *Rhinoceros sondaicus* was apparently widespread and locally numerous in Southeast Asia before the onset of intensive hunting in the mid nineteenth century (Groves, 1967). Within Vietnam, Carpentier (2006) concluded from an examination of contemporary written sources that rhinoceroses were at least locally common in Cochinchina (southernmost Vietnam) during 1850–1900; from the 1920s they started to be described as ‘rare’, with the Bien Hoa area and the Dong Nai basin providing most of the reports. They apparently disappeared from many other areas in the 1920s–1930s.

By the early part of the 20th century Loch (1937) estimated that perhaps only 40–70 Javan rhinoceroses remained globally and the species was considered one of the region’s rarest animals (Harper, 1945). Loch’s estimate for Vietnam includes 6 individuals from northern Annam and 1 from Tonkin; the population in southern Vietnam had not been discovered at that time.

The Javan rhinoceros had three subspecies. *Rhinoceros sondaicus inermis* of eastern India (Bengal and Assam), Bangladesh and Myanmar went extinct in the early 1900s (Khan, 1989; Rookmaaker, 1980). *Rhinoceros sondaicus sondaicus*, of Thailand and Malaysia to Sumatra and Java (Indonesia), was, by the 1930s, considered so rare that a special reserve was established, Ujung Kulon National Park, Java, where at least 35 persist: the taxon’s only surviving population (Hariyadi et al., 2011; Loch, 1937).

The third subspecies, *Rhinoceros sondaicus annamiticus*, was formerly widespread and at least locally abundant in Vietnam, Lao PDR, Cambodia and eastern Thailand (Corbet and Hill, 1992; Rookmaaker, 1980). Historical information on abundance and distribution is incomplete. During the mid to late 1800s it evidently persisted in relatively large numbers, but by the early to mid 1900s it was much reduced and widely extirpated (Harper, 1945; Loch, 1937). By then rhinoceroses were apparently scarce in Thailand, Lao PDR and Vietnam (Loch, 1937). The last documented record from Cambodia was in 1930 (Poole and Duckworth, 2005) A few may have persisted in remote parts of Lao PDR until the 1970s (Neese, 1975). Political unrest prevented surveys in Vietnam through much of the mid to late twentieth century and *R. s. annamiticus* was presumed extinct until in 1988 an individual was hunted from today’s Cat Tien National Park (CTNP). Field surveys in 1989 found signs over approximately 75,000 ha and suggested a population maximum of 10–15 individuals based on sign distribution (Schaller et al., 1990).

## 2. Pressures on Javan rhinoceros

### 2.1. Hunting and trade

In tropical Asia, rhinoceroses have been hunted for thousands of years. Their horns have had medicinal use in China since at least 2600 BCE. Consumption later spread to Korea, Japan and Vietnam. Asian rhinoceros horn was increasingly substituted with African horns as trade routes established (Nowell, 2012a).

In the mid to late 1800s, medicinal demand for rhinoceros horn intensified in China. A consequent increase in hunting evidently extirpated all three Asian rhinoceros species from much of their ranges (Harper, 1945; Loch, 1937). Loch’s correspondent (1937) wrote that rhinoceroses, previously numerous in Indochina, were hunted intensively for their horn by the Hmong, a mountain dwelling ethnic group who had emigrated from China. In the apparently heavy trade from Malaysia to China, rhinoceros horns were “probably worth their weight in gold”. Demand for Indian rhinoceros (*Rhinoceros unicornis*) horn in India, always high, increased rapidly in the early 1930s through Chinese demand, reflecting declines of the two species formerly widespread in South-east Asia, Javan and Sumatran rhinoceroses (*Dicerorhinus sumatrensis*) (Harper, 1945).

In Vietnam, reports collected in the 1990s suggested that 40 rhinoceroses were killed in the CTNP area alone from 1957 to 1991 (Polet and Nguyen, unpublished data). Hunting with assault rifles by local villagers seemed the most immediate threat to the few rhinoceroses remaining by 1990 (Santiapillai et al., 1993; Schaller et al., 1990). No further rhinoceros poaching was confirmed until the last individual was hunted in 2010 (Brook et al., 2012).

Increasing economic prosperity enables more Vietnamese people to afford luxury wildlife products (Nowell, 2012a). A relatively new belief in Vietnam that rhinoceros horn cures cancer, coupled with its increasing use as a perceived hangover cure and the use of ‘rhino wine’ as a perceived general health tonic and detoxifier, probably explains a recent surge in rhinoceros horn demand from Vietnam’s growing middle and wealthier classes. Rhinoceros horn’s rarity adds to its value and iconic status within the Asian gifting culture (Milliken and Shaw, 2012).

Since 2003, Vietnam has become the world’s leading importer of legal trophies and illegal rhinoceros horns from South Africa (Milliken and Shaw, 2012). China’s role in today’s poaching crisis needs clarification: there is evidence that rhino horns are moving into China. CITES pressure led almost all major traditional

consumer countries in Asia to enact rhino horn trade bans by the mid 1990s: demand was meaningfully reduced. Along with concerted efforts in range states, this ban allowed African rhinoceros populations to grow (Milliken and Shaw, 2012). The recent escalation of rhinoceros poaching in Africa driven by demand from Vietnam threatens to undo the last 20 years' conservation successes (Milliken and Shaw, 2012).

## 2.2. Habitat loss

Much Javan rhinoceros habitat has been lost throughout its range in recent centuries (Ramono et al., 1993; Santiapillai et al., 1993). Apparently occupying various habitats, unrestricted by elevation, it was probably most abundant in lowland, fertile floodplains (Groves and Leslie, 2011). Most of lowland Vietnam has been converted to agriculture (Sterling et al., 2006; Wege et al., 1999) and much of the lowland semi-evergreen forest east of the Mekong in Cambodia has also been lost (Poole and Duckworth, 2005).

Nonetheless, it is unlikely that there is a shortage of suitable habitat. Many thousands of square miles of tiger (*Panthera tigris*) habitat remain in that species' historical range, from whence tigers have been hunted out (Walston et al., 2010), and it is plausible that the same is true for this species. Although certainty is prevented by its major range contraction having preceded detailed wildlife recording, there is no remarkable, shared, feature of the habitats of its last two populations. Hunting was likely to have been a far more influential driver of decline than habitat loss. Habitat loss has rather been a contributing factor to population fragmentation, exacerbating the effects of hunting by providing access to previously remote areas, and restricting the options for population growth should hunting ever be brought under control.

Cat Tien National Park in the Dong Nai plain is among the last vestiges of southern Vietnam's once vast semi-evergreen lowland forests (Santiapillai et al., 1993). In the early 1900s the Dong Nai plains remained heavily forested, and rhinoceroses lived within 61 km of Ho Chi Minh City (Polet and Nguyen, unpublished data). The CTNP area received high volumes of defoliants by the US military during 1961–1971 (Stellman et al., 2003), degrading forest cover and composition to an unquantified extent and severity. Impacts, if any, on rhinoceroses remain unknown.

Until the 1970s the CTNP area held few people, and those present were indigenous shifting cultivators (Morris, 2004). Government relocation of people from northern Vietnam to 'New Economic Zones' brought in many of the majority Kinh and non-indigenous ethnic groups from 1975 onwards. Human population growth and the promotion of export cash crops such as coffee and cashew drove massive natural habitat loss (Sterling et al., 2006). CTNP's surrounds were largely deforested; the national park was encroached severely. Habitat thought optimal for Javan rhinoceros was disproportionately affected because it made the best agricultural land: swamps and flat alluvial land along rivers became rice paddies, and most remaining lowland forest, cashew plantations (Polet et al., 1999).

Schaller et al. (1990) were the last to document Javan rhinoceros in CTNP's Nam Cat Tien sector. Subsequent records came only from the 30,635 ha Cat Loc sector (Santiapillai et al., 1993). Rhinoceros distribution shrank by >90% from 1989 to 1999, when signs were found only in a 6500 ha area in Cat Loc's west. This, the 'rhinoceros core area' (RCA) (Polet et al., 1999), lay amid more extensive habitat abandoned by rhinoceroses. In the late 1990s, of the approximately 6100 predominantly indigenous ethnic minority people living within Cat Loc, around 200 were within the RCA. Agriculture encroached illegally into the national park, including the RCA, throughout the 2000s and dirt roads on the RCA's eastern

border connected villages to cashew plantations (Brook et al., 2011; Polet et al., 1999).

## 2.3. Small population size and the Allee effect

Schaller et al. (1990) estimated a maximum of 10–15 individuals. Such a small population is likely to be subject to Allee effects (Stephens et al., 1999). Population structure remained unknown. CTNP's last confirmed rhinoceros birth was in 1993. No further signs or sightings of young rhinoceroses were made, and indeed only one female was confirmed (CTNCP, 2004; Lap et al., 2004b). The CTNP Javan rhinoceros population perhaps had little chance of long-term survival even when re-discovered, questioning whether scarce conservation resources should have been spent only on reducing in situ threats, rather than on conservation by supplementation from Java. The last individual was poached in 2010 (Brook et al., 2012).

## 3. The conservation response for Javan rhinoceros in Vietnam

A millennium's persecution followed by a century's intense overexploitation brought Javan rhinoceros to the edge of extinction by the mid 1900s (Groves and Leslie, 2011). That it survived in Vietnam until the 1980s, without site-based protection, is incredible, particularly given the country's long history of hunting and trading rhinoceroses and its proximity to China. Its persistence until 2010 sat incongruously with Vietnam's frenetic commercial poaching, wildlife trade and rampant domestic demand for rhinoceros horn. The survival of the Javan rhinoceros here may simply be a stochastic event, which often characterise the spatial patterns of survival of remnant populations of highly threatened species. The relative ease of sourcing rhinoceros horn overseas (Milliken and Shaw, 2012) may have delayed commercial targeting of Vietnam's last few rhinoceroses.

### 3.1. 1988–1998: protected area establishment and action plans

In 1992, following the species's rediscovery in Vietnam, the rediscovery site, Cat Loc, a 30,635 ha block of forest formerly managed as a State Forest Enterprise in Lam Dong Province, was designated by the Provincial People's Committee as a Rhinoceros Sanctuary. Cat Loc was managed by the District People's Committee until 1996 when a Nature Reserve Management Board was established under the provincial Forest Protection Department. In 1998, Cat Loc Rhinoceros Sanctuary and Tay Cat Tien Nature Reserve in Binh Phuoc Province were merged with Nam Cat Tien Nature Reserve in Dong Nai Province to form the present day CTNP. Management responsibility was transferred to the Ministry of Agriculture and Rural Development (MARD) (Polet et al., 1999). Javan rhinoceros featured on the park's logo.

Cat Loc lies approximately 5 km from the rest of CTNP, across the Dong Nai River. An early 1990s proposal to connect the sectors by protecting the intervening habitat (Santiapillai et al., 1993) was never implemented. Extensive human settlement and agricultural conversion within the proposed corridor rendered this no longer viable by the late 1990s (Morris and Polet, 2004).

The 1998 "Action Plan for the Preservation of the Vietnamese Rhino from 2000–2010" was developed by the IUCN SSC Asian Rhino Specialist Group and various Vietnamese government institutions. The goal was to re-establish viable populations of the Vietnamese rhino in Vietnam and in other secure habitats throughout its range. The short-term target was the extension of the occupied rhino habitat to at least 15,000 ha in 5 years time [by 2003/4] and a proportional increase in the number of rhinoceros (AsRSG, 1998). The action

plan, presented to and discussed with MARD, was never formally endorsed (GP pers. obs.).

### 3.2. 1998–2004: the Cat Tien National Park Conservation Project and resettlement

From 1998 to 2004, WWF implemented a US\$13 million Integrated Conservation and Development Project (ICDP) named Cat Tien National Park Conservation Project (CTNCP). Javan rhinoceros was a main flagship species (CTNCP, 2003). The project's overall goal was: *The remaining forests of Cat Tien National Park and adjacent forest areas are effectively conserved to sustain biodiversity, protect the water catchments of the Tri An reservoir and Dong Nai River and to provide benefits for local people living around the National Park.* This goal was expected through (1) supporting protected area management for effective protection of the park, (2) reducing human impacts on the park to sustainable levels, (3) developing a landscape-scale strategy to support CTNP management, and (4) providing institutional and administrative support for effective management of CTNP (CTNCP, 2004).

During the CTNCP (with additional finance from WWF) two Rhino Patrol and Monitoring Units (RPMUs), composed of 6 rangers and 3 local villagers in total were established, trained, equipped and supported (WWF AREAS, 2004). Two international advisors from Umfolozi Game Reserve, South Africa, and the International Rhino Foundation trained staff in data collection and protection (Polet, 2004).

Monitoring focused on determining rhinoceros population size and structure. Footprint data initially suggested a minimum of 7 rhinos (Polet et al., 1999) but 2001 analyses using the same methods (and re-evaluating old casts) concluded a minimum of 2 individuals (Bui Huu Manh, 2001). In 2002, 1–3 individuals were estimated (Bui Huu Manh, 2002). Camera-trap photographs and footprint data in 2005 and 2006 concluded that 3–4 animals could be present, including 1 female (Nguyen and Polet, 2007). Microsatellite analysis of faecal samples from 2001 and 2002 suggested at least 4–6 individuals, including both sexes (Fernando and Melnick, 2003). The accuracy of these methods is questionable. Discrimination between individual Javan rhinoceroses using footprint measurements and camera-trap photos has not been equivocally demonstrated. The microsatellite study used a limited set of Indian rhinoceros primers untested on non-faecal Javan rhinoceros (tissue) for polymerase chain reaction (PCR) amplification reliability and variability (Brook et al., 2012).

From 2000 to 2003, the RPMUs monitored and patrolled for up to 10 days per month in the 6500 ha RCA (Lap et al., 2004a,b). In 2003, as a consequence of “severe disturbance” to the rhinoceroses from intense human pressure in the park, RPMUs dropped to one team of 3 rangers, led by the Rhino Conservation Officer (the staff member from CTNP's Scientific Department overseeing all rhinoceros activities) (Van Strien et al., 2003). Patrols focused on the perimeter of the RCA, to control access routes and gather intelligence on hunting for approximately 12 days per month (WWF AREAS, 2004).

In parallel to CTNCP, a \$3.45 million land-use re-arrangement and resettlement programme supported by the Royal Netherlands Government (\$450,000 for pilot resettlement of two villages) and the Government of Vietnam (\$3 million committed for the remaining settlements) was planned in and around the Cat Loc sector of CTNP (WWF AREAS, 2004). Development and expansion of cashew plantations, roads and settlements were believed to be restricting rhinoceros range and behaviour (CTNP, 2003). Therefore, the project aimed to consolidate and increase Cat Loc's natural habitat by (i) excising agricultural land and several communities residing inside the park (5100 ha land, 5480 people), mostly along its boundaries (Morris and Polet, 2004), and (ii) resettling four villages

from inside the RCA to outside the national park (812 ha agricultural land reclaimed, 410 people) (WWF AREAS, 2004). The pilot resettlement, implemented by CTNCP, followed World Bank guidelines and safeguards on resettlement. Two years behind schedule, the resettlement process began in 2003 (CTNCP, 2003); the boundaries of the park were re-defined in 2004.

### 3.3. 2005–2007: post CTNCP

At the end of CTNCP (June 2004) the Chief Technical Advisor concluded that the RPMU was satisfactory but needed stronger management from CTNP. CTNP seemed to have the skills and capacity to manage rhinoceros protection, needing only technical and financial support (WWF AREAS, 2004). After CTNCP closed, WWF had no on-site presence at CTNP.

From 2005 to January 2007 WWF funded 1 RPMU to patrol for 12 days per month. This new project “Javan Rhino Conservation in Cat Tien National Park – Vietnam” had the following objectives: (1) *In two years the undisturbed rhinoceros range is increased to 15,000 ha, via moving forward with the Resettlement Action Plan for the two pilot villages;* (2) *Adequate protection and biological management of Javan rhinoceros is ensured, through support of the RPMU;* (3) *Mutually beneficial co-existence between people and rhinos is improved through pilot resettlement of two villages;* and (4) *Positive attitude towards the park and its rhinos is maintained amongst at least 50% of school children in the immediate vicinity of the park, via a conservation education programme.* The previous CTNCP Chief Technical Advisor (GP) off-site, provided technical and logistical advice.

Patrolling and monitoring declined during the project; for instance, no patrolling was conducted during February and March 2006 (Nguyen and Polet, 2006). No footprints were plaster-cast, and no dung samples were taken, although teams encountered dung and footprints often. When project funding ended in January 2007 WWF recommended that CTNP appoint one staff member as a Rhino Conservation Officer to oversee continuation of RPMU duties under guidance of a member of the IUCN SSC Asian Rhino Specialist Group (Nguyen and Polet, 2007).

By 2006 resettlement had stalled. Only the two pilot villages had been moved or compensated for land reclaimed by CTNP (Nguyen and Polet, 2007). Difficulty coordinating the resettlement procedures between the two donors and slow and often conflicting procedures of the donors, Vietnamese government and the World Bank, including the release of funds, significantly delayed the process. Changing resettlement regulations increased legally binding resettlement compensation prices, and created disagreements over compensation packages which delayed implementation further (Morris, 2004).

### 3.4. 2007: National Javan rhinoceros workshop

In 2007, a workshop entitled “the Vietnamese rhino conservation workshop” assessed urgent, reasonable and feasible solutions for conservation of the rhinoceroses. The workshop's aim was to broker an agreement between NGOs, senior Vietnamese scientists and government institutions, on moving forward with one of a number of intensive management options for the population. Conflicting conservation and development interests in Cat Loc meant that little progress had been made on the action plan since it was developed. The area of habitat occupied had not increased since 1998 and nor had the rhinoceros population. The workshop was attended by national, provincial and district level representatives of the Government of Vietnam, CTNP staff and the conservation community (WWF, IUCN, Asian Rhino Project, BirdLife International in Indochina, and donors) (CTNP, 2007). Representatives debated a number of options: (i) allow the two non-resettled villages to remain within Cat Loc and provide development



support; (ii) allow the two villages to remain within Cat Loc, provide development support and fence the RCA; (iii) translocate the two villages; (iv) translocate the rhinoceros population from Cat Loc to Nam Cat Tien, which has more rhinoceros habitat and less human disturbance.

The participants did not agree on an option. WWF supported resettlement of the remaining two villages, or, secondly, relocating the rhinoceroses to Nam Cat Tien. Representatives from the Government of Vietnam (Deputy Minister of MARD and Vice President of Cat Tien District, Lam Dong Province) supported neither resettlement nor rhino translocation, nor bringing rhinoceroses from Indonesia to Vietnam, when the Vietnamese population's precise number and structure were unknown. They wanted community development within Cat Loc and for communities to 'co-exist' with the rhinoceroses. The provincial government used the workshop to withdraw support for completion of the resettlement project. Several participants from Vietnamese scientific institutions called for a survey to determine the rhinoceros population structure, to inform decisions on resettlement and rhino translocation (CTNP, 2007).

Owing to the impasse over resettlement and conservation options, an emergency short-term action plan (2007–2010) and an updated long-term strategy (2007–2017) were developed and agreed by MARD (CTNP, 2007). Among the short-term commitments were (i) CTNP maintains security in the rhino habitat by frequent and effective patrolling (at least 10 days per month in the RCA); (ii) CTNP dedicates one staff to lead rhinoceros work (Rhino Conservation Officer); (iii) Village Monitoring Units are trained to assist RPMU with monitoring activities on a weekly basis; (iv) disturbance to rhinoceros and habitat is minimised by villagers agreeing to road closures, and further in-migration to the two remaining villages is not permitted, non-indigenous people are relocated outside of Cat Loc, and CTNP and villagers define land for cashew and land on which new agricultural development is not permitted. WWF committed to seek a permanent staff member at CTNP to assist action plan implementation. Only one of these measures was implemented: appointment of a Rhinoceros Conservation Officer, who doubled as Chief of the Scientific and Technical Department at CTNP. MARD later agreed with the two non-resettled villages that they could remain within the park (CTNP, 2007).

### 3.5. 2008–2010: Patrols and survey

From 2008 WWF Vietnam supported CTNP patrolling within Cat Loc. From July 2009 until May 2010, WWF and CTNP agreed on 21 days' patrolling per month within the RCA, with data from patrols (including patrol tracks on GPS) provided monthly to WWF. No month achieved 21 days. Data, obtained late, showed that the project's first three months had respectively 16, 9 and 9 days' patrolling. From November, park staff submitted data from the field survey claiming it as patrol effort. Actual patrolling declined to zero until March 2010. Discussions between WWF and the park director to improve patrols lead to no discernable improvement (Brook et al., 2011). In April 2010 WWF supervised 21 days patrolling with FPD. WWF agreed with the CTNP Director to extend patrolling support from May until the end of August 2010, as long as patrolling was carried out within the RCA as agreed and patrolling data were transferred to WWF within 2 weeks. CTNP was informed that the contract would cease were these conditions not met. By mid-June, WWF had received no patrolling data from CTNP since April, despite repeated requests. The WWF-CTNP agreement was therefore terminated at the end of June.

In 2008 WWF sought funds to determine the rhinoceros population status, to stimulate implementation of conservation actions agreed at the 2007 workshop, or to pull out of a lost cause. The survey, from late October 2009 to early April 2010, used dogs to detect rhinoceros faeces, to determine population number and structure

via faecal DNA analysis and capture-mark-recapture analysis (Brook et al., 2012). Pre-survey, WWF and the International Rhino Foundation had supported development of Javan rhinoceros primers by Queen's University, Canada.

The 2009–2010 survey collected 22 rhinoceros dung samples during the first 4 months and recorded locations of all rhinoceros signs found. During the survey's last two months, neither dung nor new footprints were recorded. Shortly after, a decomposed rhinoceros carcass found had a bullet in its leg and its horn had been removed. The rhinoceros probably died from the shot (Streicher et al., 2010). Genetic analysis of the faecal samples and of tissue from the dead rhinoceros confirmed that all samples came from one rhinoceros. Stool bacterial diversity assays supported this conclusion. With this animal's death, the Vietnamese Javan rhinoceros population was extinct. Such analysis of faecal samples from 2004–early 2009 (which did not amplify for genetic analysis) suggested that at some time during 2004–2009 two rhinoceroses inhabited CTNP, of which one was the individual found dead in April 2010 (Brook et al., 2012).

## 4. Inadequacy of the conservation response for Javan rhinoceros in Vietnam

### 4.1. Hunting and trade

The proximate cause of Javan rhinoceros extinction in Vietnam was poaching, facilitated by weak enforcement of anti-poaching and anti-trafficking laws, driven by increasing demand for rhinoceros horn. Given the millennia-long demand for rhinoceros horn, the well-documented recent increase in domestic demand for rhinoceros horn (Milliken and Shaw, 2012), and the high price of rhinoceros horn, protection for the Javan rhinoceros population in 2009/2010 was insufficient (Brook et al., 2011). The decline in protection and conservation activities probably resulted from a combination of factors, discussed below.

#### 4.1.1. Inadequate investment in law enforcement and protected area management leads to extirpations of species affected by poaching and trade

Effective protection is the only proven method of in situ rhinoceros conservation. African rhinoceros declines in the 1980s directly related to inadequate protection and resource shortage in national conservation authorities (Leader-Williams, 1991). Indian rhinoceros and southern white rhinoceros (*Ceratotherium simum simum*) populations recovered through protection of small populations in small areas when resources were insufficient to protect them over their entire range. In Kaziranga and Chitwan National Parks, staff successfully protected their rhinoceroses in the 1970s and 1980s with densities of 1 ranger per 2 km<sup>2</sup> and 1.2 km<sup>2</sup> respectively (Leader-Williams, 1991). In 2013, Kaziranga National Park had 700 park staff for 500 km<sup>2</sup> providing adequate protection for both rhinoceros and other high-value species including tiger (1 staff per 0.7 km<sup>2</sup>) (Goodrich et al., 2013). In comparison, Vietnam's national legislation stipulates 1 FPD ranger per 5 km<sup>2</sup> (Decision No. 186/2006/QĐ-TTg, 2006). Few protected areas in Vietnam reach this density: Cat Loc had 26 rangers responsible for 300 km<sup>2</sup> (1 ranger/11.5 km<sup>2</sup>) (CTNP, 2003). Moreover in Vietnam many of these 'rangers' are not assigned to patrolling.

Vietnam's high human population density challenges effective protected area management, yet India with a similar human footprint maintains species of high value to hunters and traders, including Indian rhinoceros and tiger (Duckworth et al., 2012). Annual government funding for centrally managed protected areas in Vietnam (including CTNP) was estimated at \$894/km<sup>2</sup>; significantly higher than the average annual funding for protected areas

in South and Southeast Asia, estimated at \$500/km<sup>2</sup> (Emerton et al., 2006). However, in Vietnam funding for protected areas is directed towards capital expenditure at the expense of patrol and management activities (Emerton et al., 2006). Many protected areas see law enforcement as a low priority (all authors pers. obs.). NGO funding and technical support may temporarily encourage law enforcement activities but such activities typically do not outlast NGO projects in Vietnam (all authors pers. obs.), at least partly because they have not been institutionalised within the national level protected area management framework.

#### 4.1.2. Protection efforts for high value trade species must include monitoring of law enforcement efforts and staff performance, and ensure accountability of staff

CTNP demonstrated low commitment and motivation to patrol and to monitor the rhinoceros population after the CTNCP had concluded in 2005. The decline in patrolling and monitoring after 2005 was partly because of the withdrawal of WWF's on-site presence; WWF had formerly monitored and overseen all rhinoceros monitoring and protection activities. By 2004 staff capacity had been built so CTNP could have managed the RPMUs with limited support, but personnel changes soon after project close (including within RPMUs) and a lack of external support to build capacity in new staff (especially in law enforcement) meant capacity was probably insufficient. Furthermore, without first addressing the root causes of the low capacity, management and motivation in Vietnam, such as the lack of a central protected area management authority and of a well trained ranger force (Boer, 2012), rapid and unpredictable staff turnover, and the lack of protected area and staff monitoring systems or accountability (Appleton et al., 2011), no project can expect its achievements to endure past its completion.

#### 4.1.3. Complacency regarding threats to species can lead to local extinctions

In 2009/2010, CTNP staff seemed not to see hunting as a threat to the rhinoceros population, despite evidence of high hunting pressure in Cat Loc (SMB pers. obs.). With no dead rhinoceros found since 1988 CTNP staff presumably assumed that this equated to zero poaching (SMB pers. obs.; Lap et al., 2004b). Yet there seem to have been two rhinoceroses in the park sometime between 2004 and 2009. The other's fate is unknown: poaching cannot be ruled out. Its carcass was never discovered, demonstrating insufficient patrol of the RCA. This complacency in the face of high and increasing domestic demand for rhinoceros horn and the unregulated market for wildlife products demonstrate a stark disconnect between CTNP and the global conservation community.

#### 4.1.4. Trade in rhinoceros horn is poorly regulated

The lack of site-based protection for Javan rhinoceros is compounded by Vietnam's poorly regulated trade in rhinoceros horn (Nowell, 2012b). Numerous Vietnamese nationals, including embassy staff, have been implicated in the highly organised illegal trade in rhinoceros horn from South Africa since 2004 (Milliken and Shaw, 2012), including in questionably legal rhinoceros trophy hunting. South Africa hunting permits have since not been awarded to Vietnamese nationals (Emslie et al., 2013). Law enforcement data from USA and South Africa overwhelmingly implicate Vietnam as the primary destination for rhinoceros horn sourced from those countries, with Chinese and Thai nationals also involved. Yet law enforcement in Vietnam remains seriously lacking (Emslie et al., 2013). Very little of the legal trade in horns from South Africa to Vietnam was registered according to Vietnam's CITES data (Milliken and Shaw, 2012), no illegal rhinoceros horns were seized coming into Vietnam between 2008 and June 2012, and there was little indication of enforcement follow-up on

evidence of trafficking provided by South African authorities (Nowell, 2012b). However, seizures from late 2012 to date may demonstrate willingness on the part of the Vietnamese government to begin tackling these issues.

Rhinoceros horns are traded as an "open secret" in many markets in Vietnam, and increasingly via the internet and informal channels such as personal connections to government officials (Milliken and Shaw, 2012). The need for Vietnam to review its national policy and regulations regarding rhinoceros trade has been highlighted, to ensure adequate legal penalties are in place and enforced, and close legal loopholes (Nowell, 2012b). Underpinning these actions is an urgent need for Vietnam to demonstrate strong political will, from the highest levels of government, to make combating rhinoceros horn crime a national priority (Milliken and Shaw, 2012). Vietnam's low response to wildlife crime is typified by the investigation into its last rhinoceros death going no further than to identify the bullet as of the type used in AK-47 and CKC assault rifles, commonly used throughout the country (Streicher et al., 2010). Efforts by WWF to encourage the National Environmental Police to launch an official investigation were unsuccessful (SMB pers. obs.).

## 4.2. Habitat loss

By 1999 the Javan rhinoceros in Vietnam occupied only 6500 ha, less than 10% of that presumably occupied in 1989 (Schaller et al., 1990). It remained this size until 2010 despite both action plans' recommendations to expand available habitat (AsRSG, 1998; CTNP, 2007). Small-scale encroachment occurred continually, even within the RCA (Brook et al., 2011; Polet and Ling, 2004).

The cornerstone of habitat improvement measures, the multi-million dollar resettlement project, neither increased the area of rhinoceros habitat significantly, nor reduced disturbance. Resettles were allowed to cultivate pre-resettlement cashew plantations inside the park (SMB pers. obs.) and 65% of relocated households purchased additional cultivated land (cashew) with their resettlement compensation inside the buffer zone of Village 5, which was formerly part of CTNP before demarcation and is still enclaved within Cat Loc (Hoang Lan Huong, 2007).

#### 4.2.1. Hesitancy to make difficult decisions affecting species can lead to extinction

The Government's hesitancy to support and implement various options to safeguard the rhinoceroses was among the main reasons why agreed conservation actions were never implemented and the short-term targets of the 2000/2007 action plans were not achieved. This was exacerbated by the lack of conclusive evidence of the rhinoceros population's size and status. Uncertainty over rhinoceros population viability became a reason for delaying decisions and avoiding difficult courses of action, including resettlement and rhinoceros translocation options (all authors pers. obs.; CTNP, 2007). The political impasse and the reluctance of provincial governments to support conservation might have deterred CTNP and national ministry staff from following the 2007 emergency action plan.

#### 4.2.2. Conservation and short-term development objectives cannot always be reconciled

Beyond establishing a protected area, government support was notably lacking for rhinoceros conservation through CTNCP, and policies conflicted between provincial and national government (GP pers. obs.). Within Cat Loc, Lam Dong provincial government prioritised short-term development over the conservation activities agreed in the 2007 emergency action plan, resulting in a failure to close the road between the two resettled villages, implement

night-time closure of another road, and change a new road's route to avoid the rhinoceros area (GP pers. obs.).

Furthermore, government did not consider for resettlement a large enclave settlement in the northeast of Cat Loc (village 5), instead prioritising it for development (Morris and Polet, 2004). In 2008 the village's access road was developed, connecting it to the neighbouring commune and facilitating growth and agricultural expansion that almost bisected Cat Loc. This development would have prevented the rhinoceroses' movement – had any survived – into approximately a quarter of Cat Loc and the State Forest Enterprises to the east (Polet and Ling, 2004).

#### 4.3. Cross-cutting issues

##### 4.3.1. Multiple authorities managing protected areas can hinder conservation efforts

Low political support for rhinoceros conservation and a general management neglect of Cat Loc compared with the rest of CTNP (ACW & SMB pers. obs.; CTNPCP, 2003) was almost certainly influenced by its complicated management. Cat Tien National Park spans three provinces and is managed centrally by MARD, but each province influences management to varying degrees. The three provinces did not always agree or coordinate within CTNP. Dong Nai Province was generally more supportive of conservation than were Lam Dong and Binh Phuoc provinces. With CTNP's headquarters in Nam Cat Tien, Dong Nai Province tended to express greater ownership of the park (GP pers. obs.). Lam Dong Province contains Cat Loc so was most directly responsible for the rhinoceroses. Yet, poorer than Dong Nai, it was more concerned with short-term tangible economic development than with retaining the rhinoceroses (Dudley and Stolton, 2010). As protected areas of global importance, CTNP and other equally important protected areas should be managed by a national entity rather than by the provincial level (Vietnam Development Report, 2011).

##### 4.3.2. Long-term technical and financial investment from NGOs and donors is vital, given the long time-frames required for species recovery

Efforts to conserve Javan rhinoceros in Vietnam suffered from low support for species-focused conservation, and fundamental misunderstandings by donors and NGOs of methods appropriate to address the conservation problems. This situation applies to many other species in the region.

In the 1990s and early 2000s global conservation became less species-focused and took a more anthropocentric approach, often through Integrated Conservation and Development Projects (ICDPs) (Brooks et al., 2010). This shift reflected many donors' priorities and views of some within the conservation community itself. Funds were increasingly elusive for species conservation, enforcement and protection (Dudley and Stolton, 2010), particularly so for a perhaps doomed population of a Critically Endangered species (ACW pers. obs.). Rhinoceros conservation was only a part of CTNPCP, a 6-year ICDP. Dedicated, additional investment would have been required to affect a population recovery in the style of African or Indian rhinoceroses. Donor cycles are not well fitted to the decades usually required to return a very small population of a large vertebrate to viability (e.g. Leisher, 2001).

Even within WWF national and international levels had uneven commitment to rhinoceros conservation. Several factors hindered WWF from justifying significant investment in CTNP post CTNPCP: ignorance over the rhinoceros population size and status; government and park oblivion to the rhinoceros crisis, including their disinclination to make difficult decisions requisite for success; and problems in raising funds in such circumstances. Partly to fill the funding gap in CTNP, WWF undertook livelihood projects in the buffer zone, but these interventions were weakly linked to

conservation goals (BL, SB pers. obs.). Rhinoceros-focused work resumed in 2008 – by then too late.

##### 4.3.3. Conservation and protected area management aims and procedures must be institutionalised within government agencies at the national level, for the long-term success and sustainability of conservation efforts

CTNPCP's significantly improved park management at the local level (CTNPCP, 2003) did not outlast the project, culminating in the rhinoceros' extinction. Conservation Projects and organisations should pay greater attention to national-level policy reform to ensure an enabling environment for effective conservation and protected area management.

## 5. Conclusions

Vietnam's Javan rhinoceros population was near extinction when rediscovered. Plans – still appearing reasonable – proposed to thwart the subspecies's extinction faltered because of: (1) fundamental site-level failure to protect and manage the rhinoceros population; (2) low political will for decisions required to recover the subspecies; (3) insufficient focus from the conservation and donor community; and (4) ignorance of the population status, which exacerbated points 2, 3 and possibly 1.

These conditions are systemic within Vietnam's protected areas: minimal, ineffectual patrolling; barely enforced wildlife trade laws; poorly trained staff and protected area directors unaccountable to conservation aims; and investment poorly directed for conservation benefit (all authors pers. obs.). A dedicated national protected area agency, well trained, professional ranger force, and institutionalised international standard practices for conservation and protected area management, already recommended (Appleton et al., 2011; Boer, 2012), should help to address these issues if implemented. Several of these issues are common to other countries in Southeast Asia and need to be addressed if imminent species extinctions will be minimised (Duckworth et al., 2012).

Whilst efforts were made to link the management of the Javan rhinoceros population in Vietnam to other global rhinoceros conservation efforts, particularly during development of the national action plan and capacity building of national park staff, these efforts ultimately failed or were inadequate. Site management decisions were largely made within a local or national context with little reference to case studies of the management of similarly imperiled species elsewhere (all authors pers. comm.).

Lessons from this case may prevent similar constraints from facilitating extinctions of rhinoceroses in Indonesia and Malaysia, where several of the same hindrances to effective conservation of rhinoceroses have occurred. Sumatran rhinoceros populations continued to decline in the 1980s and 1990s after conservation programmes had been implemented, due to poaching and habitat loss. Law enforcement programmes were not adequate to prevent local extinctions from occurring. Once actions to arrest the species' declines had been identified, these actions were never fully implemented, particularly if they were challenging and conflicted with other land-use policies (Rabinowitz, 1995). Whilst protection has improved at some sites in recent years, Sumatran rhinoceros continued to decline by an estimated 32% between 1995 and 2011. Zafir et al. (2011) suggest that more political support (commitment of Indonesian and Malaysia decision-makers to conservation strategies), better enforcement of wildlife laws and improved cooperation among stakeholders are prerequisites to save this species from extinction. Whilst significant progress has been made in the last 2 years, including increased political will at high levels within the governments of Indonesia and Malaysia (Duckworth et al.,



2012), it remains to be seen whether Sumatran rhinoceroses will continue to suffer from a legacy of indecision and insufficient action (all authors pers. comm.).

Similarly, despite a 1993 Indonesian Rhino Conservation Strategy outlining key actions needed, endorsed by the Ministry of Forestry, (Directorate General of Forest Protection and Nature Conservation, 1993), the last Javan rhinoceros population is threatened by delayed decisions on habitat improvement, on intensive population management options, and on translocation to a second site (all authors pers. obs.). For nearly a decade the same recommendations have been made for the Javan rhinoceroses in Indonesia: enhance the capacity of Ujung Kulon National Park to hold more rhinoceroses through habitat management; establish a second population outside and away from Ujung Kulon National Park (which is vulnerable to catastrophic events); establish an accurate knowledge of the population to facilitate active population management; enhance protection protocols; and monitor disease spread in the park. All of these actions are being addressed by conservation organisations but not at the scale and pace that is required to make considerable progress. In fact a dearth of government decision-making has repetitively hampered conservation action for the species in Indonesia. The lack of government action and decision-making, such as the identification of a site to establish a second population, or re-zoning of the park to permit habitat management, is dangerously similar to the situation described here for the Javan rhinoceros population in Vietnam.

Decision-makers understandably vacillate over Critically Endangered species. At a personal level, the political risks of implementing unproven and unpopular conservation measures may outweigh the potential benefits of success. This is particularly true when benefits will appear only after the decision-maker's political term, and where they are not held accountable for inaction, but where failure of an action (e.g. translocation) will bring immediate censure. Doing nothing is generally the easiest option. A lack of universal support for risky actions may increase the chance of inaction, thus increasing risk of extinction (Vanderwerf et al., 2006). Decision-makers' fear of risk and of blame (as a result of failure) perhaps hindered more intensive management actions for the now extinct endemic Hawaiian bird the Po'ouli (*Melamprosops phaeosoma*). The decision to undertake captive propagation came too late for this species (Vanderwerf et al., 2006).

The extinction of the Yangtze River dolphin (*Lipotes vexillifer*) resulted from human activities; largely, uncontrolled and unselective fishing. Despite two decades of international workshops, little effort was made to implement an ex situ recovery programme, despite this being consistently advocated by scientists and policy makers as an essential short-term goal for survival of the species (Turvey et al., 2007). Vanderwerf et al. (2006) and Turvey et al. (2007) suggest that decisive action must be taken early, before a time when a species' future rests on a single risky endeavour.

Southeast Asia is the world's priority for averting imminent non-marine vertebrate species extinctions, partly as a result of the huge demand of wildlife for the luxury food, medicine, tonic, trophy and captive markets. This is coupled with a preponderance of poorly managed protected areas and heavy recent habitat loss. Recognition led to the IUCN Species Survival Commission convening the Asian Species Action Partnership (ASAP); an emerging programme co-ordinated by IUCN SSC on behalf of its member organisations. ASAP is being developed to assist implementing agencies and their partners minimise the impending extinctions among South-east Asian non-marine vertebrates, through enhancing coordination, prioritisation and implementation of conservation efforts (Duckworth et al., 2012).

Such enhancement involves documenting mistakes made and lessons learned. These are relevant outside Vietnam: in particular, for the world's only remaining population of Javan rhinoceros, in

Indonesia, and for other conservation-dependent species of high trade value. Pressures on such species are likely to continue to increase. To be successful, conservation efforts must be more focused, adaptable, decisive under limited information, and committed to long-term investments in species and sites.

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