

**THE STATUS AND CONSERVATION OF
JAVAN RHINOCEROS, SIAMESE CROCODILE,
PHASIANIDAE AND GAUR
IN CAT TIEN NATIONAL PARK, VIETNAM**

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**BY
DAVID MURPHY**



Ambassade van het
Koninkrijk der Nederlanden

**CAT TIEN NATIONAL PARK CONSERVATION PROJECT
TECHNICAL REPORT NO. 50
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The Cat Tien National Park Conservation Project is a joint initiative of the Ministry of Agriculture and Rural Development (Hanoi) and the WWF-Indochina Programme, funded by the Governments of Vietnam and The Netherlands.

Executive Summary

Cat Tien National Park is home to a number of species of high conservation value, amongst which the Javan Rhinoceros (*Rhinoceros sondaicus annamiticus*), Siamese Crocodile (*Crocodylus siamensis*), rare Phasianidae species (pheasants and partridges), and Gaur (*Bos gaurus*) are of the highest priority. To expand the information on their populations, on which conservation management decisions are based, the Cat Tien National Park Conservation Project has implemented surveys and established monitoring programmes since 1999.

Ongoing research on the Javan Rhino has helped to develop a picture of an animal more critically endangered than previously thought. Current estimates of the population are 2-6, with a possible estimate of 3 individuals remaining in their small range in southern Cat Loc. Of equal concern is the absence of any breeding signs for the last 7 years, and though the presence of a female has been confirmed it is not clear if there are any males. The chances of increasing the population are very marginal and will require larger areas of undisturbed habitat and the presence of male and female animals. What is preventing this is the large human population surrounding the rhino range that continues to encroach on existing habitat and increase disturbances. The presence of villages in the forest, and regular human movement between them, also restricts rhino movement to other available habitat.

The first re-established population of Siamese Crocodile has been successful but is threatened by poaching. Since its implementation in 2001 the Siamese Crocodile Re-establishment Programme has released a total of 60 individuals into Bau Sau (Crocodile Lake) and monthly spotlight surveys have indicated that there is a relatively stable population in the lake of Bau Sau. If the population is protected there is good potential for breeding, but if protection is not improved the population could be lost again to poaching.

Annual surveys for rare Phasianidae have identified key populations of Orange-necked Partridge (*Arborophila davidi*), Green Peafowl (*Pavo muticus imperator*), Germain's Peacock Pheasant (*Polyplectron germaini*), and Siamese Fireback (*Lophura diardi*). Orange-necked Partridge favour undisturbed hill-forests, Green Peafowl favour open/forest edge habitats, and Germain's Peacock Pheasant and Siamese Fireback favour lowland non-bamboo forest. There was a lower density in subsequent surveys at sites where human disturbances had increased. Human encroachment on habitats within the Park and in adjoining State Forest Enterprises, and hunting for trade and subsistence, are the greatest threats to these populations.

There are 4-5 herds of Gaur in the Park with key herd sites in eastern Nam Cat Tien, Bau Sau, Sa Mach, Dang Ha, and southern Cat Loc. Gaur activity is focussed on sites of important resources (such as grazing areas and saltlicks), but as they require many resources and different habitats herds roam over established ranges. The herds that visit Sa Mach and Dang Ha also use habitats in adjoining State Forest Enterprises. The population in Cat Tien National Park is one of the most significant in Vietnam as it appears relatively intact with multiple herds and a range of protected habitats. However, its future is threatened by increasing hunting pressures, the loss of habitat along the Park's boundary and within State Forest Enterprises, and potential disease transmission from roaming domestic cattle.

The conservation requirements for each species (along with their current status and threats) are summarized in Table 1 (p 4). For all species effective protection from forest guards is needed to mitigate the increasing impacts of habitat encroachment and hunting. Strong Park management to implement conservation requirements and improved protection will be essential to secure a future for the key species.

Table 1. A summary of the status, threats and conservation requirements for Javan Rhinoceros, Siamese Crocodile, Phasianidae, and Gaur in Cat Tien National Park, Vietnam. (Threats and conservation requirements were developed alongside those detailed in the Conservation Management and Operational Plan for Cat Tien National Park (Cat Tien National Park Conservation Project, 2003).

Species	Current Status	Threats	Conservation Requirements
Javan Rhinoceros	<ul style="list-style-type: none"> • 2-6 individuals (most likely 3) - <i>Critically Endangered</i> • Restricted to an area of approx. 5,000ha in southern Cat Loc • No signs of breeding in the last 7 years • No confirmed male rhino 	<ul style="list-style-type: none"> • Critically small and isolated population • Loss of habitat through encroachment • Disturbance from human activities • Lack of biological information on population to make informed management decisions 	<ul style="list-style-type: none"> ➢ Alongside external specialists, discuss a contingency plan outlining management options if no male rhino are confirmed soon. ➢ Clear boundary demarcation and enforcement. ➢ Management to file encroachment cases with local authorities. ➢ Reclaim encroached land. ➢ Resettlement of households in rhino range. ➢ Community awareness of boundaries and select regulations for villages (i.e. hunting, entering forest, cattle grazing, grass-cutters near forest edge etc.). ➢ Conservation education. ➢ Forest guard patrols focussed around southern Cat Loc and of minimum disturbance. ➢ Monitoring by specialized rhino team (RPMU) with full-time staff commitment. ➢ Maintain a relationship with a relevant facility to test new dung samples for DNA in order to improve the technique, identify sexes, and compare results ➢ Attract external PhD. and MSc. students.
Siamese Crocodile	<ul style="list-style-type: none"> • First re-established population for the species successful but is threatened by poaching - <i>Critically Endangered</i> • Re-establishment programme released 60 individuals • Stable population in Bau Sau (Crocodile Lake) • Local information says poaching still occurs – current protection is inadequate • Good possibility of breeding if protected 	<ul style="list-style-type: none"> • Hunting • Presence of fishing nets (accidental drowning) • Planned dams upstream 	<ul style="list-style-type: none"> ➢ Improved forest guard patrols focussed around the Bau Sau Wetland Complex. ➢ Inform local law enforcers about violations and appropriate laws. ➢ Regularly visit known hunters/traders in Dak Lua. ➢ Conservation education. ➢ Removal of fishing nets in the Bau Sau Wetland Complex. ➢ Submit EIA to the Vietnam Electrical Authority, Government of Vietnam and MARD. ➢ Lobby demonstrated (researched) effects of dams on CTNP. ➢ Pursue RAMSAR convention recognition of the Bau Sau Wetland Complex.
Phasianidae (pheasants and partridges)	<ul style="list-style-type: none"> • Populations of Orange-necked Partridge (<i>Endangered</i>), Green Peafowl (<i>Vulnerable</i>), Germain's Peacock Pheasant (<i>Vulnerable</i>), Siamese Fireback (<i>Lower Risk</i>) and other species • Key sites for populations in hill forest, wetlands, and undisturbed forest sites • Lower index of density at sites of human disturbance 	<ul style="list-style-type: none"> • Encroachment and disturbance • Hunting (trade) • Hunting (subsistence) • Pressures on populations outside the Park's boundary 	<ul style="list-style-type: none"> ➢ Clear boundary demarcation and enforcement. ➢ Management to file encroachment cases with local authorities. ➢ Forest guard patrols. ➢ Conservation education. ➢ Support management boards of SFEs to incorporate a conservation agenda in their operations.
Gaur	<ul style="list-style-type: none"> • 4-5 herds - <i>Vulnerable</i> • Herd locations: eastern Nam Cat Tien, Bau Sau, Sa Mach, Dang Ha, and southern Cat Loc • Largest herd of approx. 24 individuals at Bau Sau • Utilize habitat outside the Park's boundary, such as in State Forest Enterprises (SFEs) 	<ul style="list-style-type: none"> • Hunting (trade) • Pressures outside the Park's boundary • Grazing by domestic cattle • Small population 	<ul style="list-style-type: none"> ➢ Improve standards of forest protection. ➢ Forest guard patrols focussed at key herd sites. ➢ Support management boards of SFEs to incorporate a conservation agenda in their operations. ➢ Community awareness and agreement on: boundaries and regulations prohibiting cattle grazing within CTNP. Sourcing alternative grazing sites and fodder for domestic cattle. Fences at appropriate sites. ➢ Grassland management through annual controlled burn.

Acknowledgements

This report has been based on the numerous surveys, and countless hours in the field, that have been spent gathering and analysing information on Cat Tien National Park's key species. These have been: All past and current members of the Rhino Patrol and Monitoring Unit (especially Bui Huu Manh and Vuong Duy Lap who have lead the team), Dr. Nico Van Strien of the International Rhino Foundation, and Dr. Nguyen Xuan Dang of the Institute of Ecological and Biological Resources (IEBR) for work on Javan Rhino; the forest guards of Bau Sau (especially Nguyen Thanh Long) for monthly spotlight counts of Siamese Crocodiles, and all the partners who have contributed to the re-establishment programme (detailed in the section on Siamese Crocodiles); the staff of the Science and Technical Department (TD) of Cat Tien National Park who have carried out annual Phasianidae surveys, in particular Nguyen Tran Vy (of IEBR) and Nguyen Hoang Hao (of the TD) who have lead surveys; and Ben Hayes and Stephen Ling who carried out surveys for Gaur and other mammals.

All of this work has been supported by the Science and Technical Department of Cat Tien National Park, and the Forest Protection Department whose prime role has been the protection of the species and habitats in the area.

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The photographs on the cover were taken by: Mike Baltzer/WWF (Javan Rhino); David Murphy (Siamese Crocodile); Nguyen Hoang Hao (Orange-necked Partridge); and Ina Becker (Gaur).

ABBREVIATIONS

CTNP	Cat Tien National Park
CTNP-CP	Cat Tien National Park Conservation Project
FPD	Forest Protection Department
RPMU	Rhino Patrol and Monitoring Unit
SFE	State Forest Enterprise
TD	Science and Technical Department/Centre for Scientific Research

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Introduction

Cat Tien National Park (CTNP) (Map 1), located in the south of Vietnam, is home to many unique species of animals. These include 68 confirmed mammal species, 320 confirmed bird species, and 66 confirmed reptile species. This high biodiversity can be attributed to the abundant resources and stability of the tropical environment as well as the variety of habitats. Because the Park straddles two biogeographic zones – the forests of the Annamite Range in the hilly north and the forests of the Mekong complex in the lowland south – variations in topography, hydrology, and vegetation types support a range of habitats that sustain a diversity of flora and fauna. However, the uniqueness of many species is because of their rarity.

Rarity is a common feature of a sizeable proportion of the animal species at CTNP. Twenty-six percent of the Park's mammal species, five percent of bird species, and twelve percent of the reptile species are red listed by the IUCN (Hilton-Taylor, 2000). Limited geographic ranges, although a compounding factor in the rarity of some species, do not account for the rarity of most red listed species because of the wide ranges of many mammals, birds, and reptiles. A history of habitat loss and hunting has caused the decline of the majority of animals, eliminating the presence of many from most areas of their former ranges and elevating the conservation status of remaining populations.

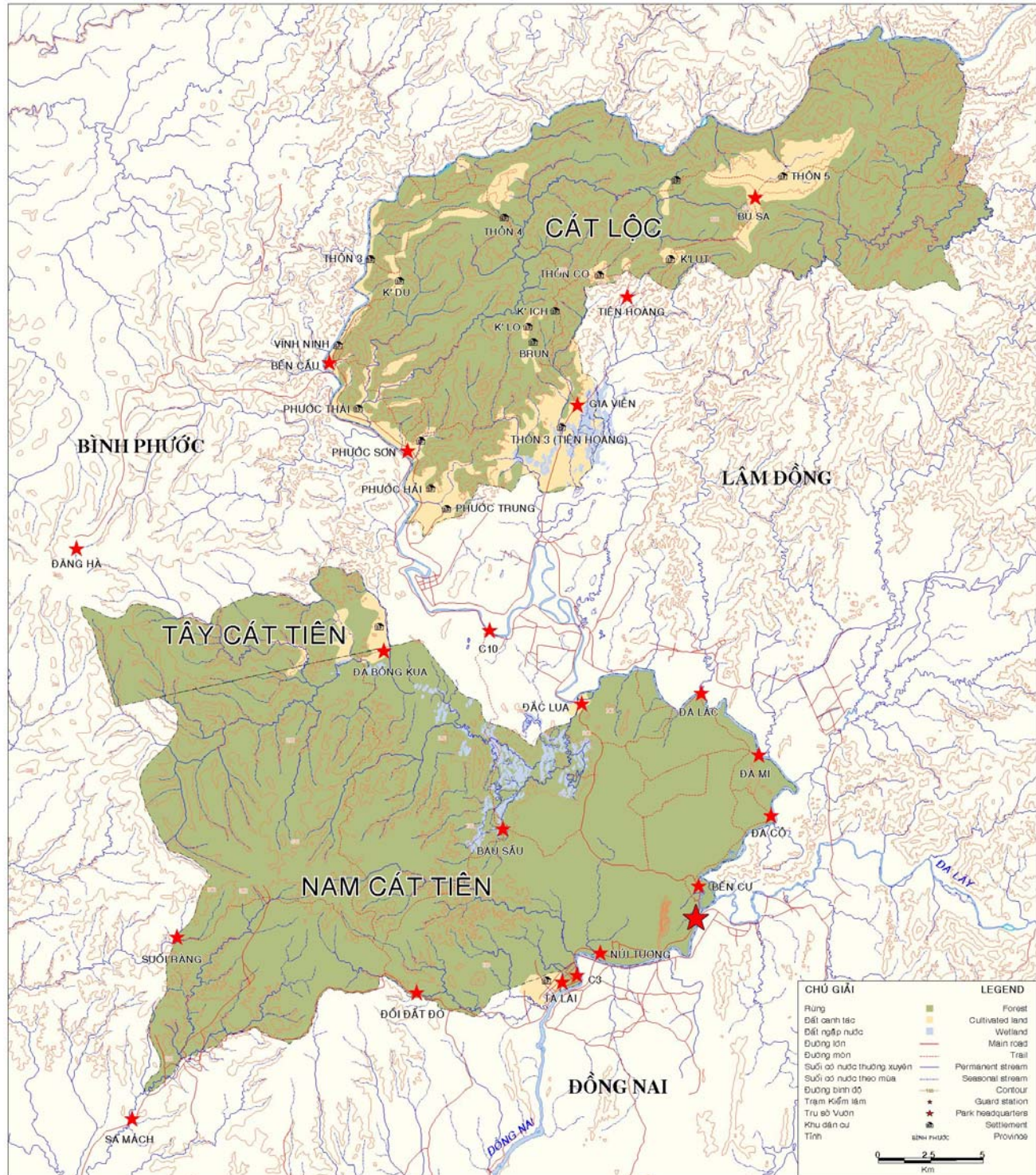
Since the incursion of the Cat Tien National Park Conservation Project (CTNP-CP) in 1998 new activities have been initiated to enhance protection and reduce human pressures on the habitats and species of CTNP. For many conservation activities the results benefit a range of species (e.g. grassland management, improved patrol techniques for forest guards, conservation education etc.). However, the CTNP-CP also initiated a small number of species-specific activities. Focal species were selected because of interventions required to prevent the decline of critical populations, the need for expand information on very rare species, and limited resources restricting species-specific activities to conservation priorities.

At CTNP species-specific activities are focussed on the Vietnamese subspecies of the Javan Rhinoceros (*Rhinoceros sondaicus annamiticus*), Siamese Crocodile (*Crocodylus siamensis*), rare Phasianidae species (pheasants and partridges), and Gaur (*Bos gaurus*). Activities for these species include research and management with ongoing work to assess the status of their populations. To improve the conservation of these species Park management needs to base informed decisions on the current status of populations.

Evaluating the status of these species has been the combined effort of different researchers in many surveys over several years. This report aims to collate the existing information, assess and summarise the current status and conservation requirements for Javan Rhino, Siamese Crocodile, Phasianidae, and Gaur in CTNP.

VƯỜN QUỐC GIA CÁT TIỀN

CAT TIEN NATIONAL PARK



Map 1. Cat Tien National Park, Vietnam.

Javan Rhinoceros

Justification

The Javan Rhinoceros (*Rhinoceros sondaicus*) is the rarest large mammal on earth. The species once ranged over a large portion of Southeast Asia, occurring in three distinct subspecies: *Rhinoceros sondaicus sondaicus* in Indonesia, *R. s. inermis* (now extinct) through Bengal, Assam, and Myanmar, and *R. s. annamiticus* from Indochina to Thailand. Javan Rhino were driven to the brink of extinction from hunting during the colonial era, and the loss of its forest habitat. Now *R. s. sondaicus* is restricted to 50-60 individuals in Ujong Kulon National Park, Indonesia, and *R. s. annamiticus* to less than 10 individuals in Cat Tien National Park, Vietnam.

The Javan Rhino is a small, solitary forest rhino. Like other large herbivores, minerals found at saltlicks are a vital component of their diet, and wallows are important for temperature regulation. Reproduction is slow with one young born every 4-5 years. Because the species is solitary they occur at low densities. At CTNP the population is restricted to an area of approximately 5,000ha in the south of the Cat Loc sector, which is one constraint on the population (Map 1). Another constraint is the breeding potential of the population with little recent evidence of juvenile rhino and none on the sex ratio of the population. The cryptic behaviour of Javan Rhino restricts data collection to indirect observations. Estimates of the Cat Loc population have ranged from 15 individuals in 1990 (Schaller *et al.*, 1990), to a minimum of 5-6 and a maximum of 7-9 in 1999 (Nguyen Xuan Dang and Pham Huu Khanh, 1999).

The critically low population of Javan Rhino has been the focus of management activities by CTNP and the CTNP-CP. These have included: reclaiming a key saltlick, boundary re-demarcation and resettlement plans to minimize the levels of human disturbance in and around the rhino's habitat, conservation education to elevate the awareness on this species, and periodic surveys. However, a lack of information on the remaining population still limits the conservation of this subspecies.

To expand the biological information on Javan Rhino, and so the knowledge base on which conservation management decisions are made, the CTNP-CP created the Rhino Patrol and Monitoring Unit (RPMU) in August 2001. The purpose of the RPMU is to carry out monthly monitoring of Javan Rhino with a priority commitment on staff-time.

Research and Monitoring

Since its rediscovery there have been several surveys on the Javan Rhino in Cat Loc (Schaller *et al.*, 1990; Haryono *et al.*, 1993; Nguyen Xuan Dang and Pham Huu Khanh, 1999; Nguyen Xuan Dang *et al.*, 1999; Polet *et al.*, 1999b). Regular monitoring began with the creation of the Rhino Patrol and Monitoring Unit (RPMU) by the CTNP-CP. The RPMU carry out monthly field surveys (approximately 10 days) within the rhino range in Cat Loc. Field surveys comprise of walking existing trails and recording data on indirect rhino observations. Indirect observations are: footprints (to determine footprints of individuals, area usage, and paths of movement), dung (to collect colon-cell DNA to identify individuals), browse (to determine food plants), wallows (to determine key sites and water availability), and other sign. For all observations and survey routes exact coordinates are recorded and included in GIS maps of RPMU patrols. A detailed description of the field survey methods is available in previous reports (Van Strien, 2001; Bui Huu Manh, 2002; Murphy *et al.*, 2003) and the results of surveys have been collated and presented (Van Strien, 2001; Bui Huu Manh, 2001, 2002; Vuong Duy Lap *et al.*, 2004).

Status

The results of monthly patrols estimate a remaining population of between 2-6 rhinos. This uncertainty is based on differences between estimates from footprints and DNA-test techniques. Because of the low variation in the size and shape of footprints only 2 or 3 individuals can be identified. However, there is a degree of uncertainty in this technique as the measurements of footprints vary with slope (rhinos slightly splay their hooves when walking downhill), soil type, speed of travel, and interpretation of these requires an experienced eye. DNA tests estimate between 5-6 individuals but there is also a degree of uncertainty because of possible DNA contamination in the field and the primer (against which DNA samples were compared) was from the closely related Indian Rhino (*Rhinoceros unicornis*).

As there is only a small area of available habitat used by the rhino, and Javan Rhino are a solitary species requiring individual territories, the population is probably lower than 6 individuals and most likely about 3. A current population of approximately 3 does not indicate a population decline from the 9-15 estimated in the 1990s but a refinement of the techniques to estimate the population. Earlier population estimates were also based on footprint counts but tended to overestimate the number of individuals based on the interpretation of the footprint sizes. Because there has been improved security in the area since the early 1990s and no reported poaching events, there have probably been no large recent changes in the number of rhino with ongoing monitoring improving the estimation of the population size. Current estimates still have a degree of uncertainty and it is unlikely that there will be a more accurate estimate of the rhino population without an improvement in the methodologies for identifying individuals from footprint sizes and/or DNA typing. The use of an infrared sensor from an air-craft (that creates an image of an animal from their body heat) may be the only method that could count every individual.

But whether the population is 3 or 6 individuals it is still critically low and will not pull away from extinction unless there are new rhino born. Therefore of most concern is the lack of any signs of breeding in the past 7 years. It is not known whether this is because the remaining rhino have any breeding potential or there are other factors, such as disturbance, which are preventing breeding. Apart from one confirmed female the sex of the remaining rhino is unknown. The last confirmed rhino birth was in 1993, so there was a male present at this time, but it is not known whether he still is present. DNA tests have suggested the presence of both male and female rhino, but as this could have also been from DNA contamination these results have to be interpreted with caution. If there are both male and female rhino present another reason why there have been no new rhino in recent years is that human disturbance in the area is preventing breeding behaviour. Javan Rhino are shy and easily disturbed animals as is indicated by their change to nocturnal behaviour which is most likely a response to local human activity.

The ongoing research work on the Javan Rhino has helped to develop a picture of an animal more critically endangered than previously thought. The very low population and paucity of any recent signs of breeding suggest that this subspecies will be lost unless there is a significant turn-around for this population in the near future.

Threats

To pull away from the brink of extinction the Javan Rhino in Cat Loc will need the presence of male and female rhino and larger areas of undisturbed habitat. What will prevent this is further loss of habitat through encroachment, continual disturbance from human activities, and even if these criteria are met the population may be too critically small and lack the breeding potential to survive.

The remaining habitat for the rhino is not enough as a history of human immigration has converted large areas of habitat to agriculture, restricting the remaining rhino to a small area of forest that is effectively cut-off from other areas of potential habitat. The presence and expansion of existing villages are the major barrier for the rhino between their existing range and other potential habitat. Although this existing range is protected within Cat Tien National Park small scale agriculture continues to encroach on the Park's boundary. Encroachment

has increased from growing population pressures and the demand for land, and is compounded by the difficulty in enforcing the Park's boundary. This will be an even greater threat in the future if the Vietnamese Government implements a master plan for population increase in rural areas that will increase the demand for agricultural land.

Encroachment also reduces the buffer space between areas of human disturbance and the rhino. The Javan Rhino is very sensitive to human disturbance and current disturbance levels already have a negative impact on rhino behaviour and perhaps even on their potential to breed. With growing human presence and activity there are increasing disturbances from movement in the forest (illegal activities and travel between villages), engine noises (grass-cutters and motorbikes), and domestic animals (wandering cattle and dogs).

Although the risk of hunting is small it still exists with ongoing poaching for other species also a source of disturbance in the forest.

Conservation Requirements

To conserve the last population of this subspecies management activities are required to expand the available habitat, reduce disturbances, minimize risks of hunting, and improve the information on which management decisions are based.

An expansion of existing habitat will need to focus on improving the connections between the existing range and other potential habitat, and securing available habitat. The movement of the rhino to access other habitats outside their current range is prevented by the presence of several small villages. Therefore an expansion of the rhino's range will require the voluntary resettlement of these households. This may be possible for the small villages, such as K'Lo K'It and Village 4 but not for Village 5 which is large and has just been upgraded to a commune (Dong Nai Thuong Commune) indicating the will of local government to expand the development of the site. Securing available habitat needs the prevention of further encroachment, the maintenance and improvement of forest guard protection within the rhino range, and the support to areas of potential habitat outside CTNP (such as State Forest Enterprises) to include a conservation agenda in their operations. Prevention of encroachment will require the strict enforcement of the Park's boundary, CTNP management to file encroachment cases with local authorities, and where possible to reclaim encroached land.

Management activities to improve the quality of the rhino habitat should not increase the disturbance in the area. The planting of rhino food plants at the edge of the Park's boundary is to be encouraged (although their use by the rhino will be determined by the level of human disturbance on the boundary), but there should be no habitat modification within the rhino core range (such as preparing sites to encourage the growth of food plants) as it will probably produce more disturbance than positive impacts (Murphy, 2004).

The control of the level of disturbance will require conservation education, a strong commitment from local authorities, and the strict control of illegal activities within CTNP. A clear understanding of the impacts of disturbance amongst local residents is a prerequisite if they are to modify their activities, so conservation education is an ongoing requirement in all communities surrounding the rhino range. To support this activity and enforce any prohibitions on disturbance activities the support of local authorities is essential. The work of the CTNP Forest Protection Department needs to be maintained and improved to control illegal activity/disturbance in the forest.

All conservation requirements are based on the available knowledge of the Javan Rhino that still needs to be greatly improved. The work of the RPMU has refined the population estimates, expanded the information on the rhino, and has been the only method to monitor them over time. Therefore the work of RPMU needs to be maintained by retaining current team members in their positions with a full-time staff commitment, funds, and ongoing contact with external specialists for the analysis of results. Ongoing contact with a relevant facility is also required to test new dung samples for DNA in order to improve the technique, identify

sexes, and compare results. Further research is possible through external PhD. and MSc. students who could be attracted to study this population.

Even if all conservation requirements can be achieved the population may still not be saved if there is no breeding capacity. To address this, a contingency plan needs to be formulated between the management of CTNP, external specialists, and the Government of Vietnam outlining management options if there are no remaining male rhino.

A significant turn-around in the Javan Rhino population will only be possible by immediate action on a large scale to reduce disturbances and increase the area of available habitat, and a good amount of luck if the subspecies still has the breeding capacity to expand the population. This will require a significant commitment from CTNP, the Government of Vietnam, local authorities, and ongoing support from international donors and external specialists.

Siamese Crocodile

Justification

The Siamese Crocodile Re-establishment Programme at Cat Tien National Park is the first attempt to re-establish this species in a former habitat within its historical range. The historical range of Siamese Crocodile (*Crocodylus siamensis*) covered most of the mainland of South-East Asia and may have also included Borneo. Hunting and habitat loss have eliminated this species from most of its former range with remaining populations restricted to several sites in Cambodia and Laos, and a few sites in Vietnam and Thailand (Ross, 1998). Although there are many individuals raised in crocodile farms the species is severely restricted in the wild and red listed as Critically Endangered (Hilton-Taylor, 2000).

The IUCN/SSC Crocodile Specialist Group have outlined priority projects required to conserve Siamese Crocodile, of which "Protection of crocodile populations in Vietnam" (involving habitat protection and captive breeding) is of high priority (Ross, 1998). Platt (1999) suggested potential sites in Vietnam to re-establish Siamese Crocodiles including CTNP. Cat Tien National Park once had a population of Siamese Crocodiles in the Bau Sau Wetland Complex (BSWC) but a history of hunting drove the species to local extinction (Bembrick and Cannon, 1999). One of the key requirements for a re-establishment programme is if the original causes of the decline has been removed, and with improved protection of the BSWC since 1998 a re-establishment programme for Siamese Crocodile was initiated by the Cat Tien National Park Conservation Project (Polet *et al.*, 1999a, 2002).

Re-establishment

The Siamese Crocodile Re-establishment Programme has released individuals donated by local crocodile farms into Bau Sau (Crocodile Lake; Map 1) with the aim to establish a secure breeding population. However, not all farmed crocodiles are pure *C. siamensis* so all crocodiles in the programme are DNA-tested with hybrids excluded from releases. The first release of individuals was in December 2001 (10 crocodiles), with successive releases in March 2002 (9 crocodiles), February 2003 (7 crocodiles), June 2003 (4 crocodiles), and March 2004 (30 crocodiles) releasing a total of 60 individuals. The programme involves a range of partners: Cat Tien National Park who are the host and release site; Two private farms (The Hoa Ca Crocodile Farm and the Cu Chi Crocodile Conservation and Development Farm) who have donated crocodiles; The WWF-Cat Tien National Park Conservation Project who provides financial support and technical advice based on contacts with the IUCN-SSC Crocodile Specialist Group; The University of Canberra and Queensland University who have conducted DNA tests; Saigon Zoo who have provided technical support; and The Government of Vietnam who provided additional financial support. As an essential part of any re-establishment programme is ongoing monitoring to gauge the success (or failure) of the programme, monitoring of the released population was carried out at Bau Sau.

Research and Monitoring

The released population of Siamese Crocodiles are monitored by monthly spotlight surveys. On the new moon of every month a team of two staff (an observer and a boat driver) circumnavigate the lake of Bau Sau in a canoe using a spotlight to count the eye-shine of crocodiles. Although not all individuals are observed using this method, spotlight surveys, that follow a specific format, is an established method to calculate a population index. Monthly spotlight surveys have been carried out at Bau Sau since January 2002 and a detailed description of the survey methods and results has been presented in previous reports (Murphy, 2002; Murphy and Dang Cong Viet, 2002; Murphy *et al.*, 2004.).

Status

The results of monthly spot-light counts have shown an increase in the index of crocodile density in months of releases, followed by a relatively stable population within the survey area (Fig. 1). Monthly spotlight counts on Bau Sau (Crocodile Lake) in the first year observed 5-32% of the released population, which is comparable to other spotlight studies with a known population size where 9-19% of the population was observed (Woodward *et al.*, 1996). Because there are few other water bodies during the dry season it is assumed that during this time most of the surviving crocodiles will be in Bau Sau. Spot-light counts after the final release, and during the dry season, counted 19 and 11 individuals (February and March 2004 respectively) (Murphy *et al.*, 2004). As counts observe a proportion of the total population there are probably other individuals within the survey area, especially in the larger lobe of crocodiles where the presence rushes and grasses restrict visibility. Other released crocodiles may have dispersed to other areas of the wetland outside of the survey area or have been killed.

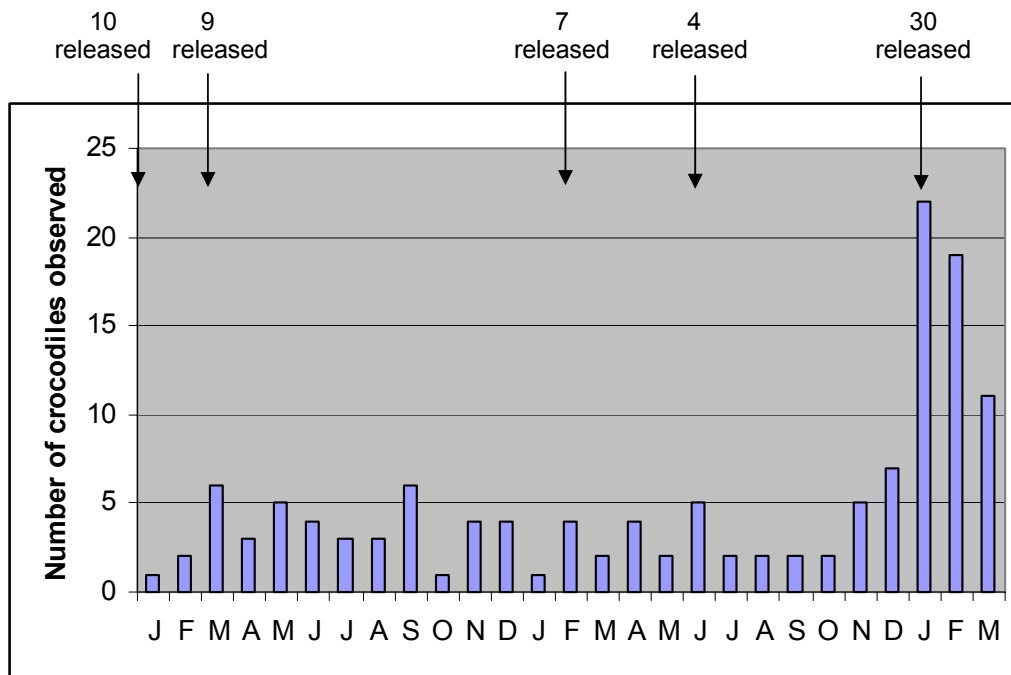


Figure 1. The result of monthly spot-light counts of Siamese Crocodiles at Bau Sau, from 2002-2004, Cat Tien National Park, Vietnam.

There is potential crocodile mortality from other crocodiles if space is limited and newly released, and smaller animals, enter established territories. But the greatest source of mortality is likely to be poaching as residents of Dak Lua have said that there have been at least 15 crocodiles killed. Crocodiles move out from Bau Sau in to the rest of the wetland complex with the rising water level during the monsoon and further away from the protection of the guard station at Bau Sau so it is not known how many other individuals have been killed. It is possible that crocodiles could leave the wetland during the height of the monsoon, when the wetland connects with the Dak Lua Stream that drains in to the Dong Nai River, but it is unlikely as the species prefers slower moving waters (Smith, 1931; Daltry *et al.*, 2003). The main reason why any crocodiles would move in to the Dong Nai River would be young animals requiring new habitat if all potential territories are already dominated by other crocodiles.

As an appropriate sex ratio has been released (2 females : 1 male), and there are available nest sites and abundant food resources in Bau Sau, there is good potential for the population to breed. The first crocodiles to be released in December 2001 will be of breeding age by

2004. As the first breeding attempt is sometimes not successful it may not be until the dry season of 2005 that there is a chance of successful breeding.

The Siamese Crocodile Re-establishment Programme has been successful in establishing a small population of Siamese Crocodile in Bau Sau but it is seriously threatened by poaching. As there is good potential for the crocodiles to breed their continued presence will be dependant on CTNP removing the threats to the population.

Threats

The greatest threat to the future of the population is poaching, which was the original cause of the local extinction of Siamese Crocodiles in the area. The 15 unconfirmed crocodiles killed, or a quarter of the released population, is a very worrying sign of the amount of poaching in the area. It is an indicator that the levels of protection in the area are inadequate. The forest guard station at Bau Sau is situated right on the lake's shore with views of the area, therefore poaching of crocodiles will most likely happen elsewhere in the wetland when the rising water level during the monsoon season allows crocodiles to move out of Bau Sau Lake. Historically it has been the residents of Dak Lua who specifically hunted crocodiles and again specific residents of this village are responsible for the crocodiles killed since their release. Most poaching is apparently carried out by a small number of repeat offenders who are known to the Forest Protection Department.

A potential cause of mortality is crocodiles drowning in the set-nets of fishermen. Illegal fishermen in the wetland often use set nets that are left and sometimes forgotten. If a crocodile gets tangled they roll to free themselves which only further entangles them in a net causing them to drown.

Although the Bau Sau Wetland Complex is protected within the boundary of CTNP its future could be seriously impacted by the construction of dams upstream on the Dong Nai River. There are three dams planned along the Dong Nai River within the region of CTNP: Dong Nai dams 3, 4 and 8. Dong Nai 3 and 4 would be located upriver from CTNP and will flood a very rare intact riverine forest block. These dams may also cause a reduction in peak discharge of the Dong Nai River. Peak discharges cause a reverse flow in the Dak Lua stream, thus feeding water into the Bau Sau Wetland Complex within Cat Tien National Park. A reduction in peak discharge in the Dong Nai River therefore may lead to a reduction in the size of this important wetland, with implications for the habitat quality and available area for crocodiles. This is now a serious threat as the Vietnam Electrical Authority has recently approved the feasibility plans for Dong Nai 3 and 4.

Conservation Requirements

To prevent Siamese Crocodiles from a second local extinction the management of CTNP needs to address the threats of poaching, drowning from fishing nets, and the impacts of planned dams.

The threat of poaching is serious and to reduce it will require improved patrolling by forest guards, pressure on the known hunters and traders, and support from local authorities. With reports of crocodile poaching still occurring in the area the forest guard patrols in the Bau Sau Wetland Complex need to be improved. As there are only a few individuals who are poachers and traders, and their names are often known by the Forest Protection Department (FPD), these individuals need to be regularly visited by the FPD and local community leaders. Conservation education is also a useful tool to inform people about the impact of their actions and needs to be focussed on the known hunters and schools of Dak Lua. Another lack of deterrent for poachers is a low level of understanding in the Vietnamese judicial system about the impacts of hunting animals resulting in small punishments for convicted poachers who then return to hunt. During legal cases for poaching Park management needs to inform local law enforcers and officials about violations and the existing laws in Vietnam.

The prevention of poaching needs strong support from Dak Lua commune and residents. To help achieve this it would be useful to have a meeting in Dak Lua with representatives from

the commune, Park, FPD, police, and known violators. This would give a forum to inform about the importance of the crocodile population and the threats, and seek strong support from the commune and police to prevent poachers and enforce prosecutions.

Currently staff of Bau Sau forest guard station remove abandoned fishing nets from the wetland and this needs to be maintained. It has been suggested to negotiate with the residents of Dak Lua to allow line-fishing but not electro- or net fishing in the wetlands. However, staff of the Forest Protection Department of CTNP said that as it is not economically viable to fish with a line poachers would still continue to use nets and electro-fishing, and additionally official rules cannot allow any harvest of species within the boundary of a national park.

Addressing the threat of planned dams is more difficult as it is on a large scale and involves large amounts of development pressure. However, at a minimum the management of CTNP needs to submit an environmental impact assessment for the potential impact on CTNP to the Vietnam Electrical Authority, Government of Vietnam, and Ministry of Agriculture and Rural Development, and continue to lobby these bodies. Currently the Park is also nominating the Bau Sau Wetland Complex as a RAMSAR site (wetlands of international importance), and if accepted will bring more recognition to the importance of conserving the site.

Cat Tien National Park has been the first site where Siamese Crocodiles have been re-established within their former range. This programme has involved a range of partners and has successfully achieved a small population in Bau Sau. However, this population is threatened by poaching and could become extinct again within a few years without improved protection.

Phasianidae

Justification

Cat Tien National Park has a diverse community of the Phasianidae (pheasants, partridges, junglefowl, quails, and francolins) including several rare species. The Phasianidae community in CTNP consists of 9 species, of which 4 species are red listed by the IUCN (Hilton-Taylor, 2000): Endangered – Orange-necked Partridge (*Arborophila davidi*); Vulnerable – Green Peafowl (*Pavo muticus imperator*) and Germain's Peacock Pheasant (*Polyplectron germaini*); and Lower Risk/near threatened – Siamese Fireback (*Lophura diardi*). Of particular conservation value is the Orange-necked Partridge, which is the only member of the Phasianidae endemic to southern Vietnam (Robson, 2000).

Within Vietnam, habitat loss and hunting has reduced many Phasianidae species from their former ranges. Protected areas, such as Cat Tien National Park, are important for the future of these species as the high population density in Vietnam's rural landscape places continual pressure on remaining populations and their habitats. However, the conservation of species is compounded by a lack of knowledge about their local distribution and status, and the impacts of poaching and habitat conversion. At Cat Tien National Park all previous observations of Phasianidae have come from a few re-visited sites and the status of species across the rest of the national park is unknown. Improved management and protection of these species within the national park requires more information on local populations.

Research and Monitoring

To expand the information on the Phasianidae in CTNP annual surveys have been carried out since 1999. The purpose of surveys has been to assess the status of Phasianidae species across CTNP and establish a baseline to monitor the populations of key species at key sites. The focus of surveys was the 4 red-listed species (Orange-necked Partridge, Green Peafowl, Germain's Peacock Pheasant, and Siamese Fireback). Surveys were carried out between January – July, covering the breeding season of most species when individuals are more conspicuous and therefore more easily observed. During surveys members of the survey team walked defined line-transects, and recorded direct and indirect observations to calculate an encounter rate (individuals/Km) for every species on each transect. A detailed description of the survey methods and results is available in previous reports (Nguyen Tran Vy *et al.*, 2000, 2001, 2002; Nguyen Hoang Hao *et al.*, 2003).

Status

Populations of Orange-necked Partridge, Green Peafowl, Germain's Peacock Pheasant, and Siamese Fireback had a variable distribution across CTNP with different habitat requirements between species. Of these the most distinct in distribution were Green Peafowl that are only present in habitats that include open areas (wetlands, grasslands, and forest edge). Orange-necked Partridge favour forested hills over 150m a.s.l. They were rarely observed below this altitude but most likely move down from hills in search of food and mates. Germain's Peacock Pheasant and Siamese Fireback had more general distributions as they were found in most forested habitats, but rarely in bamboo dominated forests, and never in grasslands.

Within these habitats indices of density were variable. Orange-necked Partridge had the highest counts in habitats of wood forest (non-bamboo) between 300-600m a.s.l. Key sites for Orange-necked Partridge populations are either side of the Park boundary in the north-east of Cat Loc and the north-west of Tay Cat Tien (Map 1), which had the highest encounter rates. Hilly areas of Tay Cat Tien, the south-western region of Nam Cat Tien, and central Cat Loc were also important regions. Germain's Peacock Pheasant and Siamese Fireback had the highest counts in one area of lowland wood forest (<150m a.s.l.). Key sites for Green Peafowl were at Bau Sau, Dak Lua, and Nui Tuong.

Other Phasianidae species observed during the same surveys also had species-specific distributions with Silver Pheasant (*Lophura nycthemera*) only recorded above 300m, Scaly-breasted Partridge (*Arborophila charltonii*) in a variety of forest habitats but not in grasslands, and Red Jungle Fowl (*Gallus gallus gallus*) who were recorded in most habitats with high numbers in grasslands and lowland wood forest.

There was generally not much variation between years in the indices of density for each species at different sites, apart from a general decrease in 2002 (Nguyen Tran Vy *et al.*, 2002). This may have been caused by the very dry season during that year with fewer water sources forcing birds to move to other areas of water, or weather conditions affecting bird behaviour and reducing their calling frequency and conspicuousness (and therefore the index of density).

Human disturbances in 2002 were also the most likely cause of lower counts at particular sites. Fewer individuals were recorded near villages where there was increased human activity (Nguyen Tran Vy *et al.*, 2002). Where there were the greatest changes was for Orange-necked Partridge at sites of new human disturbances. Lower indices for Orange-necked Partridge density were recorded at sites just outside the Park boundary in Vinh An and Nghia Trung State Forest Enterprises where noise and habitat disturbance was produced by an increase in human activities between 2001-2002, and at Dak Lua and Nui Tuong Hills inside the Park boundary where the quarrying of road material also produced a lot of disturbance (Nguyen Tran Vy *et al.*, 2002).

In 2003, when the dry season was cooler than 2002, there was a generally higher index of Phasianidae density in comparison to 2002, which supports the theory that variations in weather have an effect on the density of Phasianidae or their conspicuousness (Nguyen Hoang Hao *et al.*, 2003). Orange-necked Partridge were still never recorded at sites of habitat disturbance, open land or human activity, illustrating how sensitive this species is to human disturbance.

The annual pheasant survey at CTNP has established an important base-line of the populations that needs to be maintained.

Threats

The greatest threat to the Phasianidae community at CTNP is disturbances from human activities and the hunting of rare species. Human disturbances come from local villages, activities in State Forest Enterprises, and even some Park activities. Villages within, and on the border of the Park, produce disturbances from encroachment and other activities that come from an increasing population and demand for resources. There is a high density of Kinh (ethnic Vietnamese) living around the boundary of the Cat Loc sector, especially in the south and east. The villages within Cat Loc are mainly populated by S'Tieng and Chau Ma (two different tribal groups). Ongoing encroachment occurs around Villages 3 and 5, and Phuoc Son where forest is cleared for cultivation. Encroachment has also increased in State Forest Enterprises, as has the alteration of habitats through logging and the collection of non-timber forest products. Within CTNP the quarrying of road material at Dak Lua and Nui Tuong Hills produced noise disturbance and also destroyed habitat.

Hunting has impacts on populations through direct mortality as well as disturbance from human activity in the forest. As described for Siamese Crocodiles above, hunting is mainly carried out by repeat offenders that take species opportunistically to satisfy increasing demand from urban markets. Even with a level of protection provided by the Park's Forest Protection Department there are many daily incursions in to the forest. Subsistence hunting is also carried out by residents from tribal villages (S'Tieng and Chau Ma tribes) located in Cat Loc. Local residents often hunt Orange-necked Partridge and other Phasianidae especially to use certain feathers for ornamentation and other hunters favour them for their beauty as an ornamental pet (Nguyen Hoang Hao *et al.*, 2003).

Conservation Requirements

The conservation of the Phasianidae community in CTNP will require activities focussed on reducing encroachment, disturbances, and hunting. To prevent further encroachment there needs to be clear boundary demarcation and enforcement. The Park is currently re-demarcating its boundaries and informing local residents of the boundary locations. However, forest guards patrols will still need to regularly check the boundaries to record cases of encroachment and Park management has to file encroachment cases with local authorities. Encroachment and disturbances of populations outside the Park are more difficult to address. However, as there is greater interest from State Forest Enterprises (SFEs) to receive input to improve forest protection, the management of CTNP can support management boards of SFEs to incorporate a conservation agenda in their operations.

Disturbances and subsistence hunting within CTNP need to be targeted with conservation education to inform residents of the impact of their activities supported by enforcement where required. As most sources of disturbance are around villages, and subsistence hunting is from tribal villages in Cat Loc, the sites of required conservation education are easily identified. Additionally, any future construction within CTNP needs to source material from outside the boundary of the Park to reduce the disturbance of habitats.

Hunting for trade can only be addressed by the maintenance and improvement of forest guard patrols, especially at key sites for rare Phasianidae. As for most human related threats the indirect pressure for hunting comes from growing populations and an increasing demand for resources (CTNP-CP, 2003), which will require conservation education in urban areas as well as more work by the Forest Protection Department in different towns to reduce the trade in wildlife.

The Phasianidae in CTNP is a relatively intact community with representative species in all major habitats. As the Park covers a range of habitats, and is the largest protected area in the limited geographic range of Orange-necked Partridge, all the species have good potential for long-term survival if the threats to populations are addressed. Unfortunately, negative impacts from hunting persist and are increasing for encroachment and disturbance. Park management has to target these threats, especially at key sites for Orange-necked Partridge in Cat Loc, to prevent the decline of populations.

Gaur

Justification

The Gaur (*Bos gaurus*) population in Cat Tien National Park is one of the most significant in Vietnam. Although CTNP is isolated from other notable Gaur populations along the border with Cambodia and Laos, the Gaur population is important because of the sharp decline of this species within Vietnam. Gaur range from India to South-East Asia and are red listed as globally Vulnerable (Hilton-Taylor, 2000), and listed as Endangered in Vietnam (Red Data Book of Vietnam, 2000).

The conversion of forest habitat to agriculture and the continual pressure of illegal hunting have reduced Gaur in Vietnam to small populations across fragmented habitats (Duckworth and Hedges, 1998). Duckworth and Hedges (1998) stated that if hunting continues at the same level of previous years Gaur will soon become extinct in Vietnam. The CTNP population is not only significant for its presence but also its level of protection. The Forest Protection Department of CTNP are reputedly one of the best in Vietnam, which is reflected in the higher level of protection in CTNP compared with other locations. With minimal (or an elimination of) hunting pressures the national importance of the CTNP Gaur population will increase.

Despite its significance little is known about the status of Gaur in CTNP with most reports based on local reports and indirect evidence. To improve the amount of information on which management and protection is based the CTNP-CP initiated surveys and other data collection to assess the status of Gaur.

Research and Monitoring

The assessment of the Gaur population was based on field surveys and records of anecdotal observations. The first survey was carried out in 2000 and visited areas in the east of Nam Cat Tien and the south of Cat Loc (Ling, 2000). A brief survey for the Nam Cat Tien sector was carried out in 2003 (Yeo and Binks, 2003). As anecdotal observations can be useful for collecting repeated observations over time, especially of rarely seen species of high conservation status, observations of Gaur were collated from the CTNP Wildlife Register between 2000-2002 (Murphy, 2001; Murphy and Phan Duy Thuc, 2002). The most recent, and comprehensive, survey was carried out in 2004 that revisited sites surveyed in 2000, and new sites to cover most key areas of Nam Cat Tien and the north of Cat Loc (Hayes, 2004).

Status

There are 4-5 confirmed herds of Gaur within CTNP. Two confirmed herds are in the east of Nam Cat Tien, with activity centred on the Bau Sau Wetland Complex, the small lakes near the eastern boundary (Bau Da Mi, Bau Trau and Bau Bo), and the Nui Tuong Grasslands (Map 1); 1 confirmed herd is in the south of Cat Loc; there are probably 2 herds in the west of Nam Cat Tien, with activity near Sa Mach in the south and Dang Ha in the north; and as Gaur have been confirmed in the Loc Bac and Da Te State Forest Enterprises it is possible that they also use the habitat in the adjoining north-east of Cat Loc (Hayes, 2004).

Gaur favour sites of particular resources, such as grazing areas and saltlicks, although each herd has an established range and move between habitats. The herds in the east of Nam Cat Tien favour the wetland and grassland sites mentioned above for grazing, and the herd in the south-west regularly visit the saltlick near Sa Mach (Hayes, 2004). However, as Gaur require not only sites for grazing and mineral salts, but also water resources, and forest for shelter and browse, they visit a range of habitats. The size and overlap of the herd ranges in CTNP is not well known, but most likely similar to the 78 km² range size recorded by Schaller in India (1967), although these will be different and possibly larger in CTNP because of the differences in forest habitats (Hayes, 2004). The herds at Sa Mach and Dang Ha regularly move between habitats within the Park to those in the adjoining State Forest Enterprises. The herds in the east of Nam Cat Tien have many grazing sites around the wetlands, but their

movement is probably more restricted by the Dong Nai River that forms the eastern boundary of the Park and the few habitat sites amidst the agriculture on the other side of the river. But this has not stopped a few Gaur who have been recorded crossing the Dong Nai River at night to graze on agricultural land in Da Te district.

Because of the difficulty in observing all individuals for each herd sighting (with individuals spread over an area and in the forest edge) and estimating numbers by hoof-prints, the exact sizes of the herds are unknown. The largest herd is at Bau Sau and consists of at least 24 individuals. But the recent loss of 2 individuals, which were caught in the snares of hunters, has already reduced the size of this herd. This herd size also appears to be quite stable with similar counts between years.

The Gaur population at CTNP appears to be relatively intact with 4-5 herds and the required habitats within the Park. It has not been possible to record any population fluctuations, but the stable herd size observed at Bau Sau suggests that there have been no major changes in recent years, which needs to be confirmed by further research. Surveys have been useful to begin understanding the Gaur population at CTNP but more information is required for their conservation. Future research will need to address population fluctuations, herd interactions, the impact of threats, and the use of habitats outside the Park.

Threats

Although not large, the Gaur population in CTNP is potentially viable on the long-term because there is a small meta-population of multiple herds and good habitat. What will threaten the long-term viability of Gaur in the area is the continued pressure from hunting, changes to habitats used by Gaur outside the Park, the impacts of domestic cattle, and the long-term risks of a small population restricted to a limited area.

Hunting is an ongoing pressure that has a direct and indirect impact on Gaur. Direct impacts come from poachers directly hunting Gaur which is growing with increasing consumption of wildlife meat in urban centres and decreasing natural resources. Indirect impacts from hunting come from the disturbances produced by poachers. Disturbances include noise from human activity, but more importantly the risk of Gaur getting injured from snares set for other species. Last year a young Gaur was found dead in a snare near Sa Mach. Snares may also be set purposely for Gaur with the remains of 2 Gaur found in snares near Bau Sau in April 2004.

Encroachment on existing habitats is an increasing threat caused by growing human populations and demand for land surrounding the Park. This is of particular concern for Gaur in the west of Nam Cat Tien who also use habitats in adjoining State Forest Enterprises that have less protection than within CTNP.

Domestic cattle can cause negative impacts when they visit grazing sites used by Gaur. Their presence are a risk to Gaur because of the potential for transferring domestic diseases to a closely related wild population, direct disturbance of Gaur herds, and competition for grazing resources. In CTNP domestic cattle roam from villages, and are also lead to graze wetland and grassland sites on the Park's boundary that are used by Gaur.

Conservation Requirements

To mitigate the threats to Gaur will require conservation activities focussed on improving protection, reducing encroachment especially within Gaur herd ranges in adjoining State Forest Enterprises, and the management of key habitat sites including the restriction of domestic cattle at grazing sites used by Gaur.

Reducing hunting pressures will require improved forest protection on the short-term and greater pressures on the wildlife trade and education for consumers on the long-term. Of prime importance is the maintenance and improvement of the work carried out by forest guards within CTNP. Forest guards are the first line of protection for Gaur and other species through their patrols for poachers and removal of snare-lines. Cat Tien National Park has reputedly one of the best Forest Protection Departments (FPD) in Vietnam. However, if there

are growing pressures on natural resources protection levels themselves will need to be increased. Additionally, a recent survey found certain forest guard trails inadequately maintained suggesting a minimum range of patrolling in some areas and a serious risk of poaching with snares (Hayes, 2004). To maintain and strengthen an effective patrol schedule against poachers will require strong leadership from the head of the FPD and the heads of guard stations, clear patrol trails, and a commitment from forest guards to carry out extensive patrols. It is hoped that the salary for, and the number of, forest guards can both be increased in the future to improve protection in all protected areas across Vietnam.

Improved protection and boundary patrols will also help to identify and reduce encroachment into CTNP. As the protection of other Gaur habitats in State Forest Enterprises (SFEs) falls outside of the management of the Park, the management boards of SFEs need support to learn how they can improve their own protection and incorporate a conservation agenda in their own operations. As there is a growing interest from SFEs in Dong Nai and Lam Dong provinces in conservation, now is a good time for CTNP and other agencies to provide this support.

Restricting the access of domestic cattle to grazing sites used by Gaur is a contentious issue for local farmers who have come to rely on these sites for their income. Any effort to control domestic cattle will first require conservation education for local farmers, so they can be aware of the issues and the Park's boundary, and support from local community leaders to help enforce regulations. At sites where the area has limited access a fence may be possible to restrict the access of wandering cattle (Murphy, 2004). However, unless a fence/barrier is agreed on by local residents it will not be respected and can be easily destroyed. As restricting the access of cattle to a grazing site impacts on the economics of a local farmer, other possible options for grazing need to be sourced outside of the Park as part of a solution, or using alternative sources of cattle-feed such as the husks from rice or other crops.

In recent years CTNP has implemented an annual controlled burn of the Nui Tuong Grasslands in order to stimulate the growth of new grass thereby improving the grazing for Gaur and other ungulates. This has been very successful with regular Gaur sightings after the controlled burn as an indicator of improved habitat quality, so this activity needs to be maintained (Murphy, 2004).

The current status of Gaur in CTNP, and their continuing disappearance from the rest of Vietnam, supports the claim that the population in the Park is one of the most significant in Vietnam. To ensure that this population still remains significant will require ongoing work by CTNP and surrounding State Forest Enterprises to conserve the separate herds and their habitats in order to maintain a functioning meta-population.

Conclusions

From 1999-2004 work carried out by the Cat Tien National Park Conservation Project has helped to clarify the status, and improve the management, of the key species in Cat Tien National Park. Gaur and rare Phasianidae (pheasants and partridges) have multiple populations/herds over a range of habitats, whereas Siamese Crocodile and Javan Rhino have single populations at specific sites. Of these the Javan Rhino is of particular concern with a critically small number of individuals in southern Cat Loc.

There is a smaller chance of long-term survival for species with single populations, such as Javan Rhino and Siamese Crocodile. The crucial difference between these species is that the Javan Rhino have a critically small population, an uncertain chance of breeding, and no other populations of the same subspecies anywhere else on earth. This is further compounded by the ongoing pressures of a lack of adequate habitat and increasing disturbances (that restrict rhino behaviour and possibly even breeding). In recent years there have been significant steps towards rhino conservation with improved protection (additional forest guard stations and more forest guards), the implementation of the RPMU, conservation education, the reclamation of a key rhino saltlick, and plans which are underway to reclaim more encroached land and resettle villages that restrict the range of the rhino. However, these are only steps towards reducing disturbances and increasing the area of available habitat. For disturbances within the Park boundary the FPD maintain a level of protection that will have to be improved if there will be a growing poaching pressures with the increasing demands for natural resources. Disturbances on the Park's boundary are more difficult to control as they are caused by growing populations, encroachment and no effective buffer zone, and their reduction will require the cooperation of the local authorities and community, extensive conservation education, and strict enforcement. Increasing the available habitat for rhino will be just as difficult as there is not much of it left, so attention needs to focus on adjoining areas of habitat with low human density. Given the huge effort that will be needed to expand habitat and reduce disturbances, and the low chances of population growth, it is quite possible that current conservation efforts have arrived too late in this population's history and the subspecies will become extinct. But as long as there still are rhino and habitat there is still a chance for their conservation and what could be even more unfortunate would be if the subspecies was lost when there was still a possibility for their recovery. There is still a future for the Javan Rhino but it will require a supreme effort from the Government of Vietnam, CTNP, local authorities and residents, and the international conservation community.

Although Siamese Crocodile have also a single population within the Park they have greater potential for long-term survival, with a good breeding potential and adequate habitat, if they are adequately protected. But current levels of protection are inadequate and poaching threatens the population's future. Their re-establishment at CTNP has been the first for the species. Hunting was the original source of their local extinction, and could be the cause of their second extinction unless protection is improved. It may never be possible to prevent every crocodile-kill, but with an adequate level of protection any occasional hunting incidents could be potentially balanced by crocodiles breeding in areas of higher protection. Strong leadership from the Forest Protection Department and increased patrolling is required to improve protection to an adequate level.

Species with multiple and interacting populations (meta-populations), such as the rare Phasianidae and Gaur, have a greater chance for long-term survival. This is because they are not dependant on the survival of one population and/or habitat so the whole meta-population will not be lost by any negative impacts to a single population/herd. However, the populations of rare Phasianidae and Gaur are by no means secure and still require ongoing Park activities to reduce the disturbances to their populations/herds and key habitats. The example of these species also highlights the improved conservation chances for species which still have functioning meta-populations. Conservation efforts generally focus on those species closest to extinction (such as Javan Rhino and Siamese Crocodile) – and this is essential to prevent their extinction and irretrievable loss. However, conservation efforts for critically endangered

species require a huge cost and may possibly be too late for some species. If resources are available, earlier conservation work on the meta-populations of rare species and their habitats will improve the chances of their long-term survival, instead of waiting till they are critically endangered which will cost more and may be too late. At CTNP, and in the surrounding landscape, rare Phasianidae, Gaur, and other rare species that are endemic to southern Indochina, such as Black-shanked Douc Langur (*Pygathrix nigripes*) and Yellow-cheeked Crested Gibbon (*Nomascus gabriellae*), have potentially long-term viable populations deserving of conservation management to prevent them becoming the next Javan Rhino.

The most important conservation requirements for Javan Rhino, Siamese Crocodile, rare Phasianidae, and Gaur are the same – securing undisturbed habitat and preventing hunting. As the forest guards are the most effective protection against hunting and encroachment their work needs to be maintained and improved to meet the level of the threats. Increasing the level of protection will require strong leadership from the heads of the Forest Protection Department and heads of guard stations, enough resources, support from the Vietnamese judicial system to prosecute and convict violators, and ideally more forest guards with larger salaries to improve protection and increase motivation. Addressing the indirect pressures behind hunting will require widespread conservation education focussing on urban centres and increased convictions of wildlife traders. The work of forest guards is also crucial to identify and prevent encroachment on habitats. However, as encroachment cases are tied to the expansion of existing communities, and often on disputed boundaries of the Park, there needs to be strong support from the authorities and leaders of communities and clear demarcation and regular checks of the Park's boundary.

Cat Tien National Park has had one of the best reputations in Vietnam for its level of forest protection. But patrol data has suggested a recent decrease in the number of patrolling hours spent by forest guards (Gert Polet, pers. comm.). Additionally other field researchers in 2004 regularly encountered snares, hunter trails, and violators in the forest (Ben Hayes, pers. comm.; Marina Kenyon, pers. comm.). The good work of the Forest Protection Department has been a major reason for the continued presence of some of the Park's rare and endemic species and any decrease in this level of protection will have serious implications for the future of the remaining populations. Park management has to take this information seriously and regularly assess the performance of the Forest Protection Department.

The conservation requirements that CTNP needs to implement for each key species are summarized in Table 1 (p 4). All of these will need ongoing support and funding.

Cat Tien National Park has a unique biodiversity that is illustrated by the presence of Javan Rhino, Siamese Crocodile, rare Phasianidae, and Gaur who have disappeared from most of their ranges. These species are not only important nationally, with few (or no) other populations elsewhere in Vietnam, but also internationally as Javan Rhino, Siamese Crocodile, and Orange-necked Partridge are endemic to the region and highly endangered. Ongoing protection and management, and research to support management decisions, is crucial to conserve their populations. To ensure that these species are part of the future of Cat Tien National Park, strong Park management will be essential in implementing their conservation requirements.

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