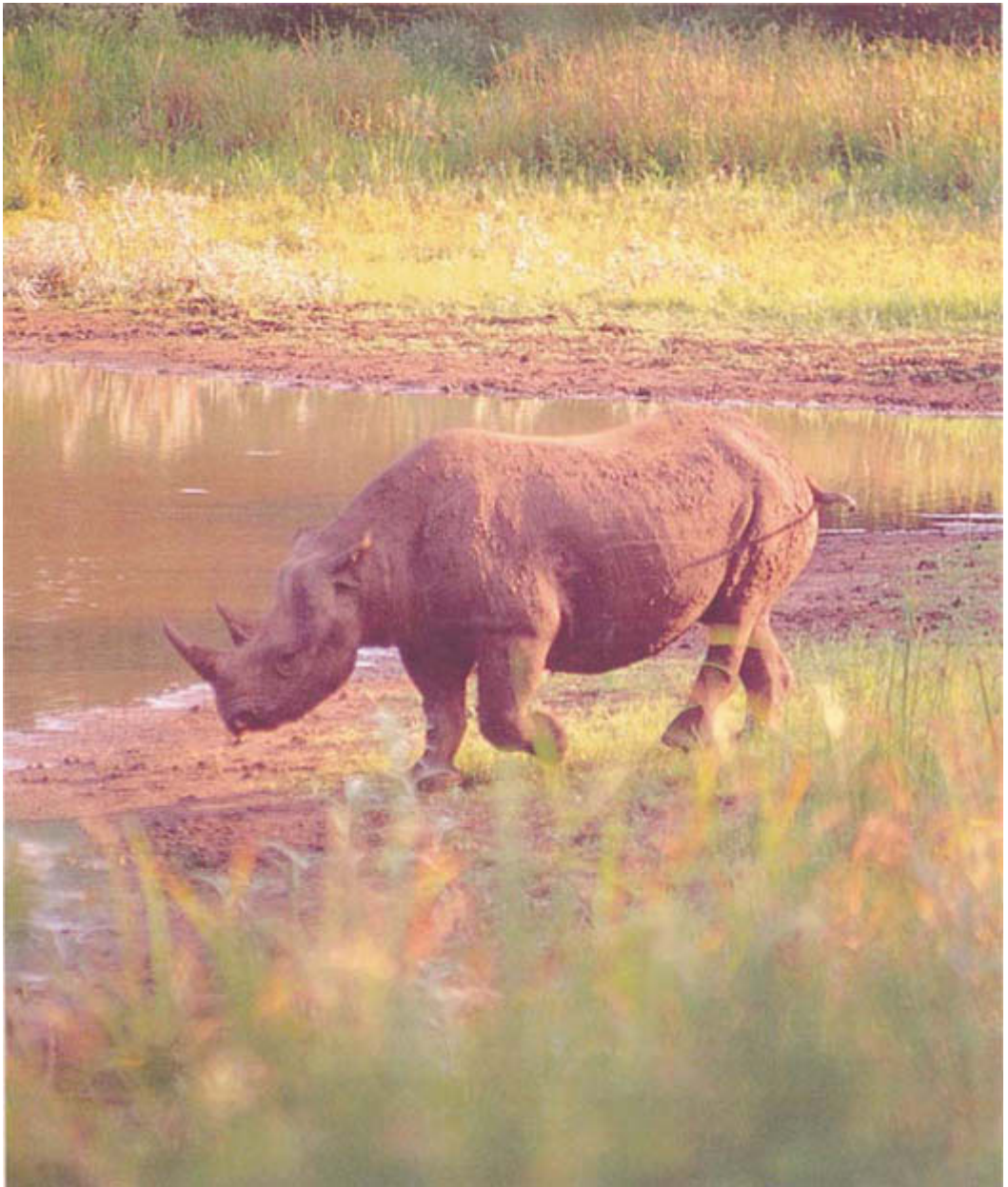
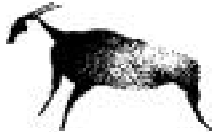


Pachyderm

JUL-DEC 1998

Number 26





SPECIES
SURVIVAL
COMMISSION

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Cover Photo credit: Taye Teferi
Caption: Black rhino in Tsavo National Park, Kenya

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Errata: "Notes from the Field" in *Pachyderm* 26, entitled Nepal Destroys Large Stocks of Wildlife Products, the date in the Table should read 9 November 1997.

CHAIRMAN'S REPORT: AFRICAN RHINO SPECIALIST GROUP

Martin Brooks

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Not that I have anything against elephants, but it is nice to have an edition of *Pachyderm* that is dominated by rhino papers from both Africa and Asia. The African Rhino Specialist Group (AfRSG) is very grateful to WWF for sponsoring the publication of this edition. Black rhino monitoring is a particular focus of this edition, and a number of papers should be of use and interest to black rhino managers and researchers on the ground. In recent years the comparison and synthesis of standardised performance data from populations within rhino metapopulations has facilitated improved biological management decision-making, contributing to the maintenance of high rates of population growth. The paper on standardised black rhino condition assessment scoring adds another useful technique to assist in the ongoing assessment of black rhino population performance. To allow us to draw comparisons between areas I would encourage everyone to standardise and use this condition scoring system. Getting a radio-collar to stay on a black rhino has also proved to be a problem for many years. Fortunately a much improved radio-collar has been developed and has proved itself in the field. Those interested will find more details in this edition. A further paper summarises and discusses the history of one of Africa's best monitored and important black rhino populations.

RHINO HORN FINGERPRINTING FOR SECURITY

In this report, I would like to focus my attention on a major project the AfRSG is co-ordinating so that law enforcement staff will be able to source confiscated rhino horn. To do this it was necessary to build upon successful, pilot horn fingerprinting projects and undertake a major project to determine the chemical composition of rhino horn from as many as possible of the major rhino populations in the African Range States. Statistical analysis in the pilot studies were limited and undertaken in isolation, and there was also a need to develop these analyses further so that horn fingerprinting can become a practical field tool. For this reason the AfRSG is undertaking a major horn fingerprinting for security project with funding from WWF.

After much effort, significant progress has been made by the AfRSG office in getting samples for analysis from as many of the Continent's key and important rhino populations as possible. Additional samples left over from early pilot studies at the University of Cape Town were also secured by the AfRSG's Scientific Officer to increase sample sizes and coverage. After thorough consultation and investigation it was decided to analyse the raw horn samples using three different techniques.

Firstly, Inductively-Coupled-Plasma-Optical-Emission-Spectrometry (ICP-OES) is being used to quantify trace elements in preference to the more old-fashioned, time consuming and more expensive Neutron-Activation-Analysis (NAA) used in the pilot studies. The ICP-OES analysis measures concentrations of 31 elements (measured in low parts per million) and 13 element ratios.

Secondly, samples are also being analysed using Laser-Ablation-Inductively-Coupled-Plasma-Mass Spectrometry (LA-ICP-MS). This technique is routinely used to fingerprint gold and recently has been successfully used to investigate stock theft. LA-ICP-MS is a qualitative technique with horn being sampled using a laser, and analysed in a Mass Spectrometer. The detection limits are in the parts per million and parts per billion region, and data are being obtained on 131 isotopes of 56 elements.

Thirdly, the horn samples are also being analysed for the lighter carbon and nitrogen stable isotopic ratios at the University of Cape Town.

Both the ICP-OES and LA-ICP-MS work is being undertaken by Anglo American Research Laboratories who have tailor-made statistical software which has the capacity to analyse the raw horn fingerprinting data from all three techniques.

The decisions on how and where to analyse the samples were made on the grounds of cost, time and labour needed both to prepare and analyse samples, continuity of analytical methodology, modernity of techniques, a preference to be able to do the analyses locally in Africa, the credibility and professionalism

of the labs and institutions involved in sample analysis, and the availability of tailor-made statistical software that can be used to analyse the data.

All horn samples in the AfRSG's possession have been prepared for analysis and both the Anglo American and Cape Town labs have been sent the first batch of samples.

This project will be completed during 1999, and the results are being eagerly awaited by law enforcement officers and wildlife investigators.

CONCERN FOR SITUATION IN CAMEROON AND THE DEMOCRATIC REPUBLIC OF CONGO

The situation in both the Democratic Republic of Congo (DRC) and Cameroon - homes to the few remaining animals of the two rarest African rhino subspecies remains critical and of concern. Lack of any real high level government will and commitment to rhino conservation in Cameroon continues to be a major problem hampering conservation of the last western black rhino (*Diceros bicornis longipes*); the unrest in the DRC, and poaching from Sudan continues to pose a threat to the remaining northern white rhino (*Ceratotherium simum simum*) in Garamba National Park.

STATUS CONTINENTAL ACTION PLAN

A copy editor is incorporating the comments of a number of reviewers of the revised updated Action Plan before it is scheduled for final acceptance by the AfRSG in June. 1,300 copies of the Action Plan will be published by IUCN in November 1999, with the revised plan being made available shortly afterwards on the World Wide Web. This plan establishes rhino conservation management priorities, and promotes strategies and approaches most likely to succeed, encouraging their adoption by conservation agencies.

AFRSG MEMBERS ACTIVE IN NATIONAL AND REGIONAL RHINO CO-ORDINATING BODIES AND WORKSHOPS

As usual, the AfRSG has facilitated co-ordination and co-operation throughout the continent, through regular

sharing and networking of information and research findings. This is promoted by the many AfRSG members who are active members of, or interface with, national and regional rhino management groups, co-ordinating committees and governmental and non-governmental conservation agencies.

In an important development, a black rhino workshop was held in Morogoro, Tanzania. This workshop was attended by the AfRSG Scientific Officer and four other AfRSG members, and led to the drafting of a fully revised and improved updated Tanzanian black rhino conservation plan.

Four AfRSG members also took part in a workshop in March 1999 which developed a draft national white rhino conservation strategy for South Africa. A wide range of stakeholders were represented at the workshop from both the State and private sectors (which now manages 22% of South Africa's white rhinos). The draft strategy produced by the workshop is being sent to the South African Department of Environment Affairs and Tourism which will seek comments prior to adoption.

Drawing heavily on deliberations of an "Indicators of Success" working group at the 1998 AfRSG meeting in Namibia, the AfRSG's Scientific Officer prepared a background document for the CITES workshop of experts to develop the indicators process further as called for by CITES Resolution Conference 9.14. This workshop was held at TRAFFIC headquarters in Cambridge in early December 1998, and sought greater input from both TRAFFIC and the Asian Rhino Specialist Group. The workshop was attended by the Scientific Officer and four other AfRSG members, and a report on progress and recommended future approaches has been submitted by TRAFFIC to the CITES Secretariat.

EMPLOYMENT OF THE SCIENTIFIC OFFICER

While lack of funds precluded the full-time employment of the AfRSG's Scientific Officer during 1998, thanks to support from IRF, WWF and the USA (via a grant to IUCN), he will be able to be employed at least till the end of November 1999.

POSTSCRIPT

Finally I would like to take the opportunity of commending the outgoing editor of *Pachyderm*, Greg Overton, for all the excellent work he has done, and on behalf of the AfRSG, to wish him well in his new job.

RAPPORT DU PRESIDENT: GROUPE DES SPECIALISTES DES RHINOS D'AFRIQUE

Martin Brooks

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Je n'ai rien contre les éléphants, mais c'est très agréable d'avoir entre les mains un numéro de *Pachyderm* dominé par des articles sur les rhinos, tant d'Afrique que d'Asie. Le Groupe des Spécialistes des Rhinos d'Afrique (GSRAf) remercie très sincèrement le WWF qui a sponsorisé la parution de cette édition. La surveillance des rhinos noirs est un sujet particulier de ce numéro, et un certain nombre d'articles devraient intéresser et servir aux gestionnaires et à ceux qui font des recherches sur les rhinos noirs sur le terrain. Ces dernières années, la comparaison et la synthèse des données standardisées des performances des populations faisant partie des métapopulations de rhinos ont facilité la prise de décision en matière de gestion et contribué ainsi au maintien de taux élevés de croissance de population. L'article qui traite de l'évaluation standardisée de la condition des rhinos noirs apporte une technique utile pour l'évaluation en cours des performances de la population de rhinos noirs. Pour nous permettre de faire des comparaisons entre des régions, je voudrais encourager chacun à standardiser et à utiliser ce système d'évaluation des conditions. Parvenir à garder un collier-radio autour du cou d'un rhino est un problème qui nous tyracasse depuis des années. Heureusement, on a mis au point un collier-radio très amélioré qui a fait ses preuves sur le terrain. Ceux qui seraient intéressés trouveront plus de détails dans ce numéro. Un article paraîtra bientôt qui résume et discute l'histoire d'une des populations de rhinos noirs d'Afrique les mieux suivies et les plus importantes.

L'IDENTIFICATION DE LA COMPOSITION DES CORNES DE RHINOS POUR LEUR SECURITE

Dans ce rapport, j'aimerais concentrer mon attention sur un projet important que le GSRAf coordonne afin que le personnel responsable de l'application de la loi soit capable de savoir d'où provient la corne de rhino confisquée. Il a été nécessaire de concevoir des projets pilotes efficaces pour analyser les cornes de rhinos et de lancer un projet majeur pour déterminer la composition chimique de cornes de rhino en provenance du plus grand nombre de populations de rhinos possible des Etats africains de l'aire de répartition. Les analyses

statistiques des études pilotes ont été limitées et isolées, et il a fallu les développer davantage pour que l'identification des cornes devienne un outil de terrain pratique. C'est pour cette raison que le GSRAf lance un projet important d'identification des cornes pour leur sécurité, financé par le WWF.

Après de gros efforts, le bureau du GSRAf a fait des progrès significatifs et reçu des échantillons à analyser d'autant de populations clés et importantes que possible du continent. Le Responsable scientifique du GSRAf a aussi acquis d'autres échantillons qui étaient restés suite à des recherches antérieures à l'Université du Cape Town d'étendre la couverture et la taille de l'échantillonnage. Suite à des consultations et des investigations sérieuses, on a décidé d'analyser les échantillons de corne brute en utilisant trois techniques différentes.

Premièrement, on utilise dans les études pilotes la "*Inductively-Coupled-Plasma-Optical-Emission Spectrometry (ICP-OES)*" pour quantifier les traces d'éléments, de préférence à la "*Neutron-Activation-Analysis (NAA)*" plus obsolète, qui prend plus de temps et est plus coûteuse. L'analyse *ICP-OES* mesure la concentration de 31 éléments (en parties par million) et les taux de treize éléments.

Deuxièmement, les échantillons sont aussi analysés par la technique de "*Laser-Ablation-Inductively-Coupled-Plasma-Mass-Spectrometry (LA-ICP-MS)*". C'est une technique qui est utilisée régulièrement pour identifier de l'or et qui a servi récemment avec succès pour analyser un lot volé. *LA-ICP-MS* est une technique qualitative, par laquelle la corne est prélevée au laser et analysée dans un Spectromètre de Masse. Les limites de détection définissent des zones de parties par million et de parties par milliards, et on obtient des données sur 131 isotopes de 56 éléments.

Troisièmement, à l'université du Cape Town, on analyse aussi les échantillons de cornes pour déterminer le taux d'isotopes stables de carbone léger et d'azote.

Le travail par ICP-OES et celui par LA-ICP-MS sont accomplis par les Laboratoires de Recherches Anglo-

Américains qui disposent des logiciels statistiques taillés sur mesure et sont capables d'analyser les données sur la composition de la corne brute acquises selon les trois techniques.

Pour décider quand et où analyser les échantillons, on s'est basé sur le coût, le temps et le travail nécessaires pour préparer les échantillons et les analyser, sur la continuité de la méthodologie analytique, sur la modernité des techniques - la préférence étant accordée à la possibilité de faire les analyses sur place, en Afrique, sur la fiabilité et le professionnalisme des labos et des institutions impliqués dans l'analyse des échantillons et sur la disponibilité de logiciels statistiques adéquats permettant d'analyser les données.

Tous les échantillons de cornes dont disposait le GSRAf ont été préparés pour l'analyse, et les labos angloaméricains et celui du Cap ont reçu leurs premiers lots d'échantillons.

Ce projet sera achevé en 1999, et les responsables du respect des lois et les enquêteurs dans le domaine de la faune en attendent impatiemment les résultats.

INQUIETUDE POUR LA SITUATION AU CAMEROUN ET EN REPUBLIQUE DEMOCRATIQUE DU CONGO

Tant en République Démocratique du Congo (RDC) qu'au Cameroun, qui abritent les quelques animaux restants des deux plus rares sous-espèces de rhinos africains, la situation reste précaire et inquiétante. Le manque de toute volonté et d'implication, quelque soit le haut niveau gouvernemental, dans la conservation des rhinos au Cameroun, continue à être un des principaux problèmes qui handicapent la conservation des derniers rhinos noirs de l'ouest (*Diceros bicornis longipes*); et au Congo, les troubles et le braconnage venu du Soudan restent une menace qui pèse sur les derniers rhinos blancs du nord (*Ceratotherium simum simum*) du Parc National de la Garamba.

PLAN D'ACTION SUR LE STATUT DU CONTINENT

Un éditeur est en train d'incorporer les commentaires d'un certain nombre de critiques du Plan d'Action révisé et remis à jour avant qu'il soit soumis à l'approbation finale du GSRAf, en juin. L'UICN publiera 1.300 copies du Plan d'Action en novembre 1999, et le plan révisé sera disponible peu après sur le World Wide Web. Ce plan établit les priorités de

gestion en matière de conservation des rhinos, met en avant les stratégies et les approches les plus susceptibles de réussir et pousse les organismes de conservation à les adopter.

LES MEMBRES DU GSRAf ACTIFS DANS LES ORGANES ET LES ATELIERS DE COORDINATION AU NIVEAU NATIONAL ET REGIONAL

Comme d'habitude, le GSRAf a facilité la coordination et la coopération à travers le continent en partageant les informations et le résultat des recherches. Ceci est dû aux nombreux membres du GSRAf qui sont aussi membres actifs - ou en relation avec - des groupes nationaux ou régionaux s'occupant de conservation des rhinos, des comités de coordination ou d'organismes de conservation gouvernementaux ou non.

Il y a eu ainsi un important atelier sur le rhino noir à Morogoro, en Tanzanie. Y ont participé le Responsable scientifique et quatre autres membres du GSRAf. Il a conduit à la rédaction d'une remise à jour complètement révisée et améliorée du plan de conservation du rhino noir en Tanzanie.

Quatre membres du GSRAf ont aussi participé en mars 1999 à un atelier qui a préparé une stratégie nationale pour la conservation du rhino blanc en Afrique du Sud. Une grande variété des responsables étaient représentés à cet atelier, venant des secteurs public ou privé (ce dernier gère maintenant 22% des rhinos blancs d'Afrique du Sud). La stratégie préparée par cet atelier a été envoyée au Département sudafricain des Affaires d'environnement et du Tourisme où des commentaires seront nécessaires avant adoption.

En s'inspirant fortement des délibérations d'un groupe de travail sur les «Indicateurs de succès» de la réunion du GSRAf de 1998 en Namibie, le Responsable scientifique du Groupe a préparé un document de référence pour l'atelier des experts de la CITES qui devait faire progresser le processus des indicateurs ainsi que l'a demandé la Résolution Conférence 9.14 de la CITES. Cet atelier s'est tenu au quartier général de TRAFFIC à Cambridge, au début de décembre 1998 et a demandé plus de participation de TRAFFIC et du Groupe des Spécialistes des Rhinos d'Asie. Le Responsable scientifique et quatre autres membres du GSRAf ont pris part à l'atelier, et TRAFFIC a soumis au Secrétariat de la CITES un rapport sur les progrès et des recommandations pour des approches futures.

EMPLOI DU RESPONSABLE SCIENTIFIQUE

Alors que le manque de fonds a empêché l'emploi à temps plein du Responsable scientifique pendant l'année 1998, il pourra être employé au moins jusqu'à la fin novembre 1999 grâce au support de l'IRF, du WWF et des USA (via une subvention de l'UICN).

POSTSCRIPTUM

Je voudrais enfin saisir l'occasion qui m'est donnée de féliciter l'éditeur sortant de *Pachyderm*, Greg Overton, pour tout l'excellent travail qu'il a accompli et, au nom du GSRAf, je lui souhaite le meilleur dans son nouveau travail.

CHAIRMAN'S REPORT

ASIAN RHINO SPECIALIST GROUP

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²Thomas J Foose and ³Nico J van Strien, Programme Officers

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The AsRSG conducted the first of its new system of regional meetings at Kaziranga National Park the week of 21 to 27 February, 1999. The host of the meeting was the Forest Department of Assam, and Manju Barua and his staff at Wild Grass Lodge greatly facilitated the logistics of the sessions. Over 70 persons attended various portions of the meetings, including: the Assam Minister of State for Forests, Aminul Islam; the Chief Secretary of the Government of Assam, AK Bora; other top level officials of the Assam Forest Department, particularly the wildlife officers, including Principal Chief Conservator of Forests P Lahan who is also the Principal Range State Representative for India on AsRSG; SK Sen, who coordinated the meeting for the Forest Department; S Doley, the Chief Conservator of Forests for Wildlife; directors or heads of all the major rhino areas in Assam, especially Kaziranga; BS Bonal, who was the local host for the meeting; representatives of West Bengal (AK Raha) and Uttar Pradesh (SP Sinha); Narayan Paudel representing the Department of National Parks and Wildlife Conservation in Nepal; representatives of local NGOs, including Anwamddin Choudury of the Rhino Foundation of Northeast India and now also the Deputy Secretary of the Forest Department; R Emslie, Scientific Officer of the African Rhino Specialist Group; AsRSG member EB Martin who has been the most active non-range-state AsRSG member for this region; SC Dey, the Deputy Chair of the AsRSG for India and Nepal; the Chair, Mohd Khan; Programme Officers T Foose and N van Strien of the AsRSG; and representatives of some past and potential external donors, eg., EIA (D Banks), IRF (T Foose), SOS Rhino (N Schaffer), North American Zoos (M Dee). The main objectives and topics for the meeting were to review and revise action plans for *Rhinoceros unicornis* in India and Nepal and to develop a viable (adequate and sustainable) funding strategy for implementation.

Points of agreement and recommendations from the meeting include:

1. The primary funding priority for rhino conservation is *in situ* activities, especially anti-poaching and habitat management combined with eco-development.
2. Rhino conservation success achieved in India and Nepal has been possible due to the extraordinary dedication and commitment of the field staff. The service conditions for these field staff, who are the guardians of this species as part of the world's wildlife heritage, need to be adequately upgraded to be commensurate with their selfless struggle.
3. The intelligence gathering systems for rhino conservation in India and Nepal are inadequate. External funds should be used to support intelligence gathering until an effective government-supported system can be developed.
4. The meeting reaffirmed that the minimum viable population of *Rhinoceros unicornis* in the wild is 2,500 rhinos in at least 10 populations with a minimum of 100 rhino each, with the optimal level being a total wild population of 5,000 individuals.
5. To develop more recognition and support for rhino conservation, the AsRSG recommends that the Government of India establish a **Project Rhino**, similar to Project Tiger and Project Elephant.
6. The Government of India and Nepal are providing considerable funds to conserve rhinos and their habitat, and these efforts have been very successful for *in situ* rhino conservation. However, because of the human demographic pressures in both of these countries, to carry this success forward into the next millennium government efforts for both India and Nepal should be augmented with significant funds from international/external sources.
7. The AsRSG should have more interfaces with the *Rhinoceros unicornis* range state governments, so that rhino conservation receives continuing and increasing support.
8. The AsRSG will sponsor a technical management advisory group comprising representatives from all major rhino areas in India and Nepal, which will be a first step towards achieving objective seven above.

Financial support for the meeting was provided by the International Rhino Foundation (IRF), WWFNetherlands, WWF-US, and WWF-UK. Some unutilised funds from the meeting budget are being applied to support a census of the rhino in Kaziranga, Orang, and Pabitora, where full counts have not been conducted since 1993.

Elsewhere, the rhino protection units (RPU) for Javan rhino in Ujung Kulon were activated in November 1998. AsRSG and IRF finalised a formal MOU with WWF-Indonesia Programme for joint support of the RPU in Indonesia. AsRSG and IRF organised and funded a meeting in early February 1999 at Sungai Dusun of managers from the four facilities with Sumatran rhinos in managed breeding situations:

Sungai Dusun (Peninsula Malaysia), the SRS at Way Kambas (Indonesia), Sepilok Rhino Breeding Centre (Sabah), and the Cincinnati Zoo (USA). In conjunction with this session, a team of reproductive specialists from the United States, Canada, Malaysia, and Indonesia conducted an assessment of the programmes and an examination of many individual rhinos in the Sumatran rhino managed breeding centres at Way Kambas and Sungai Dusun. As a result of the assessments, the group that convened at Sungai Dusun formulated new recommendations for each of the 17 Sumatran rhinos (five males and 12 females) in managed breeding situations in an effort to maximise the probability of reproduction. At this time, four of the 12 females have mated and results of pregnancy tests should be available soon.

RAPPORT DU PRESIDENT: GROUPE DES SPECIALISTES DES RHINOS D'ASIE

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Le GSRAs a tenu la première de ses réunions selon le nouveau système de réunions régionales au Parc National de Kaziranga, du 21 au 27 février 1999. Elle était accueillie par le Département des Forêts de l'Assam, et Manju Barua et son personnel ont grandement facilité la logistique des sessions au Wild Grass Lodge. Plus de 70 personnes ont assisté à différentes parties des réunions, y compris le Ministre d'Etat pour les Forêts d'Assam, Aminul Islam; le Secrétaire général du Gouvernement d'Assam, AK Bora; d'autres officiels du plus haut niveau du Département des Forêts de l'Assam, particulièrement les responsables de la faune, y compris le Conservateur Principal des Forêts, P. Lahan, qui est aussi le Représentant principal pour l'Inde des Etats de l'aire de répartition, dans le GSRAs; SK. Sen, qui a coordonné la réunion pour le Département des Forêts; S. Doley, le Conservateur en chef des Forêts pour la Faune; les directeurs ou les chefs de toutes les aires principales pour les rhinos en Assam, particulièrement, Kaziranga; BS. Bonal, qui fut l'hôte sur place de la réunion; des représentants du Bengale occidental (AK. Raha) et d'Uttar Pradesh (SP. Sinha); Narayan Paudel qui représentait le Département des

Parcs Nationaux et de la Conservation de La Faune au Népal; des représentants des ONG locales, y compris Anwaruddin Choudhury de la Rhino Foundation du nord-est de l'Inde, qui est aussi le Secrétaire-adjoint du Département des Forêts; R. Emslie, Responsable scientifique du Groupe des Spécialistes des Rhinos d'Afrique; E.B.Martin qui est le membre du GSRAs qui a été le plus actif des membres du Groupe qui ne sont pas d'un Etat de l'aire de répartition de cette région; SC. Déy, le Président-adjoint du GSRAs pour l'Inde et le Népal; le Président, Mohd Khan; les Responsables de Programme, T. Foose et N. van Strien, du GSRAs; et des représentants de certains donateurs passés ou potentiels comme EIA (D.Banks), IRF (T.Foose), SOS Rhino (N.Schaffer) et les zoos nordaméricains (M.Dee). Les objectifs et les sujets principaux de la réunion étaient d'examiner et de réviser les plans d'action pour *Rhinoceros unicornis* en Inde et au Népal et de mettre au point une stratégie de financement viable pour sa réalisation.

Les points d'accord et les recommandations pour la réunion étaient

1. Le financement prioritaire pour la conservation des rhinos va aux activités *in situ*, spécialement la lutte antibraconnage et la gestion de l'habitat associées à l'éco-développement.
 2. Le succès de la conservation des rhinos observé en Inde et au Népal n'a été possible que grâce à l'extraordinaire implication et au dévouement du personnel de terrain. Les conditions de travail de ces gens qui sont les gardiens de l'espèce en tant que partie de l'héritage faunistique mondial doivent être améliorées à la mesure de leur lutte désintéressée.
 3. Les systèmes de récolte d'informations sur la conservation des rhinos sont mal adaptés en Inde et au Népal. Il faudrait utiliser des fonds externes pour soutenir la récolte d'informations jusqu'à ce qu'il y ait moyen de mettre au point un système efficace supporté par le gouvernement.
 4. La réunion a réaffirmé que, pour être viable, la population de *Rhinoceros unicornis* en liberté devrait compter au moins 2.500 individus répartis dans un minimum de 10 populations d'au moins 100 rhinos chacune, l'idéal étant d'arriver à une population sauvage totale de 5.000 individus.
 5. Pour susciter une meilleure considération et davantage de soutien pour la conservation des rhinos, le GSRAs a recommandé que le Gouvernement indien crée un **Projet Rhinos**, comme il existe un Projet Tigres et un Projet Eléphants.
 6. Les Gouvernements d'Inde et du Népal fournissent des fonds considérables pour préserver les rhinos et leur habitat, et ces efforts se sont révélés très efficaces dans La conservation des rhinos *in situ*. Cependant, étant donné la pression démographique dans ces deux pays, il faudrait que les efforts des deux gouvernements soient augmentés significativement, de fonds provenant de sources internationales et autres, si l'on veut que ce succès se prolonge dans le prochain millénaire.
 7. Le GSRAs devrait avoir de plus nombreuses con-
- nections avec les gouvernements des Etats de l'aire de répartition de *Rhinoceros unicornis* pour que la conservation de ce rhino reçoive une aide constante et croissante.
8. Le GSRAs va sponsoriser un groupe de conseillers techniques en gestion, qui comprendra des représentants de toutes les principales aires de distribution des rhinos en Inde et au Népal; il sera un premier pas vers la réalisation des sept objectifs cidessus.
- Le support financier de la réunion a été fourni par la International Rhino Foundation (IRF), par le WWF-Netherlands, le WWF-US et le WWF-UK. Une partie des fonds non utilisés sert à un recensement des rhinos de Kaziranga, Orang et Pabitora où aucun comptage complet n'a plus été réalisé depuis 1993.
- D'autre part, les unités de protection des rhinos ont commencé à travailler à Ujung Kulon, pour le Rhinocéros de Java, en novembre 1998. Le GSRAs et la IRF ont finalisé une MOU officielle avec le Programme du WWF-Indonésie pour le support conjoint des unités d'Indonésie. Le GSRAs et la IRF ont organisé et financé une réunion au début de février 1999 à Sungai Dusun pour les gestionnaires des quatre centres chargés de la reproduction en captivité des Rhinocéros de Sumatra: Sungai Dusun (sur la péninsule Malaise), le SRS de Way Kambas (en Indonésie), le centre de reproduction des rhinos de Sepilok (Sabah) et le zoo de Cincinnati (USA). En conjonction avec cette session, une équipe de spécialistes en reproduction venus des Etats Unis, du Canada, de Malaisie et d'Indonésie ont fait une évaluation des programmes et un examen des nombreux rhinos qui vivent dans les centres de reproduction assistée de Rhinos de Sumatra, de Way Kambas et de Sungai Dusun. Suite à ces évaluations, le groupe qui s'est réuni à Sungai Dusun a pu formuler de nouvelles recommandations pour chacun des 17 rhinos de Sumatra captifs (cinq mâles et douze femelles) afin d'optimiser les probabilités de reproduction. Actuellement, quatre des douze femelles se sont accouplées, et les résultats des tests de grossesse devraient être bientôt connus.

CHAIRMAN'S REPORT: AFRICAN ELEPHANT SPECIALIST GROUP

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On the eve of Mozambique's national elephant planning exercise, it feels very much as though elephant conservation is a constant and unending process with truly no beginning and no end. As one initiative is brought to fruition another is just starting out. It is a normal ebb and flow and a healthy progression but for a volunteer Chair, an exhausting one.

As I ended my last report, we were anxiously awaiting the results of an aerial survey of one of Mozambique's last viable elephant populations, conducted by Dr. Debbie Gibson (a member of the AfESG). The count has now come and gone and confirmed that the Niassa region, in the northern part of the country, is indeed an important stronghold of elephants for the southern African region; certainly it is the largest population remaining in Mozambique (8,707 \pm 1,937). The elephant's survival is an amazing outcome considering more than 30 years of civil disruption that has plagued this beleaguered country. The government's clear will to go forward in planning a future for all its elephant populations, many having been devastated during the drawn out civil instability, is a testimony to their commitment. The AfESG has been closely involved in this process and a number of members will be participating in the strategic planning workshop in mid-April 1999.

It is not Mozambique, alone, that has strategic management planning at the top of its elephant agenda. In February 1999, technical experts (both from government and non-governmental organisations), including members and staff of the AfESG, convened in Abidjan, Cote d'Ivoire, to draft a sub-regional strategy for the conservation of the African elephant in the West African sub-region. In all my time in this position I have never experienced such honest and absolute dedication to a cause. One could easily feel that for many of the avid conservationists who took part, their *raison d'etre* is their respect for the elephants themselves. The strategic framework established a strong vision, "to ensure the conservation of the elephant and its habitats in West Africa". A number of measurable targets, with key milestones to evaluate progress along the way, were agreed and clear guidance for ongoing and newly-initiated efforts on behalf of elephants over the next five to ten years was provided. It is intended that the final draft will be taken to the highest levels of

government for adoption. It is hoped that with the political backing and commitment of the relevant governments of the sub-region and the support of donors, the strategy will ultimately be implemented at all levels. Although southern Africa has long worked at the sub-regional level on technical and policy issues, West Africa is really the first to promote management planning at the sub-regional level. Given the critical status of elephants in West Africa (over 90% of both range and numbers lost since the turn of the century), the fact that a number of the significant populations of the sub-region straddle international boundaries, the growing problems of desertification as well as forest fragmentation and loss and a clear shortage of management resources, a sub-regional approach is very likely the best hope for the persistence of elephants over the next 20 to 30 years. The adoption of a strategic framework for the sub-region will certainly herald a major achievement for the conservation of elephants in West Africa.

The members of the Data Review Taskforce and members of the AfESG Secretariat staff have been "on overdrive" for months in an all-out effort to complete the 1998 African Elephant Database (AED). The updated version, which is scheduled to be printed by the end of May 1999 and ready for distribution by the middle of the year, has been a mammoth undertaking. In some ways it is a relief that the onerous task of producing a hardcopy update is undertaken only once every three years but, in other ways, it forces us to look for means to streamline the process and have it take place as a perpetual activity rather than having to make such a strong push every triennium. Out of the 37 African elephant Range States, 32 have been updated with new population estimates, while three countries (Congo, Sierra Leone and Sudan) have no population estimates whatsoever. There are a total of 284 survey zones across Africa, of which 193 have had population estimates during the past three years. In 151 of those zones air and ground surveys and dung counts have been conducted during the past ten years. For the remaining 133 survey zones only guesses have been supplied. This gives a clear indication that there is still considerable uncertainty concerning elephant numbers on the continent.

Again, the question of future funding looms and we

await word from several donors who have been asked to support the next phase of the AED. Over the next couple of years, the intent would be to begin to use the database, in combination with other data sets currently being compiled, to develop a number of models that could provide us with insights to the future challenges for elephant conservation across the continent.

The statement on the role of the captive community in African elephant conservation, drafted by the AfESG at our meeting in January 1998 in Burkina Faso, has stimulated interest both in Africa and further a field. I am glad to report that far more attention is now being drawn to the plight of elephants, both African and Asian, in captivity. Clearly the situation for Asian elephants, with a far greater percent of their overall numbers, now living in logging camps across their range in Asia, is very grave and of urgent priority for action. African elephants, however, must not be forgotten in the debate. In May 1999, the American Zoological Association will host a special meeting in the United States, with experts from Africa and Asia, to discuss the issues and to help identify constructive solutions for those elephants whose fate has destined them to a life in captivity.

The 41st CITES Standing Committee meeting has come and gone and the decision to allow a limited, one-off trade in ivory from Botswana, Namibia and Zimbabwe is now a matter of history. As I write, the ivory sales are underway in the three countries. The individual shipments are to be consolidated in a central point and then moved as a single shipment from southern Africa to Japan. We currently do not know the outcome of this process but by the time *Pachyderm* goes to print, these sales, the price and the amounts of ivory sold will also be on public record. But there are many things that remain unknown. What, if any, will be the impacts of these sales, not only in the political arena but also in the real world of the elephants? In the short-term an "early warning" system has been established through the CITES Secretariat but any future debate regarding ivory trade will require more time and refinement by the Parties regarding the conditions under which any further trade could be allowed. The members of the AfESG can continue to contribute to the technical rigor of such debate, a challenge we should not shy away from.

The monitoring system for the illegal killing of elephants (MIKE) and the Elephant Trade Information System (ETIS) have been approved and funds have been committed from the CITES Trust Fund and the British Government for the initial phase of implementation. There has been enormous confusion regarding the respective objectives of MIKE and ETIS and an unfortunate linkage was made between the adoption of these systems and the

approval process for the one-off sales. These systems were not designed to monitor the effects of the recently approved sales nor were they developed as a mechanism to countenance future trade decisions. What is more important than clarifying what these monitoring systems are not is to make clear what they are and what they can become given real commitment and support by governments and their NGO and donor partners.

Surely, these monitoring systems should be seen as a major step forward in the recognition that elephants are an important and highly-valued global resource and, as such, their fate should be much more deliberately charted than it has been in the recent past. The establishment of a system to bring better information to managers and decision-makers at all levels is an excellent place **to** start. Although it may not be possible for this to take place for every population of every nation, ETIS and MIKE represent an opportunity to "kick start" the kind of trade monitoring and on-the-ground surveys and data collection that has in some countries fallen into abeyance and in others has never even put in place. For some of Africa's most important elephant populations, particularly those in central Africa, MIKE provides an opportunity to keep a watching brief on a number of highly vulnerable sites. In West Africa, ETIS and its associated data sets could get to the bottom of the domestic trade markets that may be playing a far greater role in the trafficking of ivory from central Africa than previously realised. It will not be easy and the successes of implementation can be no more guaranteed than the success of any other initiative on the challenging continents of Africa and Asia. There maybe "fits and starts", no doubt there will be continuous criticism. I prefer to cast my energies forward in the belief that like most things, ETIS and MIKE will grow, evolve and adapt **to** the challenges before them. Of one thing I am sure, these systems will help **to** give African and Asian elephant conservation, in all its manifestations, the profile and support required **to** ensure these magnificent beasts a future in our world.

The AfESG Secretariat will be "under construction" over the next few months. While we await word on funding requests for core support over the next year, Lamine Sebogo, the Programme Officer for West and Central Africa, will be moving back from whence he came to Burkina Faso, where he will be based in the IUCN Regional Office for West Africa. And, of course, as you are all aware, my very diligent Programme Officer of the past two years, Greg Overton, will be leaving the mainland of elephants for the island of elephant birds as he makes his way to Madagascar. I know that you will all join me in thanking Greg for his hard work and in wishing him good luck as he ventures into a life "beyond elephants".

RAPPORT DE LA PRESIDENTE: GROUPE DES SPECIALISTES DES ELEPHANTS AFRICAINS

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Alors que débute l'exercice de programmation national mozambicain sur l'éléphant, il semble vraiment que la conservation de l'éléphant soit un processus permanent qui ne connaisse à proprement parler ni commencement ni fin. Quand une initiative arrive à sa réalisation, une autre se met en route. C'est une suite normale et une progression positive, mais pour un Président plein de bonne volonté, c'est épuisant.

Lorsque je terminais mon précédent rapport, nous attendions les résultats d'une étude aérienne d'une des dernières populations viables d'éléphants au Mozambique, que dirigeait le Dr. Debbie Gibson (membre du GSEAf). Le comptage est maintenant terminé et a confirmé que la région de Niassa, au nord du pays, est vraiment un bastion important pour les éléphants du sud de l'Afrique. Elle est à coup sûr la plus grande population restante au Mozambique ($8,707 \pm 1,937$). Leur maintien est un événement extraordinaire étant donné les quelques trente années de troubles civils qui ont ravagé le pays. Le gouvernement fait preuve de la volonté évidente de s'occuper de l'avenir de toutes ses populations d'éléphants dont beaucoup ont été dévastées durant ces troubles prolongés et manifeste ainsi son engagement. Le GSEAf a été étroitement impliqué dans ce processus, et un certain nombre de ses membres participeront activement au séminaire de programmation stratégique de la mi-avril 1999.

Il n'y a pas que le Mozambique qui ait la programmation de gestion stratégique comme point principal de son agenda. En février 1999, des experts techniques (venus d'organisations gouvernementales ou non), y compris des membres et du personnel du GSEAf, se sont réunis à Abidjan, en Côte d'Ivoire, pour préparer une stratégie sous-régionale pour la conservation de l'éléphant africain dans la sous-région ouest-africaine. Au cours de toutes les années où j'ai occupé cette fonction, je n'ai jamais rencontré un dévouement aussi honnête et aussi absolu à une cause. On ressentait facilement que les éléphants sont la raison d'être de bien des conservationnistes motivés qui y ont participé. Le cadre stratégique a dressé une vision solide "pour garantir la conservation des éléphants et de leurs habitats en Afrique de l'Ouest". On a dressé la liste d'un certain nombre d'objectifs mesurables, avec des indices clefs pour évaluer les progrès accomplis et on a fourni des

directives claires pour les efforts en cours et ceux à lancer pour les éléphants dans les cinq à dix prochaines années. Nous avons l'intention de présenter le document final à l'adoption du plus haut niveau gouvernemental. L'on espère qu'avec le support politique et l'engagement des gouvernements concernés de la sous-région, la stratégie pourra finalement être appliquée à tous les niveaux. Bien que l'Afrique australe ait longtemps travaillé sur des problèmes techniques et politiques au niveau sous-régional, l'Afrique de l'Ouest est vraiment la première à promouvoir un programme de gestion au niveau sous-régional. Etant donné le statut critique des éléphants au niveau sous-régional (plus de 90% de l'habitat et des animaux perdus depuis le début du siècle), le fait qu'un certain nombre de populations significatives de la sous-région chevauchent des frontières internationales, les problèmes croissants de désertification, de fragmentation des forêts, et la perte et la raréfaction évidentes des ressources de gestion, une approche sous régionale est très probablement le meilleur espoir de conserver des éléphants au-delà des vingt ou trente prochaines années. L'adoption d'un cadre stratégique pour la sous-région entraînera certainement des résultats majeurs pour la conservation des éléphants d'Afrique de l'Ouest.

Les membres du Groupe de Travail sur l'examen des données et les membres du Secrétariat du GSEAf ont mis les bouchées doubles pendant des mois, dans un effort majeur pour terminer la Banque de Données sur les Eléphants de 1998. La version mise à jour, qui devrait être imprimée à la fin mai 1999 et prête à être distribuée vers le milieu de l'année, a été une entreprise énorme. D'une certaine façon, c'est un soulagement de ne devoir produire que tous les trois ans cette coûteuse remise à jour mais, d'un autre côté, cela nous oblige à chercher des moyens de rationaliser le processus et d'en faire une activité permanente plutôt que de produire cet effort immense tous les trois ans. Le question des financements futurs flotte à nouveau, et nous attendons une réponse de plusieurs donateurs à qui nous avons demandé de l'aide pour la prochaine phase de la BDEAf. Au cours des prochaines années, nous voudrions commencer à utiliser la banque de données, combinée avec d'autres données qui sont actuellement rassemblées, pour entreprendre un certain nombre d'exercices-types qui pourraient nous fournir des indications quant aux défis que la conservation des éléphants devra relever à l'échelle du continent.

La déclaration sur le rôle de la communauté captive dans la conservation de l'éléphant africain, préparée par le GSEAF lors de la réunion au Burkina Faso en janvier 1998, a suscité l'intérêt en Afrique et au-delà. Je suis heureux de pouvoir annoncer que le sort des éléphants en captivité, qu'ils soient d'Afrique ou d'Asie, attire maintenant beaucoup plus d'attention. Il est certain que la situation des éléphants d'Asie, dont un beaucoup plus grand pourcentage vivent maintenant dans des camps de coupes de bois ou d'entraînement répartis dans leur aire de répartition, est très grave et requiert une action prioritaire urgente, mais il ne faut pas oublier les éléphants d'Afrique dans les discussions. En mai 1999, l'Association Zoologique Américaine organise une réunion spéciale aux Etats Unis, avec des experts venus d'Afrique et d'Asie, pour discuter des problèmes et aider à trouver des solutions constructives pour les éléphants que le sort a fait vivre en captivité.

Le 41ème réunion du Comité Permanent de la CITES est terminée, et la décision d'autoriser une vente unique et limitée d'ivoire en provenance du Botswana, de Namibie et du Zimbabwe fait partie de l'histoire. Au moment où j'écris ceci, les ventes ont commencé dans les trois pays. Les chargements individuels doivent être rassemblés en un seul point et envoyés en un seul bloc d'Afrique australe vers le Japon. Nous ne connaissons pas encore les résultats de cette opération, mais au moment où ce *Pachyderm* sera à l'impression, ces ventes, les prix et les quantités d'ivoire vendues seront connus de tous. Bien des choses restent pourtant inconnues. Quel sera l'impact de ces ventes, s'il existe, non seulement dans le domaine politique mais aussi dans le contexte réel des éléphants? A court terme, on a établi un système d'"alarme rapide" au Secrétariat de la CITES, mais tout débat futur au sujet du commerce de l'ivoire exigera des Parties plus de temps et de précision quant aux conditions auxquelles serait soumis tout commerce ultérieur. Nous espérons que les membres du GSEAF pourront continuer à contribuer à la rigueur technique de tels débats, un défi que nous ne pouvons pas fuir.

Le système de contrôle des massacres illégaux d'éléphants (MIKE) et le Système d'Informations sur le Commerce des Eléphants (ETIS) ont été approuvés, et le Trust Fund de la CITES, ainsi que le Gouvernement Britannique ont promis des fonds pour la phase initiale de mise en œuvre. Il y a eu beaucoup de confusion entre les objectifs respectifs de MIKE et de ETIS, et on a fait un amalgame malheureux entre l'adoption de ces systèmes et le processus d'approbation de la vente unique. Ces systèmes n'ont pas été conçus pour contrôler les effets des ventes récemment approuvées et ils n'ont pas pour rôle d'entériner de futures décisions en matière de commerce. Mais plutôt que de préciser ce que ces systèmes ne sont pas, il est important de

décrire ce qu'ils sont et ce qu'ils peuvent devenir s'ils gagnent l'engagement et le support des gouvernements et de leurs ONG, ainsi que des partenaires financiers.

Ces systèmes de contrôle devraient vraiment être considérés comme un pas important vers la reconnaissance du fait que les éléphants sont une ressource mondiale de grande valeur et que, en tant que tels, leur sort devrait être surveillé beaucoup plus sérieusement qu'il ne l'a été récemment. La mise au point d'un système destiné à apporter de meilleures informations aux gestionnaires et aux décideurs de tous niveaux est un excellent point de départ. Et s'il n'est pas possible de suivre ainsi chaque population de chaque pays, ETIS et MIKE sont l'occasion de lancer le genre de surveillance du commerce, de recherches sur le terrain et de récoltes de données qui sont, dans certains pays, tombées en désuétude et qui, dans d'autres, n'ont même jamais existé. Pour certaines des populations d'éléphants les plus importantes d'Afrique, spécialement celles d'Afrique centrale, MIKE donne l'occasion de veiller aux intérêts d'un grand nombre de sites très vulnérables. En Afrique de l'Ouest, ETIS et ses fichiers de données pourraient atteindre le fin fond des commerces locaux qui pourraient bien jouer dans le trafic de l'ivoire au départ de l'Afrique centrale, un rôle beaucoup plus important qu'on ne le croyait jusqu'ici. Ceci ne sera pas facile, et le succès de cette entreprise n'est pas plus garanti que celui de toute autre initiative lancée sur ces continents remuants que sont l'Afrique et l'Asie. Cela peut progresser par à coups, mais la critique sera certainement toujours présente. Je préfère concentrer mon énergie vers le progrès, avec la conviction que, comme la plupart des nouveautés, ETIS et MIKE vont croître, évoluer et s'adapter aux défis qui se présenteront. Je suis certain d'une chose: ces systèmes vont aider à donner à la conservation des éléphants en Afrique et en Asie, dans toutes ses composantes, le profil et le soutien nécessaires pour assurer à ces magnifiques créatures un avenir dans notre monde.

Le Secrétariat du GSEAF sera "en construction" pendant ces prochains mois. Alors que nous attendons des réponses à nos demandes de financement des activités de base de l'année prochaine, Lamine Sebogo, le Responsable des Programmes en Afrique occidentale et centrale revient au Burkina Faso où il sera basé au Bureau Régional de l'UICN pour l'Afrique de l'Ouest. J'ajoute encore, comme vous le savez tous, que mon très efficace Responsable de Programme de ces deux dernières années, Greg Overton, quitte le Continent des éléphants pour l'île de Madagascar. Je sais que vous vous joignez à moi pour remercier Greg, pour tout le travail accompli et lui souhaiter bonne chance au moment où il s'aventure dans une vie "au-delà des éléphants".

LETTER FROM THE EDITOR

For all of you who are unaware, this will be my last edition of *Pachyderm* as editor. I will be shortly taking up new challenges in the completely different arena of biodiversity conservation, in Madagascar. For those elephant and rhino people scratching your heads, yes, there is conservation outside large mammals, although it may not be as glamorous.

First of all, I would like to say that it has been interesting and enjoyable working with each of you with whom I have had a chance to interact. I have had the pleasant opportunity to read the interesting material that has come through the door of this office over the past two years.

Because elephants are highly charismatic megafauna, every aspect of their conservation is highly charged, both politically and emotionally. More so it seems, than with any other species. People of all walks of life have an opinion on elephants, especially those working in their conservation. It has been interesting listening to the various arguments and points of view on how best to conserve elephants, but also very difficult to remain outside the fray as everyone would like to draw me into the debate. I think I have heard all points of view, varying from each extreme of the conservation spectrum, from use 'em or lose 'em to do not touch. These debates become particularly acuminate when discussing trade in elephant ivory or trophy hunting of elephants.

While acting as editor over the past couple of years, I have noticed a disturbing partiality surrounding elephant conservation and the trade in ivory, which I would like to take a little editorial prerogative here, particularly since I am leaving, and expound upon. Because the question surrounding trade in ivory has become so highly political and emotional, I feel that many people and organisations concerned with elephants have lost sight of the ultimate goal, which is to do what is best for the elephant.

Since the CITES Convention of Parties 10 decision to downlist the elephant populations for Namibia, Botswana and Zimbabwe to Appendix II, which allows the one-off trade in ivory to Japan, there has been a huge campaign to reverse this decision based often times on false information. One example comes from a country in Africa where the national authority for wildlife management has deliberately passed along information that the trade in ivory is to re-open in Africa (it is **NOT** — see the AfESG Chair report in *Pachyderm* 24), even when they know that this information is

incorrect. The hope seems to be that it will stimulate a huge public outcry and justify their position against the trade. While they may gain public support for their position, what also may occur is that poachers are given the green light and will recommence killing elephants for ivory, thinking that trade is legal once again. Is this their goal, to increase poaching levels, perhaps even to previously unmanageable levels just to say “I told you so”?

Another example is the maelstrom which currently surrounds the CITES monitoring system to Monitor the Illegal Killing of Elephants (MIKE). Many are trying to sabotage the development and implementation of the system because it is perceived to be linked with the eventual one-off trade by the three southern African nations in ivory. An Africa-wide monitoring system for elephants is needed, regardless of whether trade occurs or not. Why destroy something that will ultimately benefit elephant conservation just because it is attached to the CITES decision? Regardless of the decision to trade or not to trade, a monitoring system must be put in place for future management decisions. Sure there are problems with the system, but what continent-wide system will not have problems? It is a start in the right direction, and the system can evolve to better fit the needs of CITES and the countries involved. Should something beneficial for elephant conservation be destroyed on the hope that it MIGHT stop the one-off sale of ivory?

The decision on whether trade is resumed or not must be based on scientific evidence that it is either beneficial or harmful for elephant conservation. If it is demonstrated that the resumption of trade in ivory is resulting in increasing poaching levels and that elephant conservation efforts are suffering, than I could not agree more with those opposed — stop the trade. However, if trade is shown to benefit conservation efforts, than I would agree with those supporting trade — reopen the trade. I would like to see the problem examined a little more rationally and in an unbiased nature before a decision is taken. As scientists, everyone needs to maintain objectivity and a certain scientific rigor when analysing any situation, and this pertains to the trade in ivory as well as any other issue. I surely hope that people have not lost site of the “forest for the trees”, and that elephant conservation is still the number one priority out there — not personal or political agendas.

Note: the views expressed in this editorial in no way reflect the opinions or policies of IUCN or the African Elephant Specialist Group.

COMPARISON OF FOUR DIFFERENT RADIO TRANSMITTER ATTACHMENTS ON BLACK RHINO IN MADIKWE GAME RESERVE

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ABSTRACT

A total of 17 black rhinos (*Diceros bicornis minor*) were collared or eartagged with four different radio tagging techniques before release into Madikwe Game Reserve in June 1996, October 1996 and August 1997. Results are compared and recommendations made after 29 months of continuous monitoring of the different radio tagging techniques.

RESUME

Au total, 17 rhinos noir (*Diceros bicornis minor*) ont été soumis au port de collier à travers quatre différentes techniques de radio tagging avant d'être lâchés dans la réserve de Madikwe en Juin 1996, Octobre 1996, et Août 1997. Les résultats ont été comparés et des recommandations ont été formulées après 29 mois de suivi continu des différentes techniques de radio tagging.

INTRODUCTION

In June 1996 nine black rhinos were translocated from Pilanesberg National Park to Madikwe Game Reserve -both protected areas are situated in the North West Province of South Africa. In October 1996 ten black rhinos were translocated from Umfolozi Game Reserve in Kwazulu-Natal to Madikwe Game Reserve. In August 1997 another five female black rhinos were introduced from the Umfolozi/Hluhluwe Park in Kwazulu Natal.

The North West Parks Board is committed to conserving black rhinos in its parks. Madikwe was recently established and considered to be ideal for black rhino introductions because of its large size and suitable rhino habitat. The management of Madikwe Game Reserve accepted that intense post release monitoring is essential for the long-term management of the black rhino population, and failures and successes must be documented for future reference to improve continuously our knowledge and efficiency with black rhino translocations.

Similar attempts to attach radio tracking devices to black rhinos for intensive post release monitoring has been implemented in other countries such as Zimbabwe (du Toit, pers comm; Kock, pers comm), Namibia (Erb, pers comm) and other parks within South Africa (Morkel, pers comm). All such attempts have had failures and successes, but overall, radio telemetry attachments in the form of collars and eartags have not had significant successes due to the

problems described in the text below (Morkel, pers comm.; du Toit, pers comm.).

Each black rhino has detailed records in a master file, called an "identikit", and has its ears individually notched for identification. Madikwe has extensive areas of dense bush, so to aid in the rapid and effective monitoring of each rhino it was decided to attach radio transmitters to as many rhinos as possible before release.

Radio transmitters are notoriously difficult to attach to the neck of a black rhino because of their unusual neck shape (triangular and continuous with the top of the skull). Eartags have not remained attached for any significant time and have so far proven to be of little value in long-term radio telemetry monitoring of black rhino (Morkel, pers comm).

To determine what types of radio telemetry systems may best work for black rhino monitoring, four different radio transmitter types were used on 17 black rhinos. The goal of this study was to improve designs and techniques of attaching radio telemetry equipment to black rhinos for post release monitoring.

Horn implants were not used because the horns of most of the rhinos introduced into the Reserve were too small to fit implants, and there were no implants available at the time of the translocations. Therefore, no comment can be made on the success of horn implants compared to the radio transmitters used during this project.

DESCRIPTION OF TRANSMITTER TYPES

Two Logicpulse (TM) eartag transmitters manufactured by Merlin Systems, Inc - USA were attached to a male and a female black rhino in June 1996. These animals were released directly into Madikwe without a borma period. The transmitters had a pulse period of 1.5 seconds and were activated between 6am and 6pm on Monday, Tuesday, Thursday and Friday. The eartag consisted of a battery/transmitter disk with a 10cm long antenna. The transmitter was bolted on to another disk through a hole in the ear. The tag was 2.5cm deep and 15cm in diameter. No photo or drawing is available for this design.

Two collars made by Wildlife Decision Support Systems- Pretoria, South Africa, hereafter referred to as the McKenzie collars, were fitted on a male and female rhino in June 1996 and free-released into

Madikwe (Figure 1).

Twelve collars were designed by Dr Markus Hofmeyr and Mr Gus van Dyk - both from the North West Parks Board and are referred to here as the Hofmeyr and van Dyk collars. A Telonics MMK4 or MMK6 transmitter with a D-size lithium battery was imbedded in dental acrylic (Vertex Self-Cure Dental Acrylic). The hot and cold antennae were embedded between two layers of 3cm wide canvas machine belting (supplied by SA Belting supplies [Pty]). A 15 to 35cm special elastic horse girth strip (also 3cm wide) joined the ends of the belting. After the neck of the rhino was measured, the collar was completed and slipped over the head of the rhino to fit snugly behind the head. Two males had collars attached in June 1996 and were free-released into Madikwe. Two males and three females had these collars attached in October 1996 while still in the bomas, before their release into Madikwe. Five females had their collars fitted in July 1997 in the bomas in Umfolozi Game Reserve before being released directly into the

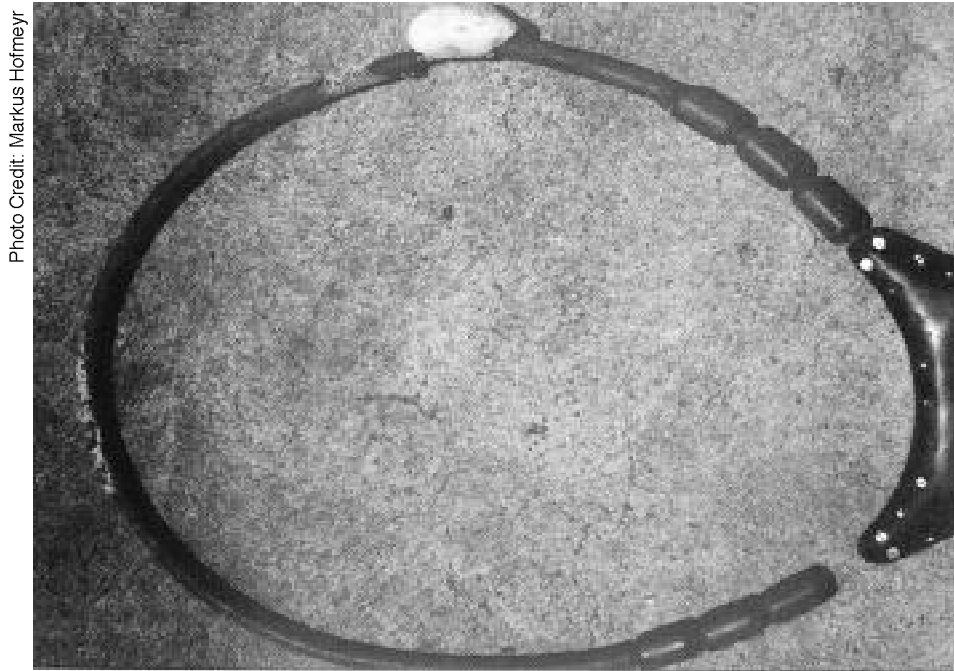


Photo Credit: Markus Hofmeyr

Figure 1. McKenzie collar.

A Telonics MMK 6 transmitter with a D-size lithium battery was placed in a pre-set acrylic casing. The casing was glued together after the transmitter/battery unit was placed in one side of the casing. The collar consisted of a steel cable fitted in acrylic beads. The cable ends were bolted around the rhino neck after a snug fit was obtained just behind the head.

in Madikwe in August 1997. The last five collars were fitted after attempts had been made to rectify the faults found in the original seven collars (Figures 2,3 and 4).

One collar designed by Ms Keryn Adcock, freelance ecologist specialising in black rhino ecology was

Photo Credit: Markus Hofmeyr

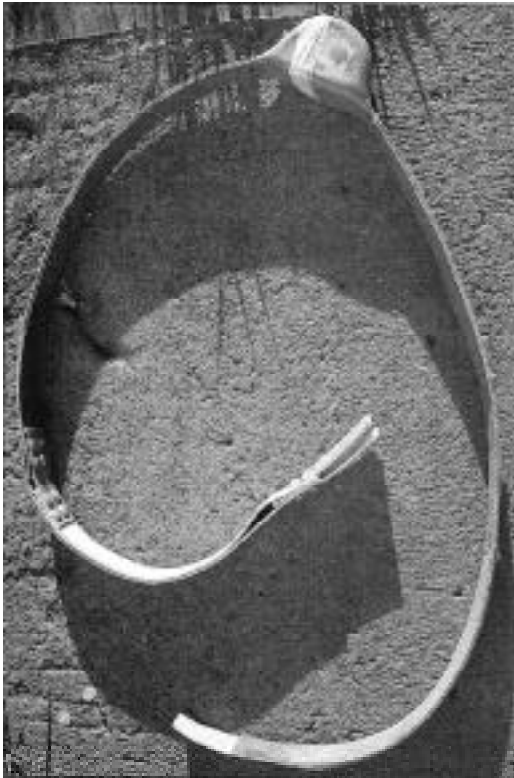


Figure 2. Photo of the Hofmeyr and van Dyk collar.

Photo Credit: Markus Hofmeyr



Figure 3. Fit of the Hofmeyr and van Dyk collar.

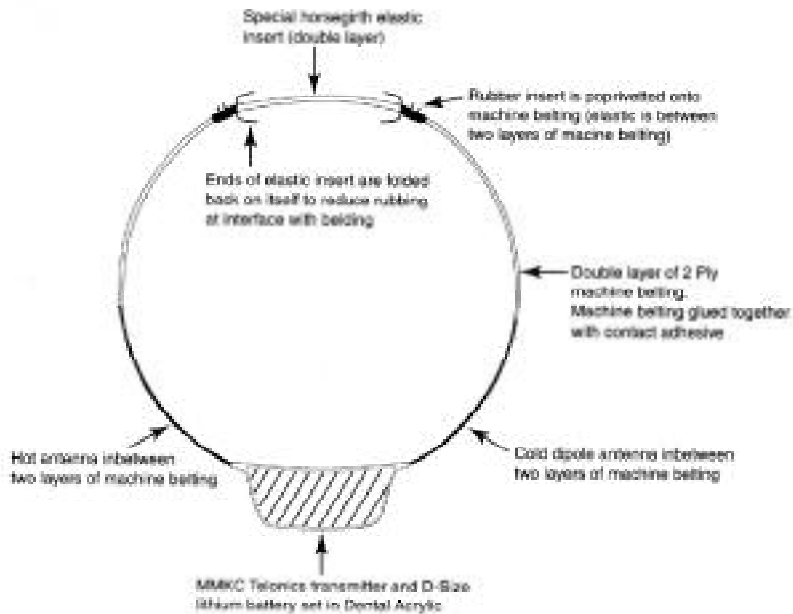


Figure 4. Diagram of the Hofmeyr and van Dyk collar.

placed on a female rhino in October 1996 and is referred to as the Adcock collar (Figure 5.). The rhino died within a week after release and will only be referred to in the text for reference only. This collar was not tested under the circumstances.

All collars had a 50cm 'hot' (this comes from the antenna port on the transmitter) and 'cold' (this comes from the negative, ie. from the battery) antenna. Receiving equipment consisted of a TR4 Telonics receiver with a Telonics 'rubber duck' antenna. The transmitter frequency range was between 148 to 149.5 MHz. All telemetry monitoring took place on foot or from a vehicle. Hills were frequently climbed to obtain



Figure 5. Photo of the Adcock collar.

optimum range.

RESULTS OF DIFFERENT TRANSMITTER *Disadvantages* TYPES

A brief summary of the advantages and disadvantages are given which became apparent during the monitoring period from fitting of the collar (indicated in brackets) **to** the date of this article. Telemetry monitoring took place randomly for 22 **to** 28 days every month. Range distances for the signal apply for ground telemetry only - aerial telemetry was not used.

Eartag

This method was applied to one male and one female rhino in June 1996.

Advantages

- small and lightweight.
- aesthetically acceptable.
- no visible irritation to the rhino.
- quick to apply.
- eartags still attached **to** the ear after ten months with no visible lesions or irritation to the ear.

Disadvantages

- slow pulse frequency resulted in poor localisation of the signal.
- duty cycle impractical, which resulted in difficulty locating the actual
- transmitter. transmission range is a third of the range of a collar-fitted transmitter. Under optimal conditions a 3km range was obtained. Range was always less than 1km on flat ground in wooded terrain.
- short life of functional transmitter even with data cycle and slow pulse frequency (date last signal recorded- 19/9/96 and 10/11/96 respectively for the two eartags transmitters). The functional transmitter life for the eartags was four months and six months respectively. The eartag transmitter came out of the

ear of the female after ten months and after 11 months in the male.

- signal transmission was irregular and not constant to a set frequency i.e., a receiver had to be fine-tuned at each recording to obtain the best signal.
- signal transmission was severely affected by body movements of the rhino and frequently could not be picked up from a constant receiving position.

Comments

Eartags are ideal for small reserves especially if aerial telemetry is used, but are not suitable for ground telemetry in larger reserves due to the disadvantages mentioned above. Considerably more time was spent locating eartag transmitters than collar transmitters (recordings were taken once a week as compared to daily recordings for the collars). Poor range and weak signal also make the eartags unsuitable for ground telemetry. One eartag obtained a nick in the antenna soon after the rhino's release, which resulted in halving the already poor range.

The eartags proved motto fulfill the requirements of intense post release monitoring because of the few records and intense searches for the rhinos with eartags. They did supply limited data but rhinos without radio transmitters were seen more frequently than these two rhino. The effort used to fond these two rhinos could have been better for tracking rhinos without radio transmitters.

Adcock collar

This collar was fitted to one female in October 1996.

Comments

Unfortunately this collar was placed on a rhino which died one week after its release. No reliable data could be collected within such a short monitoring period. Further testing is necessary but this collar type could work. Good signal strength and range were obtained from the few days of monitoring.

McKenzie collar

This collar was fitted to one male and one female in June 1996.

Advantages

- fairly easy to fit.
- sits snugly just behind the neck without any signs of visible irritation to the neck.
- aesthetically very pleasing, can hardly be seen on the neck.
- good signal strength and range (optimum conditions -10km range), signal is also very constant.

- durable.

Disadvantages

- no elasticity in collar, can only remove it manually, could damage the rhino if it grows into the collar or if the collar gets hooked onto a solid object.
- both collars stopped transmitting well before the expected battery life should have expired due to water leaking into transmitter housing via the antenna cable and rusting the battery and antenna connections, causing the transmitter to stop transmitting. Collars stopped transmitting two weeks and six months after attachment to the rhino.
- need to re-immobilise the animal to remove the collar.

Comments

This collar technique could work well if the battery problems can be rectified. It is aesthetically acceptable, and after ten months of attachment no visible lesions or irritation could be seen. The first collar on the female came off after four months. The second collar on the male came off after eight months. The fact that there is no elasticity does predispose the collar to problems, because the rhino may grow or get caught on a branch and damage itself. The rhino needs to be frequently monitored and the collar removed if necessary.

This collar design did allow for the intense post release monitoring of rhinos with minimal effort and was ideal when considering the range and signal strength.

Hofmeyr and van Dyk collar

This collar was fitted to two males in June 1996 and to four females and two males in October 1996 and again to five adult females in July 1997.

Advantages

- easy to attach once the collar is fully made up
- elastic insert allows collar to expand or shrink which allows a snug fit with no visible irritation to the rhino
- aesthetically acceptable
- durable
- very good signal strength, range and consistency (optimum conditions - 15km range)
- if the collar should catch on a rigid object the elasticity allows it to give or even come off if necessary
- elastic insert will most likely perish with time so that immobilisation will not be necessary to remove the collar. The elastic is expected to last for up to two years, which is slightly shorter than the expected battery life.

Disadvantages

- essential that snug fit is obtained when the neck is at its maximum diameter, as a loose collar will easily come off.
- if too tight (eg. if the animal grows), the collar could cause lesions on the neck.
- if the elastic insert is too long it tends **to** break easily and also allows the collar to come off easily if the rhino frequently robs itself on its neck.
- the attachment of the rubber insert to the belting is the weak link in the collar. All except one collar that came off was a result of the rubber tearing at the attachment either from excessive force or continuous rubbing. Two collars slipped over the head of the rhino because they were attached too loosely.

Comments

Two collars attached in July 1997 are still attached at the date of this article being written (15 months later). Both collars still fit snugly and no visible lesions or irritations are present. Two of the collars remained attached for 18 and 19 months respectively. The rubber attachment broke at those times, which resulted in the collars coming off. This was considered an advantage because the transmitters were recovered without having to re-immobilize the animal.

The above-mentioned collar, which remained attached for 19 months, did cause some discomfort to the rhino. It was a male animal which appeared to have had a fight with another rhino in September 1997. The rhino obtained a head wound and the collar was pulled diagonally over the right ear and into the head wound. The collar remained in this position and prevented the wound from healing. The rhino was darted on foot, and the collar proved **to** be essential as the rhino ran five kilometres before becoming immobilised. Without the collar, this animal would not have been found because of the difficult terrain. The collar was removed and the wound cleaned. The wound has appeared to heal properly (Figure 6).

This incident highlights the importance of regularly checking on radio collared animals **to** monitor any negative impacts the collars may have on the rhino. Fortunately, darting on foot is possible without too much risk of losing the animal. This in turn reduces the cost of darting, because the expense of an aircraft can be saved.

One of the collars attached to a male in October 1996 came off after six weeks. This collar was visibly loose when attached and the rhino lost condition after



Photo Credit: Markus Hofmeyr

Figure 6. Wound caused by fighting and irritated by the collar.

his release, which resulted in the collar becoming even looser. The collar first moved diagonally across the head (fitting behind the eye and between the ears across the bottom of the jaw) where it remained for four days without any visible signs of irritation to the rhino. It came off on the fifth day.

Two female rhinos with collars died within one week of their release, but both rhino had their collars still attached at the time of death.

Two collars attached to rhinos in October 1996 lost their collars at four months and five months respectively after attachment. Both these collars broke off. Both breaks were situated at the attachment of the rubber insert into the machine belting. This is the weakest point of the collar. If the insert were shorter, breakage may have been prevented. In future the rubber insert will only be 15cm long and will be situated on the top of the neck because robbing is unlikely to affect this part of the collar. The fact that the collars broke indicates that both collars were under a fair amount of stress when this happened. For the requirements of this study the design fulfilled its purpose by breaking, because if it did not break the rhino may have been injured. The collars did, however, remain on the two rhinos long enough to determine their home ranges.

The collar fitting technique recommended after the initial trial of seven collars was used on five rhinos released in to the Reserve in August 1997. The technique was refined from the original seven Hofmeyr and van Dyk collars and attempts were made to avoid the mistakes which occurred during the fitting of the collars in the trial period.

The new collars were made out of machine belting (supplied by SA Belting Supplies [Pty]) 3.5cm wide. The transmitter and battery were set in dental acrylic (Vertex Self-Cure Dental Acrylic) and attached to the belting. The transmitter had a 50cm hot and cold antenna. The two antennas were placed and glued between two layers of 2-ply belting with contact adhesive. An elastic insert (special horse girth with a width of 3.5cm) with a maximum length of 15cm was attached to one end of the belting and the other end was secured to the belting once the collar had been measured around the neck of the rhino. The elastic was doubled up and fastened to the belting with pop rivets. Care was taken to affix the elastic insert in such a manner that it lay on top of the neck of the rhino once attached and not on the side of the neck.

The collar was put around the neck of the rhino after a snug fit was obtained with the rhino lying in a relaxed position - i.e., the neck must be stretched out and the head must be lying freely on the ground. If the animal becomes immobilised while head pressing or with its head pressed up against an object, then the neck measurement becomes unreliable due to the huge difference in the diameter of the neck. The key to attaching these collars successfully is to fit them snugly while the neck is in its most relaxed state (i.e. when the neck diameter is at its minimum).

A properly fitted collar sits just behind the jaw and in the neck fold immediately behind the ear base. The collar must sit tightly, but with at least a thumb width between the collar and the neck. The elastic band must be in a position where it is just about stretching.

Of the five collars fitted in July 1997, one was removed after two weeks while the female was still in the boma, as the rhino developed a skin reaction. The collars were all made one night before the being attached to the rhinos. Each collar was painted black with 'AEROLAK LACR-SPRAY', a quick drying spray paint. The glue used to stick the collars was 'PATTEX' contact adhesive. The type of skin reaction was typical of an allergic reaction —redness, swelling, and itchiness, and the rhino rubbed itself raw on the lesion. The collar was removed a day before the rhino was released. Subsequent sightings of the rhino showed complete healing with no complications. This female was also pregnant at the time, and gave birth prematurely in the bomas before release. The calf died two days after birth. The fact that the female was far advanced in her pregnancy may have been a factor in her hypersensitivity to the collar or its components.

Two of the collars came off after seven and ten months respectively. One was possibly broken off during a fight (deduction made from tracks in the area where the collar was found), and broke off at the joint of the rubber and belting. The second collar was found with the rubber again torn at the joint of the belting and the rubber insert. Excessive rubbing may have caused this collar to break.

Final results indicate that this collar design may work well with black rhinos. The collar fit and length of the elastic insert are important for this collar to stay in place, i.e. the collar needs to fit snugly just behind the head with a short elastic insert (maximum 15cm in length) situated at the top of the neck. The North West Parks Board will continue to use this design on black rhino to test its reliability fully.

An additional three collars of this type were attached to three black rhinos in Kruger National Park using the same attachment technique as described above. No complications have been reported to date and a similar result as was achieved in Madikwe has been attained in Kruger National Park. One collar broke off after seven months and one is still attached. The third collar stopped transmitting after a few months and has not been found.

Another useful function of this collaring technique was fitting it to a sick rhino. A sick black rhino was darted on foot in Madikwe and the collar fitted during the immobilisation. The animal was then monitored closely on a daily basis after receiving treatment. Unfortunately the rhino died two weeks later, but the collar proved to be useful and was still attached snugly when the rhino died.

This collar design was also tried on an injured white rhino in Pilanesberg National Park (van Dyk, pers corn) and it came off after four months. No lesions were visible on the rhino's neck. The collar fit was slightly loose, and this may have been the reason it came off. The rhino could, however, be monitored closely on a daily basis. This particular rhino was darted three times for follow-up treatment, and darting would not have been possible if the rhino was released without the collar due to the difficult terrain. In addition, this collar design did allow for an intense post release monitoring of rhino with minimal effort, and was ideal while they were working when considering signal range and strength.

DISCUSSION

An interesting problem became apparent while collaring the rhinos. The neck size of a black rhino can change by up to 15cm depending on its posture at any one time. This needs to be taken into consideration when fitting any collar. Ideally the collar needs to be fitted snugly when the neck is at its minimum diameter. Some of the rhinos headpressed against the boma wall during the immobilisation phase when the collars were attached. When the animals headpressed the neck diameter was at its maximum, and this became apparent when the rhinos awoke and relaxed their necks, causing a tight fitting collar to become loose. The overall condition of the rhino also influences the diameter of the neck. In all cases the collars were loose with condition loss and fitted snugly after the condition improved. Based on these findings, it is questionable if fixed collars are at all ideal for rhino because of their varying neck diameter as discussed above.

Collar summary

- Collar transmitters gave greater signal strength, consistency and range than the eartag transmitters.
- Eartag transmitters were found not to be ideal for ground telemetry in Madikwe.
- McKenzie collars could be promising if transmitting life could be extended.
- Hofmeyr and van Dyk collars show promising preliminary results and these are recommended for trials in other parks and reserves on black rhinos.
- Neck diameter variability is an important consideration when attaching collars.

The results of the different collaring techniques are summarised in Table 1.

CONCLUSION

The Hofmeyr and van Dyk collar technique was tested most extensively in Madikwe Game Reserve because the initial trials showed that it was a potentially useful technique.

The recommended collaring technique from the trials is the Hofmeyr and van Dyk collar. If attached correctly the collar can stay on the rhino for up to 19 months. There are inherent weak points, which reduces the attachment time. All except one collar of this design broke off at the attachment of the rubber insert and the belting. If more rhinos are collared in Madikwe Game Reserve, then this technique will be used with the as yet untested strengthened joint of the rubber insert and the belting.

The above mentioned collar technique has shown similar and improved results compared with other collaring techniques elsewhere in Africa (Morkel, du Toit, Kock and Adcock, pers comm).

Only two rhinos reacted to the collar negatively and no life threatening side effects were seen on any of the collars. The telemetry information obtained from the radio tagging devices has provided the Reserve management with invaluable information regarding the post release movements and population dynamics of the released rhinos. Without the aid of radio telemetry, little post release data would have been collected because of the difficult terrain to monitor the rhinos in Madikwe.

The Hofmeyr and van Dyk collaring technique is recommended for other parks in Africa and could be used on other rhino species in Africa and in Asia. Further improvement of the technique must be researched and compared to the horn implant as a radio tracking attachment in black rhino.

Table 1: Summary of success or failure of the initial collars attached to rhino

Rhino name	Collar Type	Duration of transmission	Optimum transmitting distance	Comments attachment distance
Totolina	EARTAG	4 months	3km	Did not give good results in Madikwe; attachment time good
Hansa	EARTAG	6 months	3km	Did not give good results in Madikwe; attachment time for eartag transmitter.
Hughey	MCK collar	6 months	10km	Water leaked to the battery and connection to transmitter rusted, cable rusted and broke off resulting in collar coming off the rhino
Buglehorn	MCK collar	2 weeks	7km	Same problem as above; collar assembly not good because of water leakage and rusting.
Female 1	ADK collar	N/A	10km	Rhino died within one week of release with collar still attached
Female 2	H & vD collar	N/A	15km	Rhino died within one week of release with collar still attached
Female 3	H & vD collar	N/A	15km	Rhino died within one week of release with collar still attached
Maoka	H & vD collar	Still transmitting after collar came off	15km	Collar was visibly loose when attached and had a 25cm elastic insert, collar came off intact.
Champion	H & vD collar	As above	15km	Collar visibly loose and had a 20cm elastic insert, collar broke off at elastic attachment to belting; elastic on side of neck.
Tholo	H & vD collar	As above	15km	Collar was visibly loose when attached and had a 20cm elastic insert, the collar broke off at elastic attachment to belting, elastic on side of neck.
(*)George	H & vD collar	As above	10km	Collar broke off at elastic attachment to belting, elastic visibly perished; rhino immobilised after collar attached for 15 months to treat superficial wounds caused by collar irritating wounds caused by fighting; no complications and wounds healed quickly, ground darting with the aid of telemetry.
Mpofu	H & vD collar	As above	15km	No complications noticed to date; first collar attached with snug fit and 15cm elastic insert, correct fit. Rubber insert perished.
Mimapinda	H & vD collar	As above	15km	No complications experienced to date, released August 1997 in Madikwe (free-release).

Table 1. Continued

Rhino name	Collar Type	Duration of	Duration of	Optimum	Comments
		transmission	transmission	transmission	attachment distance
		distance	distance	distance	
Kwezi	H & vD collar	As above	7 months	15km	No complications experienced, collar fitted while rhino was headpressing and collar fitted very tightly in that position, once the rhino relaxed the collar fitted snugly. From evidence from tracks she may have been in a fight which resulted in the collar breaking off.
Zondo	H & vD collar	As above	10 months	15km	No complications, free release into Madikwe, 2 Aug 1997. Collar broke off at join of belting and rubber insert. Extensive rubbing may have been the cause.
Punana	H & vD collar	As above	Still attached	15km	No complications; free-released into Madikwe 20 August 1997.
Ester**	H & vD collar	As above	2 weeks	15km	Removed while still in bomas at capture site (Umfoloji G.R.) because of skin reaction to paint or glue from collar; lesions superficial and disappeared once collar was removed.

Note:

- MCK collar = MCKENZIE COLLAR; ADK collar = ADCOCK COLLAR; H & vD collar = HOFMEYRAND VAN DYK COLLAR.
- Optimum transmitting distance refers to the maximum distance over which radio transmitter signals were received with a Telonics TR4 receiver. Only ground based telemetry was used, and optimum transmitting distance indicates distances obtained under field conditions. Greater distances are expected if radio telemetry is done from an aircraft.
- Duration of transmission indicates actual transmitting periods of transmitters while attached to the rhino. Some of the collars came off before the expected battery life expired.
- Duration of attachment refers to the time the collar stayed on the rhino.
- (*) The collar on 'George' slipped into a wound, which was caused by fighting with another rhino. The collar may have been pulled into the wound, which was in front of the right ear, by the actual fight. The wound was very superficial but the collar irritated it so that it would not heal. The rhino was darted on foot and the collar was placed back around the neck. The collar looked in good condition. The wound healed within a week without complications.
- (**) One collar was removed from a female rhino due to be released in Madikwe. She showed a skin reaction two weeks after the collar was attached to the animal.

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Mr Gus van Dyk from Pilanesberg National Park spent many hours helping me make and design the Hofmeyr and van Dyk collars and I thank him sincerely for his advice and help. Lastly, I would like to thank the Management of Madikwe Game Reserve for supporting the project and allowing me **to** do this work.

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DEDICATED FIELD STAFF CONTINUE TO COMBAT RHINO POACHING IN ASSAM

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RESUME

L'état d'Assam dans le Nord - Est de l'Inde, abrite 69% des grands animaux à come unique du monde, que sont les rhinos, *Rhinoceros unicornis*. Aujourd'hui, la population totale des rhinos en Assam, est estimée à 1406 individus (voir tableau 1). Ce rapport examine les récents incidents du braconnage sur les quatre principales zones des rhinos en Assam (voir le tableau 2 et la carte) et souligne les efforts consentis pour la protection de ces rhinos. La nécessité d'étendre les aires de conservation de la faune en vue de réduire le nombre de rhinos isolés peut être aussi remarquée. Les problèmes majeurs autour de la conservation des rhinos, liés au manque de fonds pour la lutte contre le braconnage, le maintien et le développement, sont décrits avec un résumé des principales requêtes fournies par les agents de terrain, ainsi que des suggestions pour prévenir la croissance du braconnage. Ce document est basé sur un travail de terrain, conduit en Inde en Janvier 1998.

INTRODUCTION

The state of Assam in north-east India is home to 69% of the world's wild greater one-homed (or Indian) rhino, *Rhinoceros unicornis*. Today's population in Assam totals an estimated 1,406 rhinos (see Table 1). This paper will examine recent poaching incidents in Assam's four main rhino areas (see Table 2 and see map) and will highlight efforts to protect these rhinos.

The need to expand wildlife areas in order to reduce the number of straying rhinos will also be looked at. The major problems facing rhino conservation which result from lack of funds for anti-poaching, maintenance and development, will be outlined, with a summary of the main requirements as provided by field staff and suggestions to prevent an increase in poaching. This paper is based on fieldwork carried out in India in January 1998.

Table 1. Estimated number of rhinos in Assam.

	Kaziranga	Pabitora	Orang	Manas	Laokhowa	Other areas	Total
1993	1,164*	56*	100	60(?)	0	25	1,405
1995	1,200	68*	90	20	0	20	1,398
1997	1,250	76*	45	5	5	25	1,406

* Census

NB These figures exclude the rhinos in the Assam State Zoo.

RHINO POACHING AND EFFORTS TO STOP IT

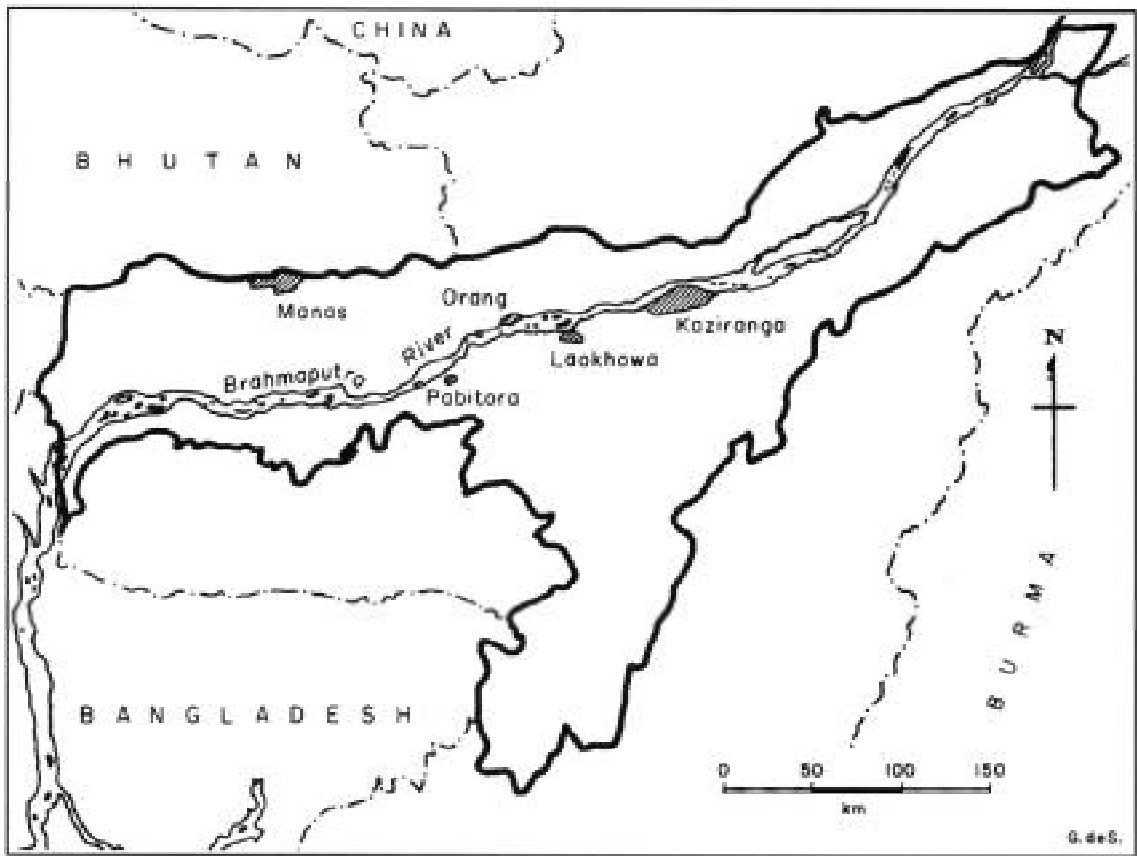
Kazingira National Park

There are approximately 1,250 rhinos in Kaziranga National Park, which is divided into west, central and eastern ranges, and each range has a range officer in charge of field staff and anti-poaching efforts. In 1997 only 12 rhinos were poached compared with 26 the year before. This was the lowest number of rhinos

poached since 1980, according to Assam Forest Department statistics (see also Table 3). The calibre of the range officer is pivotal to the Kaziranga National Park levels of poaching (see Table 4). In the past few years three of the finest range officers in the state have been posted there, which helps to explain the drop in poaching. In the western range, an excellent Range Officer, P. Sharma, in charge from 1993 to late 1997, reduced rhino poaching from 25 in 1992 and 20 in 1993 (when he arrived) to an average of five a year from 1994 to 1997. Two main strategies

Table 2. Number of rhinos poached in Assam.

	1993	1994	1995	1996	1997
Kaziranga	40	14	27	26	12
Pabitora	4	4	2	5	3
Orang	1	6	9	10	11
Manas	22	4	1	0	0
Laokhowa	0	0	0	0	0
Other areas	3	2	2	1	2
Total	70	30	41	42	28



Assam protected rhino areas in 1997

were to improve anti-poaching procedure and lift staff morale. He moved more anti-poaching patrol camps to the south boundary (30 on the fringe and 8 inside) and increased patrols to cover a maximum area, as opposed to “ambushing” (sitting and waiting), which was the previously preferred method. While his staff used elephants to patrol the whole area once a week, each morning they would check the boundary on foot. Sharma always kept the southern bank road clear for quick access, as this was vital to stop poachers. He

also kept paths clean According to Sharma, patrol paths need to be 2m wide and straight in order to see 200m ahead. Normally six labourers are required to clear a 1km path twice a year- in May before the monsoon and in October after the monsoon. When there were no funds for labourers, Sharma, his driver, the grass cutters and mahouts would clear it themselves, and Sharma would provide a big meal afterwards. Thatch is another essential requirement to prevent the camp roofs from leaking, and Sharma

always checked that thatch was collected. He motivated his men who increasingly felt anti-poaching was vital to save rhinos. Particularly important, his staff learned that no one would be placed under suspension if rhinos were poached, as before and in turn they became a motivated workforce.

Another method of reducing poaching was an improved intelligence network in the villages south of the range. An example of this occurred in July 1997. Two gunshots were heard early in the morning to the west of the Park and one of the carcasses was quickly found with its horn removed. The following morning two informers visited the Range Officer and told him where the poachers were hiding. At midnight five field staff and police armed with seven guns set off for the small reed house in the hills, 15km south of the Park. There, they found two .303 rifles, twenty-four rounds of ammunition and two horns, and arrested seven men (four local Karbi "tribals" and three from Manipur state). A Naga living in Dimapur town bordering Assam in Nagaland state had provided the guns. The

trying to poach a rhino in April 1994, during Sharma's tenure. Another was arrested crossing the river, but has since been released — a continuing problem with

In the Kaziranga central range, credit must be given to the Range Officer, B.N. Talukdar, for some outstanding anti-poaching encounters during his short tenure in 1995 and 1996. In the two months before his transfer, no poaching occurred. A third distinguished Range Officer, D.D. Boro, was transferred from the eastern range in December 1996 to the more important central region, and replaced Talukdar. As well as excellent patrolling, he improved the informant network with the help of NGO funding. For example, in April 1997 four informers told Boro about four poachers digging a pit to trap a rhino. In the encounter, the poachers fired and the field staff retaliated; one Assamese was killed. The informers were paid 1,000r (\$28) each while 4,000r (\$110) was given to the staff, the doctor for the post mortem and for burial costs. Boro's next encounter with poachers was in August 1997 when a Forest Guard saw footprints near the southern boundary; 12 staff in groups

Table 3. Rhino mortality in Kaziranga.

	Poaching			Natural death	Total mortality
	Pit	Gunshot	Total		
1995	6	21	27	53	80
1996	1	25	26	52	78
1997	6	6	12	48	60

Table 4. Encounters with poachers in Kaziranga.

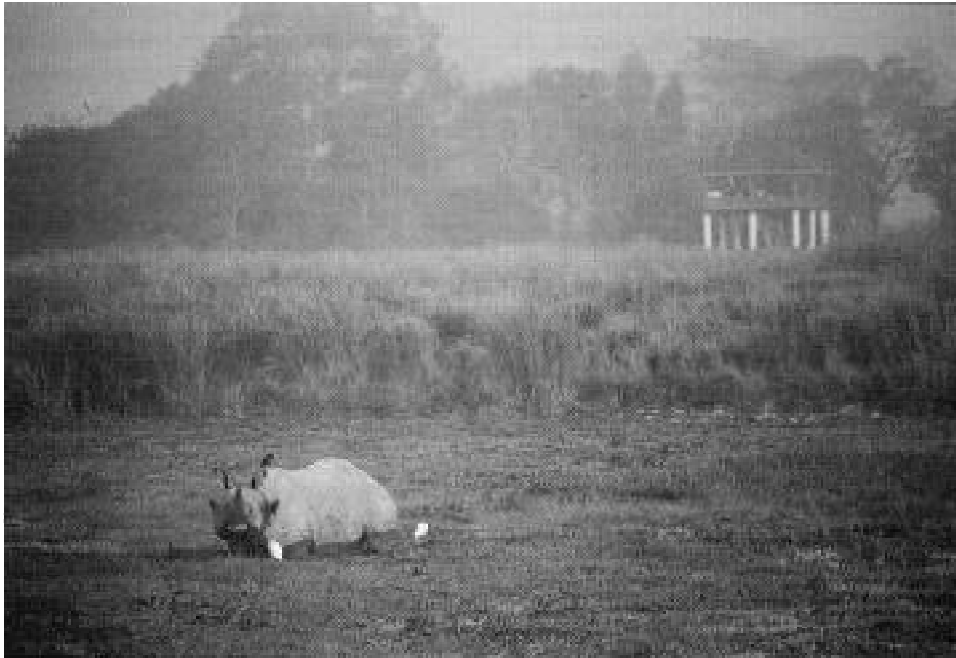
	Poachers killed	Poachers arrested	Arms recovered	Ammunition recovered	Horns recovered
1995	4	29	4	25	0
1996	9	19	7	71	0
1997	6	18	7	39	2

poachers were planning to take the horns back to him. This was one of the more successful captures in Kaziranga's history; the poachers are still in jail while the case continues. Sharma paid the two informers 10,000r (\$275) each. This capture reflects the importance of both good intelligence and close police relations, as outside the Park, police must be present on any raids. Both intelligence and police relations have improved around Kaziranga.

Sharma also helped to stop poaching from the north. An important poaching gang member living on the north side of the Park was killed in the Park while

of three silently patrolled the area. Four poachers with two .303 rifles began shooting, so the staff had to retaliate, killing one man who was carrying two tyre tubes (to cross a river), a torch, rice and a tarpaulin to sleep under. Through an informer, after one and a half months Boro found the dead poacher's wife who, with his children, initially denied recognizing his photo. Finally, the poacher's sister gave the names of two other farmers in the Karbi village who had been involved. Boro held a meeting in the village and the villagers themselves expelled the poachers. In December 1997 informers told Boro that more poachers were coming. He strategically placed his staff on the south boundary

Photo Credit: Lucy Vigne



the legal

The tourist platform in the background is a popular spot for viewing rhinos in Kaziranga, especially for people visiting by buses.

and at 1 :00am the staff saw torchlight and three poachers. One of the staff accidentally coughed and the poachers started firing. The ten forest guards were forced to retaliate until, 15 minutes later, there was no more firing from the poachers. All three were killed; they were Nagas. One had a .303 rifle while the others carried an axe, a bag of clothes, a torch, knife, and some rice. Boro paid the two informers 1,000r (\$28) each for their information and 6,000r (\$165) were spent on the poachers' burials, fuel, and for a staff party. Informers helped combat all these poaching attempts in Boro's range in 1997, demonstrating that intelligence is vital in preventing rhino poaching.

Although Boro is known to be tough in protecting his rhinos, he maintains a good rapport with the villagers. Like many villagers, he is a "tribal" himself - a member of Assam's Bodo tribe - and he relates to the villagers' problems. He threatens to kill poachers in self-defense if they enter the Park, but he also rewards them if they provide information. In this way, former poachers assist to break up poaching rings. Boro is dedicated to his work. Despite a monthly salary of 6,000r (\$158) in early 1998, he says, "My job is far more important than most as I am fighting to save a species". The rangers greatly respect Boro. He listens to his men and supports them as best he can; the staff are thus motivated under his strong leadership. In 1997 he built several temporary

camps for night patrollers and with limited funds he also put up three temporary watchtowers in the central grasslands which, he says, greatly contributed to reducing rhino poaching in his range in 1997. These temporary structures needed replacing by 1998, which Boro had been unable to do at the start of the year due to lack of money.

Another reason for the poaching decrease in Kaziranga in 1997 was because the army was posted near the northern boundary of Kaziranga in January of that year to control militant activity. It had been suggested that poachers and militants were involved together. Army and police operations, mainly in the form of roadblocks, led to 18 firearms, mostly .303 rifles, being confiscated in 1997 from suspected poachers on the north bank. This assisted in stopping poaching in northern Kaziranga that year. The presence of the army combating insurgents has thus benefited the rhinos.

According to the field staff, poaching may have declined in 1997 due to improved relations with the local people. In 1997 they were given assistance, including the development of wells for drinking water and the donation of footballs. Working from the grass roots up, regular meetings with the villagers are being held for discussions on their needs, and videos are shown to motivate people to protect their rhinos.

Photo Credit: Lucy Vigne



The best way to see rhinos close-up in Kaziranga is on elephant back, as much of the Park is too wet or the grass too high for a vehicle.

Probably the most important reason for the decline in rhino poaching in Kaziranga in 1997 was the excellent anti-poaching work. Reduced poaching since the mid-1990s lifted staff morale, despite the financial shortages and hardships. Since late 1997 there are two new range officers, however, with only Boro remaining from before. It will be a challenging time ahead.

Pabitora Wildlife Sanctuary

About 22 of the 76 Pabitora rhinos presently wander out of the Sanctuary at night to graze due to limited space, but fewer than five rhinos are usually poached annually; thus the population is still increasing steadily. The new Range Officer, M. Barua, is young and dedicated, and he has reduced poaching to three incidents in 1997 compared with five the year before (see Table 5).

The first poaching incident in 1997 was in June after two important anti-poaching patrol camps had been washed out on the eastern boundary by the monsoon; three poachers then entered from the east with a .303 rifle and shot a rhino in a forested central region of the Sanctuary. The camp guards who heard the shot had no batteries for their radio and had to come on foot to

deliver the message, by which time the poachers had escaped with the horn. Informers say the gang leader sold the horn, which probably weighed about 550g, for 190,000r (\$5,234) in Dimapur (Nagaland), and paid his assistant poachers 25,000r (\$689) each, and fishermen, who monitored the staff movements from outside, 5,000-10,000r (\$138-\$275) each.

Then in November 1997 a gang of about ten, estimated by the number of footprints, shot a rhino about 8km west of Pabitora at 8:45pm and took the horn. The poachers had learned that the staff's rifles had been removed briefly for shooting practice. The police did not co-operate in making an inquiry, and the gang-leader is thought to have paid off the officer in charge.

A week later poachers again entered from the east where, due to lack of funds, the two camps still had not been re-built by January 1998. A rhino was poached again in the forested area in the centre of Pabitora. This forest grew up since 1991 when 1km² was fenced off for deer, *Cervus eldi eldi*, to be introduced. The project was cancelled, but the trees, especially *Albizia procera*, grew fast and the Forest Department prohibits tree felling. The area now provides a good refuge for

Photo Credit: Lucy Vigne



Mr DD Boro, Range Officer for Kaziranga's central range in 1997/8, supervises all field staff and domesticated elephants in his range.

Photo Credit: Lucy Vigne



A forest guard in Pabitora Wildlife Sanctuary examines his .315 calibre rifle, but many of the petrol staff do not have guns due to a shortage.

poachers. This time it was a different *gang* leader, who also has a .303 rifle, from the same village to the east. The gang leader took the horn from his village to Jagi Road (15km south) for a week, until the horn stopped smelling, and then smuggled it again to Dimapur where a rich man in an area of the town called Nehuku usually buys horns. There is even a third gang leader in this village east of Pabitora who uses a carbine for poaching rhinos. There is no solid evidence to arrest them yet due to a shortage of money for intelligence. They are all Moslem immigrants, as are most of the people around Pabitora (M. Barua, pers. comm.).

Increased mobility of the Range Officer in 1997 (checking twice a night that the camp staff are active) has motivated the staff to patrol more. As a result no rhinos were electrocuted compared with four in 1996 (the 11 kilowatt electric power lines which cross the area are used for this form of poaching). In 1997 forest guards detected and removed three electric wires hanging down from the power lines to electrocute rhinos. Informers led to the arrest of five people in the third electrocution attempt, including one local staff member who colluded with the poachers. Many power lines are used to pump water for the paddy fields surrounding the Sanctuary. The electricity board

to 97 by 1991 and in the early 1990s the rhino population was considered the second most viable in India (Menon, 1996). The main cause of this success was due to the effort of the previously mentioned B.N. Talukdar who served for five years as Range Officer in charge of the Sanctuary, and recorded "nil" poaching in 1990. Rhinos in Orang now are the most heavily threatened. The camps have only recently been partially refurbished since Bodos heavily looted the camps' arms and radios in 1994 (Martin, 1996). Furthermore, the police were pre-occupied with other issues in 1996 and less able to assist with anti-poaching efforts. The rhino population thus declined by more than half to perhaps 45 from the beginning of 1994 to 1997. The present Range Officer, P.K. Deka, is a dedicated man, but soon after his arrival in early 1997, eight rhinos were poached. He then constructed a cap on the southern boundary from where most poachers come, and 30 home guards with 24 rifles were brought in to protect Orang. As a result, from May to December 1997 only three rhinos were poached.

With police help, Deka arrested 16 culprits linked with poaching in 1997 outside the Sanctuary, nearly all local immigrant Moslems who often hire Naga shooters. The police became more active in 1997 as the present superintendent is interested in supporting Orang. Deka

Table 5. Rhino mortality in Pabitora.

	Bullet	Poaching Electrocution	Total	Natural deaths	Total mortality
1994	0	4	4	2	6
1995	2	0	2	1	3
1996	1	4	5	2	7
1997	3	0	3	2	5

employs local people to repair these lines so they know the techniques for electrocuting rhinos! They choose the 11 kilowatt lines, not the high tension lines as sparks would be seen from these. Regular patrolling to check for hanging wires is the only way to prevent this form of poaching.

In order to improve patrols in this road-less Sanctuary, Barua and his staff (due to lack of funds for labourers) have built 2.5km of road to allow easier access by vehicle into the north of the Sanctuary near the headquarters. Although Barua requires 30km of murrum road for more mobility in the Sanctuary, this first section of road is a positive start.

Orang Wildlife Sanctuary

Orang's rhinos increased in numbers from 65 in 1985

has no informant money, but his staff manage to collect some information on poachers when visiting the market, which has helped towards certain arrests. Most poachers use guns, but pit poaching is also common. In 1995 two rhinos were poached by putting insecticide into a wallow which the rhinos drank (see Table 6).

It is important that security inside Orang does not break down again, as a rhino population in a small sanctuary can quickly be obliterated. In November 1997 a camp was looted once more, this time probably by local Moslems. Although the staff try to remain dedicated, their morale has suffered increasingly, as criminals in the villages are becoming more of a threat with the weakening of Orang's defences. This is because Orang receives the least financial support of the four main rhino areas in Assam (see Table 7). In early 1998 there were eight camps out of 23 with no firearms, making it

Photo Credit: Esmond Martin



Camps in Pabitora Wildlife Sanctuary are in disrepair with leaking roofs and collapsing walls, while inside many of the forest guards sleep on the floor without mosquito nets, making conditions hard.

Photo Credit: Esmond Martin



In January 1998, Lucy Vigne was accompanied by five armed members of the Assam Police and two mahouts for a morning's elephant ride in Manas National Park due to civil unrest in the area.

impossible for the staff to patrol against armed poachers. Morale is further lowered as staff salaries are paid very erratically. The rhino patrolling staff were not paid for five months from May to September 1997. In November 1997 all salaries were cleared, but since then, had not been paid at least to January 1998. Some salaries are very low. Casual labourers who help patrol, some of whom have been working for over 15 years, get 675r (\$18) a month (Deka, pers. comm.), making it difficult to keep men motivated.

Orang isso severely ran down that it was officially kept closed at the start of the season in November 1997 due to damaged roads and bridges. The financial position is so desperate that, according to Deka, putting scarce resources into eco-development projects for better relations with the thousands of villagers seems futile. Instead, the atmosphere is one of a continuing battle against the many locals involved in poaching. It is a hard battle to win with the field staff's present meagre resources.

Manas National Park

Money has been flowing back into Manas to rehabilitate the Park, although it is too late for the present rhino population, which has been nearly obliterated. In March 1997, during a tiger census, fresh rhino dung was found for one animal, and in another area, a second rhino was

in 1997 with 177 left vacant (see Table 9). This is due to the refusal of men to take work in this dangerous area. Patrol work is presently carried out irregularly by staff in large groups who fear being killed by Bodos. Park management is helped by the fact that funding is improving once more and salaries are paid on time. As Manas is a World Heritage Site and a tiger reserve, extra funds from central government, Project Tiger and from the Biosphere Scheme, are provided, and there is planned funding from UNESCO.

The Park was closed from February 1989 to 1 October 1995, as it was over-run by Bodo militants. Since then, it has remained open except during the monsoons and for a brief time during the election period in early 1998 when the Assam Police could not be kept there to guard visitors (R. Agarwalla, Project Director Manas, pers comm.). Relations with the military and paramilitary forces are good and this helps to reduce poaching in general.

Anew and major concern has arisen in Manas, however. The Park being on the border of Bhutan can provide a route for smugglers of wildlife products; a road was completed in 1996, running through the middle of Manas and 13km into Bhutan. Its original function was to transport oranges to Assam and staple foods back to Bhutan, but the lorries (1,016 in 1997) smuggle wildlife over the border to sell in Bhutan,

Table 6. Rhino mortality in Orang.

	Poaching			Total	Natural deaths	Total mortality
	Bullet	Pit	Poison			
1991	1	0	0	1	2	3
1992	1	1	0	2	3	5
1993	0	1	0	1	2	3
1994	4	2	0	6	4	10
1995	6	1	2	9	7	16
1996	9	1	0	10	4	14
1997	10	1	0	11	3	14

sighted. There are approximately five rhinos left in the Park. There has been no evidence of rhino poaching inside Manas in 1996 or 1997, and only one carcass was found in 1996 (see Table 8). The official estimate of 60 rhinos in 1993 was probably an over-estimate, and there are, most likely, more rhinos poached recently than thought but the carcasses were never found due to the limited patrolling by the reduced number of staff. Park management is not as effective as in the 1980s. In 1989 there were 31 camps, but today there are only 17 (one every 26km²). Of the 472 staff positions sanctioned by the Forest Department, only 295 positions were filled

pollute and erode the Park and disturb the animals (Agarwalla, pers. comm.).

In order to reduce poaching pressure in Manas in the long term, 1,400,000r (\$39,128) were spent in 1996/7 on ecodevelopment projects. There are 60 villages on the southern border with about 25,000 people, 60% of whom are Bodos, who traditionally survive off the forest and its wild animal products, and need to be offered alternative and sustainable forms of livelihoods. This would help to protect Manas, and rhinos could then possibly be relocated there in the future.

Table 7. Budgets for the main rhino areas in Assam.

	Kaziranga	Pabitora	Orang	Manas
1992/3	15,284,039 r \$ 505,759		2,766,654 r \$ 91,550	19,210,000 r \$ 635,672
1993/4	17,939,499 r \$ 574,800		2,270,828 r \$72,760	20,530,000 r \$ 657,802
1994/5	19,981,829 r \$ 628,755		3,016,187 r \$ 94,908	20,010,000 r \$ 629,641
1995/6	24,399,945 r \$ 721,252	2,968,459 r \$ 87,746	2,591,031 r \$ 76,590	16,720,000 r \$ 494,236
1996/7	29,743,018 r \$ 831,275	3,623,886 r \$101,282	3,179,626 r \$ 88,866	20,160,000 r \$ 563,443
1997/8	21,591,698 r \$ 581,203			24,763,000 r \$ 666,568

NB Earlier figures for Orang were: 1989/90=3,888,169r, 1990/1=3,458,328r, and 1991/2=2,801,581r. Manas expenditure was: 1995/6= 1 3,455,000r and 1996/7= 23,425,000r.

STRAYING RHINOS FROM THE FOUR MAIN AREAS NEED PROTECTION FROM POACHERS

Kaziranga National Park

Six additions were proposed some years ago around Kaziranga to reduce the poaching and problem of rhinos straying out of the Park. In 1997, “addition one” of 43.8km² was fully notified to the west of Kaziranga connected to the Park’s 430 km². Rhinos are already moving into this area. It is hoped that “addition six” comprising the Brahmaputra river (376.5km²) will soon be under the Park’s control. This will help to prevent poachers entering from the north, and once the cattle are removed from the islands, will extend the rhino range

further. Presently, dozens of rhinos wander out of the Park for up to two or three months.

Pabitora Wildlife Sanctuary

Pabitora’s 16km² suffer from considerable pressure from the local villagers who bring their cattle into the Sanctuary daily to graze. Of the 70% of the Sanctuary covered in grasslands approximately 30% has been degraded due to overgrazing by livestock (Barua, 1997). Cattle numbers are down from over 15,000 in 1996 to 6,000 in early 1998 because cattle are now confined in pounds if caught illegally grazing and the owners are fined. If there were no cattle degrading the area, perhaps up to 10 rhinos would still need to go out of the Sanctuary every night to graze.

Table 8. Rhino Mortality in Manas

	Poaching (bullet)	Natural death	Total mortality
1990	1	3	4
1991	3	2	5
1992	11	4	15
1993	22	1	23
1994	4	0	4
1995	1	0	1
1996	0	1	1
1997	0	0	0
Total	42	11	53

Table 9. Staff for the main rhino areas in Assam in 1997.

	Sanctioned by Forest Dept.	Forest Dept. positions filled	Forest Dept. positions unfilled	Temp. staff	Total
Kaziranga	541	441	100	85	526
Pabitora	125	79	46	17	96
Orang	60	57	3	62	119
Manas	472	295	177	54	349
Total	1,198	872	326	218	1,090

NB Most of the staff work in the field.

With no cattle in the Sanctuary it could support 30 rhinos comfortably (M. Barua, pers. comm.). Therefore, either 15 rhinos should be moved, or an area to the north-west of the Sanctuary, proposed previously as an addition, should be incorporated. This potential addition of 38km² is government-owned land, and has no permanent inhabitants, but is used for rice paddies by the neighbouring communities. To the west of this area is a hill which would provide rhinos with much needed high ground in the annual floods, and to the north is the Brahmaputra river, a natural boundary. The decision to make this extension, which the Range Officer surveyed in 1997, lies with the state government.

Orang Wildlife Sanctuary

Orang's 78.8km² would be difficult to expand, as all surrounding land, including the river islands, is occupied. Ideally, the river islands on the southern side should be included in the Sanctuary to reduce the proximity of a heavy poachers' presence on that side, and to provide more grazing space to the rhinos. Presently, Orang has space and plenty of grassland for the current rhino population, due to their reduced numbers. If rhino numbers increase substantially, as is hoped, more space will be required.

Five rhinos wandered out of the Sanctuary and apparently arrived in Laohkowa Wildlife Sanctuary in October 1997, according to Deka. Laohkowa's rhino population was decimated in 1983 during a breakdown in law and order among the local Moslem immigrants. If rhinos can survive and breed in Laohkowa, the Sanctuary (covering 70km²) could become an important protected rhino area for surplus rhinos from Orang or elsewhere. As a note of caution, however, in early 1998 forest guards detected eight poaching pits, so the area is still far from secure.

Manas National Park

Manas, with its core area of 519km² and its buffer zone of 2,837km², is sufficiently large to reintroduce

rhinos from other parts of Assam in the future. As it is an important area for other rare species, including tigers, funding will be made available if relative stability is maintained. Rhinos once crossed to neighbouring Royal Manas National Park in Bhutan, which provided a natural addition of land of at least 439km². As late as December 1996, the Bhutanese Forest Officer said that four rhinos were still crossing over to Bhutan at night to graze in Royal Manas National Park. These four rhinos which strayed across the river have not been seen since and have probably been poached in Manas.

FINANCIAL PROBLEMS FACING THE ASSAM FOREST DEPARTMENT

According to the Principal Chief Conservator of Forests of Assam, P. Lahan, 1997 has been the worst year in over 30 years for official funding to the protected rhino areas of Assam. This is especially true of Kaziranga National Park which has 84% of all the rhinos in the state. Since the early 1990s, the budget for Kaziranga had increased in rupees and dollars every year from \$505,579 in 1992/3 to \$831,275 in 1996/7. However, the budget for the financial year 1997/8 in dollars was down by over 30% from the year before (see Table 7). Furthermore, studies have shown that for rhino conservation to be successful, large sums of money need to be spent per unit of protected area (Martin, 1996). For Kaziranga the official budget per square kilometre has been reduced from 69,170r (\$1,933) in 1996/7 to only 45,572r (\$1,227) for Kaziranga plus "addition one" for 1997/1998, over a 35% decline in dollar terms. The amount of money given for maintenance of roads, bridges and camps, and money to buy supplementary food for the departmental elephants has been severely reduced (Bezbaruah and Talukdar, 1997; Vigne and Martin, 1998). Even when a specific allocation is made available, it may take months for the money to reach the Park. Thus, sometimes salaries are paid months late and inoperable equipment remains unrepaired (see



Only eight elephants are able to patrol in Orang Wildlife Sanctuary as the other four working elephants presently have young calves.

Similarly, the budget for Orang Wildlife Sanctuary reached a recent high of 3,888,169r (\$230,752) in 1989/90, but by 1996/7 the budget was only 3, 179,626r (\$88,866), just 38% of the 1989/90 budget when converted into US dollars. As a result, there has been almost no maintenance for the Sanctuary. Lack of funds has led to the worst rhino poaching in Orang for any area in Assam since 1995.

The reason for the overall decline in the budgets for Kaziranga and Orang, and the even sharper reduction in money for development projects and routine maintenance in all four main rhino areas of Assam is due to problems of maintaining law and order. With the Bodos and others fighting in the western part of the state and the continued agitation from the United Liberation Front of Assam in the east near Kaziranga, the state government has had to spend more money to protect its citizens. Thus, budgets for government departments such as Forests have been reduced to pay for improved law enforcement.

Fortunately, NGOs have recently put relatively large sums of money and equipment into rhino areas. Since 1996, WWF India, the Environmental Investigation Agency, Care for the Wild, the Rhino Foundation and other smaller NGOs based in Assam have donated items such as vehicles, speed boats, uniforms and water filters. In 1997, the major NGO donors

provided at least \$41,000 to Kaziranga and \$21,000 to Manas. TRAFFIC India supplied in 1997 25,000r (\$689) for intelligence money for Kaziranga (according to M. Misra, the director), and WWF India donated 60,000r (\$1,653) each to Kaziranga and to Manas to set up intelligence networks (according to M.K. Ranjitsinh of WWF India).

Until the mid-1990s NGOs gave relatively little assistance to the rhino protected areas in Assam as the government budgets were considered to be adequate, and the state government did not request such assistance. Now, with worsening government budgets, the NGO contributions will increase in importance, which will be especially necessary for intelligence gathering and paying for information on poachers and traders in rhino horn.

RECOMMENDATIONS

1. Range officers in Orang, Pabitora and perhaps Laokhowa need intelligence money to set up informant networks and pay rewards for information. NGOs should provide this money, as accountability required by the state and central governments is difficult because informers' names must not be recorded in the accounts, to insure confidentiality. More intelligence funding is needed for Kaziranga.

2. Patrollers require more anti-poaching equipment, especially modern rifles, wireless sets, solar panels for re-charging batteries and good torches. Vehicles need to be repaired or replaced when broken and provided with more fuel.
3. Field staff, notably those living in the camps, should have adequate supplies of uniforms including boots and jackets, as well as mosquito nets, water filters, field kits etc. They should also be provided with food rations as an incentive to entrust them with rhino anti-poaching work. Other armed personnel, such as the Armed Forest Protection Force, the police and para-military force receive food rations and the anti-poaching staff should be provided with the same benefit (P. Sharma, pers. comm.). They should also be given medical assistance to motivate them in this stressful, hardship post. Rewards for exceptional work would further increase staff morale.
4. More funds are required to repair washed-out roads and bridges. Watchtowers of reinforced concrete are needed (specifically for central Kaziranga and Pabitora). Run down camps need repairing, especially the leaking roofs, and new camps should be built where necessary.
5. Protected areas with elephants for patrol work need funds for regular food and medicinal supplies, which became increasingly erratic in 1996 and 1997.
6. The total field staff allocations need to be filled. In 1997, out of the 1,198 positions in Kaziranga, Pabitora, Orang and Manas, 326 were vacant.
7. Field staff need better training, especially in the use of firearms.
8. Salary and other staff payments must be made on time. In 1997, several months sometimes passed before wages were received.
9. The judiciary must take more seriously rhino poaching and trade in rhino horn.. Poachers and middlemen are still released or bail after only a few days, and almost none is imprisoned for any length of time.

CONCLUSION

Despite the worst shortage of maintenance and development funds in the memory of Assam Forest Department staff in the Wildlife Division, and with gloomy future prospects for adequate finances, rhino numbers have remained stable in the state over the last

Photo Credit: Lucy Vigne



As seen here in Manas, Indian tourists pay \$2.50 to ride a Park elephants the mornings while foreigners pay \$13.50; the dual price structure was introduced in October 1996. This is the same for Kaziranga (see Table 11).

Table 10. Equipment in the main rhino areas of Assam in 1997

	Kaziranga		Pabitora		Orang		Manas	
	Working	Broken	Working	Broken	Working	Broken	Working	Broken
Radio sets	100	23	5	2	6	0	?	?
Country boats	90	10	6	4	11	0	4	2
Speed boats	5	2	1	0	0	1	1	2
Trucks	1	1	0	0	0	0	}	}
Jeeps	6	4	1	0	2	0		
Tractors	0	1	0	0	0	0		
Vans	0	1	0	0	0	1		
Motorcycles	1	5	0	0	0	0	?	?
Rifles	?	?	20	0	16	0	150	0
Shotguns	?	?	1	0	5	1	?	?
Elephants		38	4	1	12	7	12	24

Table 11. Visitors and revenue raised in Kaziranga.

	Indians	Foreigners	Total visitors	Revenue	
				Rupees	Dollars
1993/4	50,794	486	51,280	652,141	20,895
1994/5	48,501	781	49,282	692,903	21,803
1995/6	16,998	2,057	19,055	761,212	23,501
1996/7	14,735	957	15,692	1,819,084	56,841

NB Park entry fees increased in October 1996:

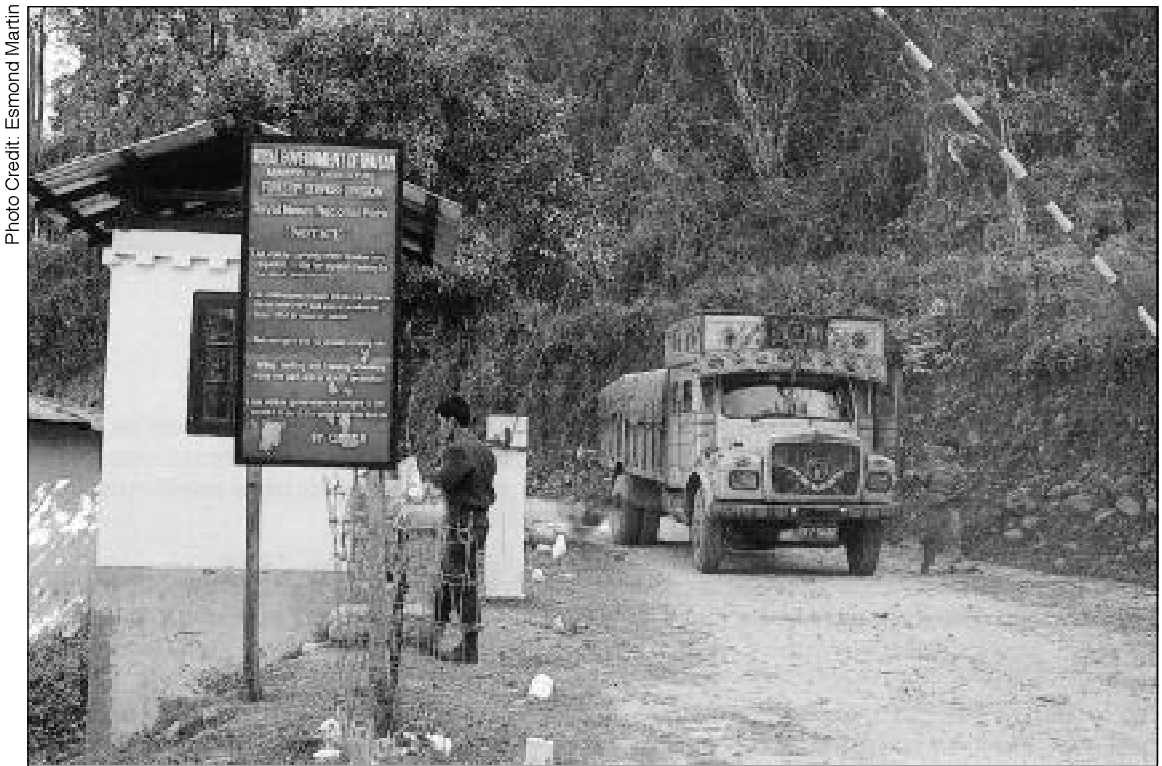
- 1) for Indians from 5-10r, plus vehicles 50-150r, and elephant rides 50-100r per seat;
- 2) for foreigners from 5-175r, plus vehicles 50-150r, and elephant rides 50-525r per seat.

few years. In 1997 there was a decrease in rhino poaching in Kaziranga, but an increase in Orang. In Kaziranga, a handful of outstanding range officers have improved patrolling and intelligence gathering, and have given good leadership in the field, helping to keep up staff morale. NGOs have provided some vital financial help to Kaziranga, and more Assam-based NGOs are beginning to support rhino conservation. There has been an increase in roadblocks throughout the state against insurgents making it harder to move arms, and this has probably helped to reduce rhino poachers in some areas. On the other hand, in Orang the rhinos have become a main target for poachers due to lack of adequate finances for patrol work and intelligence in this Sanctuary. Furthermore, twice Orang has been attacked and looted, with arms and radio sets stolen, and the army and police were unable to recover them. Orang's rhino population must be saved from poachers by giving its Range Officer the financial support he needs. It is important not to ignore the small, protected areas in Assam. If most rhinos are

killed in these areas, poaching pressure will increase in Kaziranga because it would be the only significant rhino area remaining. The state and central governments must meet the financial needs of the field staff if Assam's rhinos are to be protected properly in the future.

ACKNOWLEDGEMENTS

We are very grateful to the International Rhino Foundation, particularly Tom Foose, and to The Columbus Zoological Park Association, especially Jack Hanna for helping to fund the fieldwork in Assam in January 1998. Thanks are due to the members of the Assam Forest Department: R. Agarwalla, M. Barua, D.D. Boro, P.S. Das, S.N. Das, P.K. Deka, A. Dey, S. Doley, P. Lahan, S.K. Sen, P. Sharma and B.N. Talukdar for their time and assistance. Thanks are also due to the NGOs, especially Aaranyak Nature Club, Green's Movement, Nature's Beckon, The Rhino Foundation and WWF India for helping with the work, as well as to Achintya Barua of Wild Grass.



Lorries drive back and forth through the middle of Manas National Park to Bhutan or a newly constructed road, increasing disturbance, pollution and poaching in the Park.

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LESSONS FROM THE INTRODUCED BLACK RHINO POPULATION IN PILANESBERG NATIONAL PARK

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RESUME

En mison du déclin drastique du nombre de rhino noir, plusieurs Etats de l'aire de répartition du rhino ont entrepris de déplacer le rhino dans des zones de sécurité ayant un habitat convenable comparable à leur ancienne zone. Le but était de rétablir les effectifs du rhino noir aussi rapidement que possible pour préserver à long terme leur diversité génétique et feiner les pertes potentielles liées au braconnage (Brooks, 1988 ; Anon,1993).

Cependant, les réintroductions et la gestion de ces nouvelles populations n'avaient pas été très correctes. Le processus de translocation nécessitait une perfection et de nouveaux problèmes survenus dans l'introduction des populations méritaient une attention paliculièrè.

Au Parc national de Pilanesberg en Afirique du Sud, le rhino noir est une population introduite qui, à travers le suivi intensif en cour, a amélioré notre compréhension sur les caractéristiques actuelles de la population du rhino, influençant les buts de conservation du rhino noir.

Le Parc national de Pilanesberg a été créé en 1979. Il couvre 550km² de montagnes rocailleuses et de diverses vallées alluviales dans un volcan alcalin érodé. La moyenne pluviométrique atteint annuellement 637 mm. Les introduction du rhino noir ont été menées en plusieurs étapes à partir de 1981 et ont concerné 24 animmaux au total. Avant le début de 1996, la population a évolué jusqu'à 42 animmaux et en Juin cette même année, Pilanesberg devint une réserve donatrice lorsque neuf rhinos noirs ont été transloqués dans la réserve de faune de Madikwe. Ce rapport résume l'histoire et les caractéristiques de la population de Pilanesberg jusqu'à ce stade.

INTRODUCTION

Due to the drastic decline in black rhino numbers, several rhino range states took steps to translocate rhino to secure areas with suitable habitat within their former range. The aim was to build-up remaining black rhino numbers as rapidly as possible, to preserve their genetic diversity in the long term, and to provide the biggest possible buffer against future potential poaching losses (Brooks, 1988; Anon, 1993).

However the re-introductions and management of these new populations has not been entirely straightforward. The translocation process needed to be perfected and new problems arose in the introduced populations which required careful consideration.

The black rhino in Pilanesberg National Park South Africa is an introduced population which, through intensive and ongoing monitoring, has improved our

understanding of rhino population characteristics currently influencing the conservation goals for black rhino.

Pilanesberg National Park was proclaimed in 1979. It covers 550km² of rocky hills and broad alluvial valleys in a weathered alkaline volcano. The summer rainfall averages 637mm annually. Black rhino introductions occurred in several stages, beginning in 1981, and involved 24 animals in total. By the start of 1996, the population had grown to 42 animals, and in June that year Pilanesberg became a donor reserve when nine black rhino were translocated to Madikwe Game Reserve. This paper summarises the history and characteristics of the Pilanesberg population up to this stage.

MONITORING

The black rhino introduced from 1981 to 1983 were closely monitored by Hillman (1982, 1983 and 1984). However, from 1984 to 1989, only the annual helicopter

Photo Credit: Keryn Adcock



game census provided any monitoring information. In 1989, monitoring efforts were increased in response to declining black rhino numbers in countries to the north of South Africa, and in accordance with the new Conservation Plan for Black Rhino in South Africa, the TBVC States (TVBC States refer to Transkei, Bophuthatswana, Venda and Ciskei - former homelands of South Africa) and Namibia (Brooks, 1988).

Wildlife biologists Hans Bjarne Hansen and Hanne Lindemann were contracted to initiate, and later update individual rhino ID-kits in annual intensive helicopter and ground surveys. An ear-notching programme commenced in 1991, which means that all animals in the Park except infant calves, are individually recognisable. Ground monitoring by Parks personnel also developed from 1989 onwards, based on the game scout training program by Sandwith (1989), and in 1984 a black rhino monitoring officer was appointed.

This population analysis is derived from the work of wildlife biologists Kes Hillman-Smith (1982,1983,1984) Hans Bjarne Hansen and Hanne Lindemann (1989, 1990, 1991,1992, 1993 and 1995) and Keryn Adcock (1994).

THE INTRODUCTIONS PHASE

The first months after release in a new area naturally a stressful period for introduced black rhino. Mortality

rates are highest around this time (Adcock 1994; Brett, in press). A variety of factors are thought to play a role in translocation success.

Boma-keeping and body condition

The introductions to Pilanesberg were staggered in time and location. The main introductions from Hluhluwe-Umfolozzi Park took place over three years with seven, four, and eight black rhino arriving in 1981, 1982 and 1983 respectively. In 1989 a further five animals were introduced.

Fourteen of the 19 initially released rhinos were neither kept in a boma before transport nor prior to release in the Pilanesberg. Two were kept in a boma for a few days before being released and three were kept in a boma for around three months in Natal and four to five days in Pilanesberg. The five from 1989 were caught over a four-day period in Mkuzi (Kwa-Zulu/Natal) and were then transported by truck to Pilanesberg and released directly.

The first 19 introductions into Pilanesberg were successful. Hillman (1982 and 1984), however, noted that the rhinos released without on-site boma-keeping were highly disturbed, which increased the rate of these new animals encountering and fighting with previously introduced rhino. Although the introductions also occurred during a major country-

wide drought, adaptation to the local food and habitat apparently did not present a problem. Although the rhino were only little or not at all boma-kept in Pilanesberg, their overall observable condition actually improved after release (Hilman, 1982; 1983 and 1984).

Age at introduction

The 1981-1983 introductions were put into age-classes by Adcock, based on drawings, photos and notes made by Hilman, along with photos taken of the rhino in 1989 by Hansen and Lindemann.

Only two males were sub-adult on arrival, and the predominantly adult and near-adult ages of the introduced rhinos may have played a significant role in the success of these initial translocations.

The five black rhino (two females and three males) brought from Mkuzi in 1989 were all sub-adult. The three young males - aged according to tooth wear from 15 to 27 months - all died within months of release from fighting injuries in one case, and apparent stress and harassment from established rhino for the others. The two females, who were about two years older than the males, settled down successfully. The death of these males, and deaths in similar circumstances in other areas, have highlighted the vulnerability of young rhino. They become more introduction into a new area than older rhino, they

are not able to defend themselves, and are not adept at finding the right food, water and cover. Such knowledge has led to improved recommendations for translocation procedures based on rhino age and sex (Brett, in press; Morkel, pers. com.; Brooks and Adcock 1997).

Density of established rhino

In South Africa, Namibia, Zimbabwe and Kenya, the problems of introducing black rhino, especially males, into an already-established population are negatively affecting conservation efforts.

During the early introductions, the abundant space available to the rhino meant that even when conflicts arose between animals, there was room to escape. This probably played a role in the success of these early staggered translocations. Subsequent changes in rhino ranges highlighted the fact that the rhino were not truly established in the reserve until at least three years after release. For the 1989 introductions, the established male density in Pilanesberg was likely a negative factor. Although total established rhino density in 1989 was about 60% of estimated ecological carrying capacity, there were eight adult male rhino, and six other independent males of three to eight years old which commanded the water and main food resources of the reserve, leaving little place for young rhino to settle.

Table 1. Home range sizes.

	Females	Males
Sub-adults, independent	63km ²	35km ²
Young adults	48km ²	36km ² - with wanderings 74km ²
Adults	52km ²	28km ²

Table 2. Home range sizes.

Adult Female	Ranges (km ²)	Source
Ndumu Game Reserve	8.65	Freese*
Weenen Nature Reserve	10.00	Pullen*
Sam Knott Game Reserve	11.54	Fike*
Shamwari Game Reserve	15.00	Corcoran (1995)
Mkuzi Game Reserve	24.00	Mulqueeny*
Lapalala Game Reserve	40.00	Ravenhill*
Itala Game Reserve	49.00	WoIf*
Waterberg Plateau NP	60.00	Erb*
Etosha NP, Otjovasandu area	60.00	Joubert and Eloff (1971)

*Information provided for RMG carrying capacity assessment.

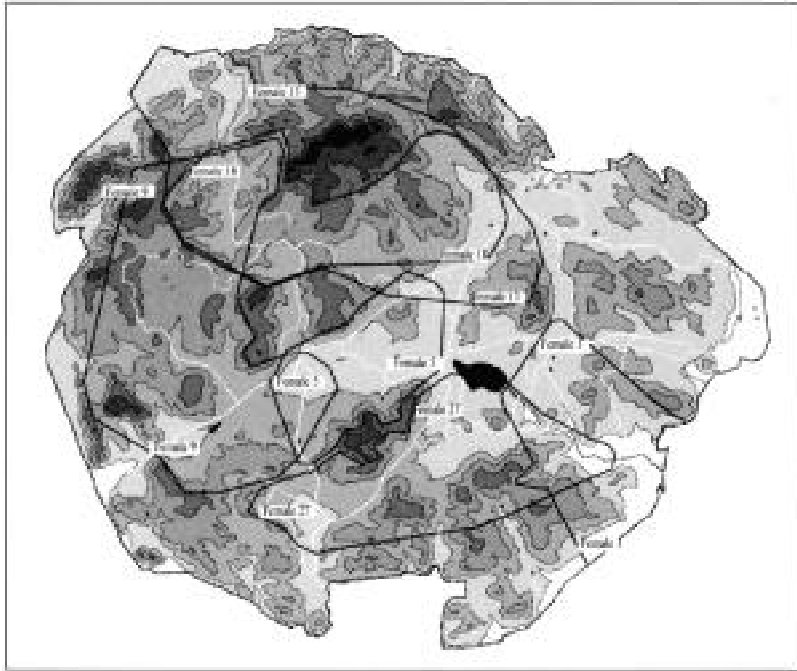


Figure 1. Ranges of older (>15 years) female black rhino in Pilanesberg.

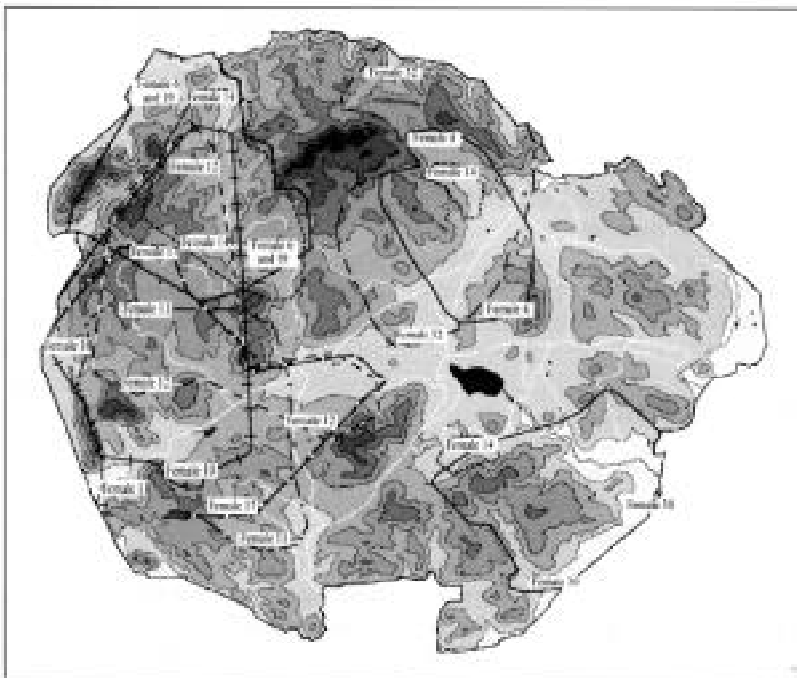


Figure 2. Ranges of young adult female black rhino in Pilanesberg up to 1996 (F32 died in 1994).

Photo Credit: Keryn Adcock



Post release mortality

The combined post-release mortality rate for the Pilanesberg introductions was 12.5% (three out of 24). Hitchins (1984) reports an overall post-release mortality rate of 6% for Natal Parks Board translocations from 1962 to 1984. From 1986 to 1995, the post-release mortality rate among South African and Namibian translocations (excluding those to Pilanesberg) was 8.4% (Adcock, 1995; and 1996). Brett (in press) reported a post-release mortality rate of 16% out of 118 translocations among Kenyan rhino sanctuaries.

THE SETTLING DOWN PHASE

Hillman (1982, 1984) found that the newly introduced black rhino stayed predominantly in the main valley in Pilanesberg which runs from south-east to north-west. Ranges overlapped greatly among both males and females. Only two males and two females moved out of this valley into areas unoccupied by other black rhino. Given the extent of range overlap, especially between the males in 1994, and the altered rhino distributions found from detailed monitoring since 1989, it appears that most black rhino took over three years to settle down and establish proper home ranges.

THE ESTABLISHED POPULATION

Males seemed less inclined than the females to explore remote parts of Pilanesberg in search of a home range. They finally settled in the main valleys near their release sites, while the females found ranges in suitable areas throughout most of Pilanesberg.

Range sizes

Range sizes in Pilanesberg seem to depend on the age and sex of the black rhino. Range size was estimated from the area enclosing most sightings, ie. excluding those outside the usual ranges of the rhino. Also hills judged to be unusable - too steep or without normal food plants for black rhino - were excluded from the home range calculations.

Female ranges were larger on average than male ranges. The rugged terrain with low habitat suitability included in the estimates result in larger home range sizes in Pilanesberg as compared with other places.

Range overlap and distribution

Adult females have a 10 to 60% range overlap (Figure 1). This level of overlap among females has been documented

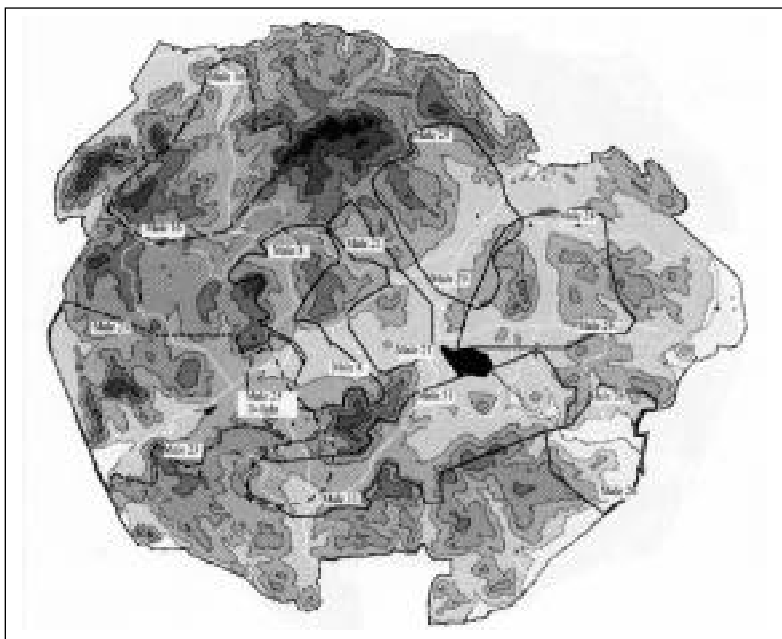


Figure 3. Ranges of older adult males of > 15 years around 1991 (solid lines). Old males 26,24 and 8 have since died. The young adult M23's core area is shown and the range of M25 who was killed in a fight. M16 was an old sub-adult at this time.

in other black rhino populations (Kiwia, 1989; Morgan Davies, 1995; Hitchins, 1983).

Sub-adult females range more widely than adult black rhino (Figure 2) (Hansen and Lindemann, 1990). Once they approach adulthood, they appear to settle down in a smaller, more defined area to have their first calf. The range sizes of these young adult females are similar to those of older females.

Adult males greater than 15 years of age have little range overlap (Figure 3), indicating that black rhino in Pilanesberg behave territorially:

- only one mature male occupies a given range.
- males demarcate their "territories" by urinating and scraping on dung piles.
- fighting is the major cause of death among male rhino (Adcock, 1995; Brett, in press), including those in Pilanesberg.

The male ranges seem to be keyed to permanent water supplies, and it is probably because of the water distribution that only part of Pilanesberg is occupied by adult male black rhino.

Sub-adult and young adult male ranges overlap those of mature bulls. These young males - at least until age eight

and often longer - are generally tolerated by the mature bulls. The sub-adult male ranges are often similar to their mothers.

Male social behaviour

Male black rhino seem to mature socially later than females. In Pilanesberg female calves become independent of their mothers at a younger age than males (averages equal two years one month [four females] versus three years [seven males]). The average for both sexes is two years nine months). Sub-adult males are frequently seen with their mother beyond three years old, while young females wander more, and associate temporarily with other mature females, but only occasionally their own mother (Hansen and Lindemann 1990).

Based on sightings of five males, from eight to ten years old and onwards, the males wandered farther afield than before - their ranges still overlapping each other and those of old bulls. It is supposed that by this age such bulls have still not established a home range or a territory. Some of these bulls had not fully settled even at 14 to 15 years of age. Figure 4 gives the ranges up to 1996 of the young adult male black rhino.

The tolerance that established bulls can show for sub-adult and young adult males and the frequent lack of

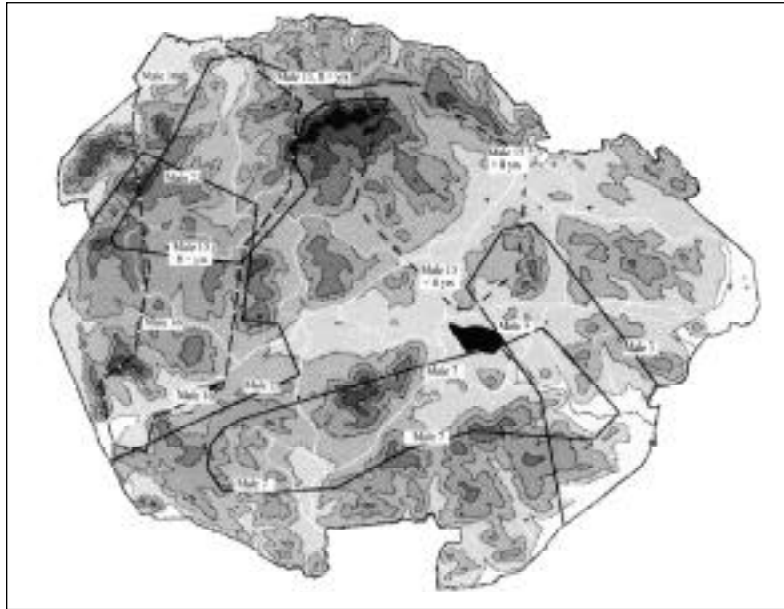


Figure 4. Ranges of young adult male black rhino in Pilanesberg up to 1996. These rhino started to wander further afield than usual in the few years up to 1996, especially male 15, 16 and 23, who's ranges previously did not overlap.

knowledge on the ages of individual rhinos, could be why some workers have concluded that black rhino are non territorial (Hitchins and Anderson, 1983; Goddard, 1967; Schenkel and Schenkel-Hullinger, 1969). In Ngorongoro Klingel and Klingel (1966) and in Serengeti Frame (1980) found, however, that black rhino males were territorial in a similar way to white rhino (Owen-Smith, 1974).

Surplus males

Although the sex structure of the whole Pilanesberg population was generally biased towards males until 1995, the number of mature males has remained almost constant at around eight or nine since the first introductions (Table 4). The total number of males has also stayed around 16. The experience from Pilanesberg, together with events in other, newer populations (Adcock, 1995; Brett, in press) suggest that there is a limit to the number of males an area can carry.

These findings have important implications for the translocation and conservation management of black

rhino in smaller populations (<75 animals). Excess male black rhinos should ideally be removed to promote population performance in restricted areas. However, these surplus males cannot be easily placed in established populations for reasons mentioned above. Male-only sanctuaries could be setup, but this is expensive and wasteful, as funds and land for translocations to start new breeding populations of black rhino are at a premium. Few private landowners are prepared to pay for animals that are expensive to protect and that cannot be used for anything but tourism.

In 1990 the benefits of hunting surplus - preferably old or aging - male black rhino was put forward (Hansen and Lindemann, 1990). In this way, excess males could be removed to the benefit of black rhino population performance by generating income for the required intensive security and monitoring. Unfortunately, international issues have prevented this solution from being adopted so far. Still, surplus male rhino has become a critical issue in most black rhino conservation areas in South Africa and elsewhere.

Table 3. Cause of rhino deaths.

	Old age	Fighting	Fight Injuries/ Harassment	Missing - Presumed Dead	Shot	Unknown
Males	2	5	3	2	1	2
Females	1					2

Photo Credit: Keryn Adcock



MORTALITIES

Fifteen male and three female black rhino mortalities have been recorded in Pilanesberg. When possible dead rhino were aged according to the tooth wear classes by Hitchins (1978). The number of fighting incidents among the male deaths again suggests that social pressure is a significant factor.

From 1981 to 1995, the yearly mortality rate averaged 3.6%. However, during the first six years no mortalities were recorded, while over the last nine years, mortality averaged 6%. If the three young males introduced in 1989 are excluded from calculations, the rate averaged 5% from 1987.

REPRODUCTION

Age at first calving

In Pilanesberg, the average age at first calving was 7.5 years (range 6.8 -8.8 for the seven females). Ages at first calving (AFC's) of around 7 to 8 are found in populations performing satisfactorily (Adcock 1996). AFC's of less than 6 years has been recorded, but this is rather rare. Lindemann (1982) found females in

captivity reach sexual maturity (ability to conceive) at 5.5 - 6.5 years but only produce their first calf at 8.3 years on average.

Interval between calves (ICI)

The frequency distribution of observed intervals between calves is skewed (Figure 5). While the average observed inter-calving interval in Pilanesberg's black rhino is 34 months (Hansen and Lindemann 1995) or 2.8 years, the most likely ICI (mode) is 2.6 years (from 20 observations, range 2.1 years to 5.8 years). Pilanesberg's females have shown an average breeding performance, as southern African modes have been 2.3 (*D.b. bicornis*) to 2.7 (*D.b. minor*) years (Adcock 1998).

The ICI distributions indicate that some calves have died early or been aborted and therefore never having been detected. ICI is thought to decline with female age, however there has been no indication as yet that the older females (ranging from c. 15 to c.33 years old) in Pilanesberg had longer interval between calves than the younger females.

Overall population performance

The population growth rate has averaged 5.77% per year (ie. the modelled Pilanesberg population growth

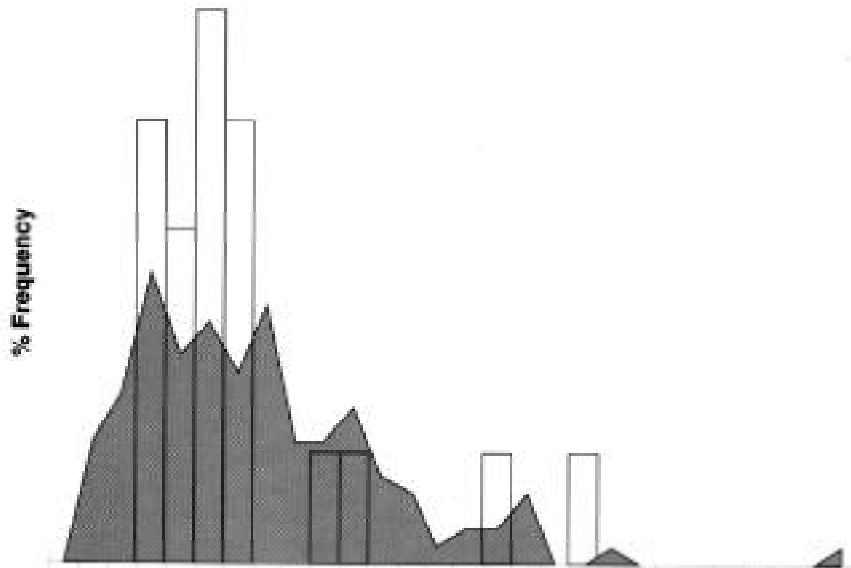
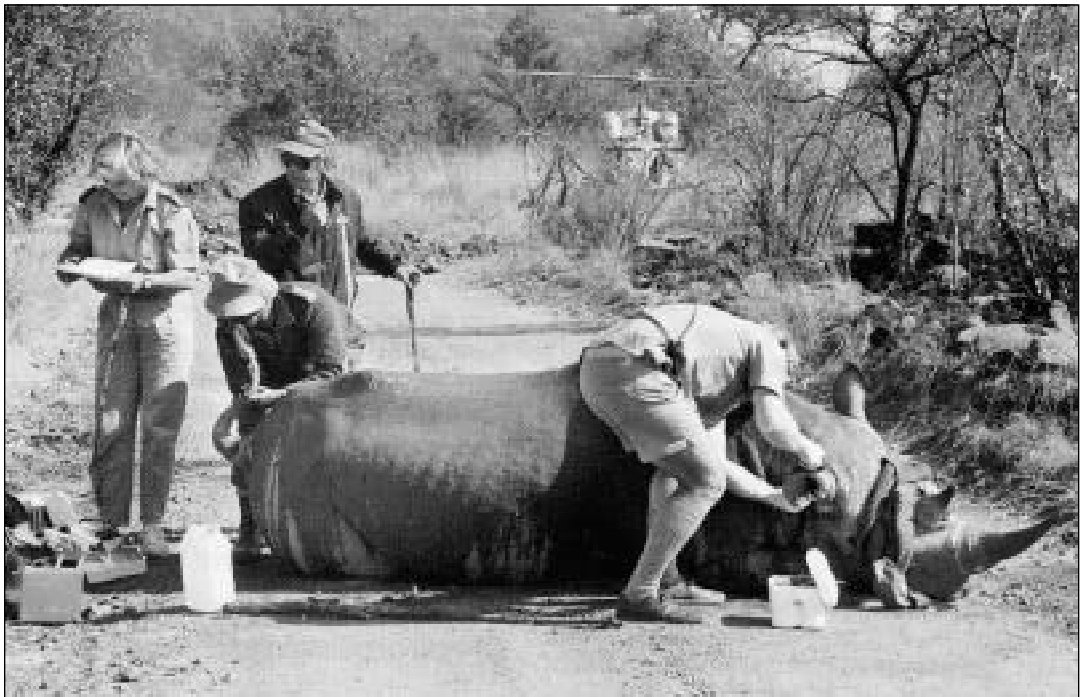


Figure 5. Frequency distribution of inter-calving intervals from Pilanesberg (bars) versus those in other in the rest of South Africa and Namibia (shaded area) - from data submitted to the Rhino Management Group.

Photo Credit: Keryn Adcock



rate from 1981 (seven rhino) to 1995 (42 rhino), accounting for introductions). Growth rates in other South African populations range from -8.9% to 11.3%.

While female breeding performance in Pilanesberg has been favourable, it is still below optimum population growth (>7% per year, ICI near to two years), probably due to the following factors:

- many male deaths through fighting (social pressure).
- longer average inter-calving intervals than can be achieved.
- loss of calves in late pregnancy or around the time of birth.

Additional factors that can affect the future population performance are:

- the skewed sex ratio of calves born (no female calves were born between 1989 and 1993).
- social pressure among males continues unless alleviated by further removals.
- slower calving rates of the six older females.
- deaths among the three remaining older bulls, and their replacement by younger bulls, may disrupt mating patterns and affect calving success.
- inbreeding.

AGING RHINO

The near-annual photographic records and ear-notching immobilisations of Pilanesberg's black rhino have provided relative body size and horn growth pattern information, improved aging criteria and age-class definitions for this species (Adcock, 1997; Emslie *et al.*, 1993; Adcock, *et al.*, 1996). Specifically this demonstrated that black rhino are not fully grown (adult) until at least their seventh to eighth year. The basal

diameter of the rear horn (reflecting skull dimensions) stabilises after this age. Body weight is known to affect fecundity, and young rhino would need to approach 80% of their adult body weight before successfully conceiving (Owen-Smith, 1988). That this commonly occurs when the females are about 6.2 years, giving average ages at first calving of 7.5 years, supports this.

RHINO DENSITIES AND PILANESBERG'S ECOLOGICAL CARRYING CAPACITY

The density of the black rhino in Pilanesberg was 0.076/km² for the population level of 42 rhino reached in 1995. If only suitable black rhino habitat (ie. about 60% of the park) is considered, the maximum density was about 0.15/km². However local densities in some areas of the Park reach levels of over 0.22 rhino per km². The overall density in Pilanesberg is nevertheless low compared to areas of similar rainfall, like 0.3/km² in Ndumu, 0.42/km² in Hluhluwe/Umfolozi, 0.2/km² in Itala and 0.22/km² in Mkuzi.

Pilanesberg's population is still below its ecological carrying capacity (ECC). However no formal survey of Pilanesberg for black rhino habitat use and impact has yet been made, and estimates of ECC have varied widely:

Knowledge on rhino ecology from Pilanesberg and other rhino areas in the region, indicate that Pilanesberg's ECC is influenced by the:

- generally poor nutrient status of the Park, based on the geology and derived soils.
- extent of steep, rocky and inaccessible terrain.
- influence of frost on browse quality.
- impact of other browsers.
- length of the dry season.

Table 4. Reported rhino densities

Black rhino per km ²	Number of rhino	Reference
0.218	120	Goodmari-Collinson arid Ferrar, 1989*
0.109-0.145	60-80	Patrickson, 1988*
0.145-0.1818	80-100	Thompson, 1986*
0.105	58, but also thought to be >50, up to 100	Hillman, 1982:1983.
0.96	50	Emslie arid Adcock, 1993

* internal Bop. Parks Board reports

Photo Credit: Keryn Adcock



A DONOR POPULATION

Information gained from monitoring the black rhino of Pilanesberg National Park has contributed towards the understanding of many factors affecting black rhino populations in Africa. Pilanesberg and North West Parks and Tourism Board also made a direct contribution to black rhino conservation by becoming a donor population in 1996, when nine black rhino were translocated to found a new population in the nearby Madikwe Game Reserve.

ACKNOWLEDGEMENTS

We thank George Phiri for his dedication to the black rhino in Pilanesberg. The work of Dr Keffen in monitoring and darting the rhino is also greatly appreciated, as well as the ground-based work of game scouts and rangers and the never failing interest and assistance from Senior Warden Johnson Maaka. We are also grateful for the sponsorship and support from Endangered Wildlife Trust, Mazda Wildlife Fund and Stocks and Stocks Lodges.

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THE DISTRIBUTION OF ELEPHANTS IN NORTH-EASTERN GHANA AND NORTHERN TOGO

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RESUME

La population d'éléphants (*Laxodonta africana*) du Togo est répartie dans deux zones dont, l'une est située au centre, et l'autre à l'extrême nord (MET, 1991; Okoumassou, 1997). Les éléphants de l'extrême nord, se déplacent souvent et traversent la frontière jusqu'au nord est du Ghana et des deux côtés de la frontière, il y a des plaintes concernant les dégâts de cultures. Quelques informations datées de 1990 sont disponibles sur les éléphants du nord du Togo (MET, 1991; Stalmans et Anderson, 1992), mais il y a très peu d'informations au stade actuel. Du côté Ghanéen, très peu de connaissances existaient sur les éléphants. Cependant, les administrations des districts étaient de plus en plus inquiètes des dégâts de cultures (Sam, 1994). Une étude préliminaire a donc été entreprise d'Avril à Juin 1996 par les autorités des deux pays. L'objectif était de déterminer le statut des éléphants et d'évaluer le problème des dégâts. Ce rapport décrit les changements récents sur la distribution des éléphants, et un autre rapport (Sam *et al.*, ce volume) fait une description des conflits homme - éléphant.

INTRODUCTION

Togo's elephant (*Laxodonta africana*) population is found in two ranges, one in the centre and one in the far north (MET, 1991; Okoumassou, 1997). The northern elephants often move across the border into northeastern Ghana, and on both sides of the border there are complaints of crop-raiding. Some information is available on the northern Togolese elephants up to 1990 (MET, 1991; Stalmans and Anderson, 1992), but there is little current information. On the Ghanaian side little was known about the elephants and the district administrations were becoming concerned about crop-raiding (Sam, 1994). Therefore a preliminary study was undertaken from April to June 1996 by the wildlife authorities of the two countries. The objective was to determine the status of elephants and evaluate the crop-raiding problem. This paper describes recent changes in the distribution of elephants, and a second paper (Sam *et al.*, this volume) describes human-éléphant conflicts.

STUDY AREA

The Ghanaian portion of the study area consisted of the Upper East Region plus a small part of the Northern Region. The Togolese part consisted of the Région des Savanes plus the prefecture of Kandé in the Région de Ia Kara (Figure 1) (The Ghanaian Regions are divided

into districts, while those in Togo are divided *into prefectures*).

The mean annual rainfall for 1976 to 1995 was 958mm for Navrongo in Ghana, and 1,039mm for Mango in Togo. There is a single wet season lasting from about April to November. The vegetation is Sudanian savanna woodland (White, 1983) but some authors have called it Guinea savanna (eg. Taylor, 1952; Boateng, 1970). It consists of deciduous short trees, usually less than 15 metres tall, and shrubs. The canopy is not closed and there is a dense medium or long grass layer in the late wet season. Fires are frequent. Forest Reserves protect the banks of the major rivers on the Ghana side (Figure 2). Outside the reserves the vegetation has been transformed by human activities (Boateng, 1970; White, 1983). On the Togolese side there are two National Parks (Fosse-aux-Lions and Kéran); the Oti-Mandouri and Galangashie Game Reserves; the K hunting reserve; and the Forêt de Doung and Barkoissi Forest Reserves (Figure 2).

The Koulagouna river rises near the Fosse-aux-Lions NP and flows westwards, becoming the Moraga river on the Ghanaian side of the border. This river continues westwards, meeting the White Volta and then the Red Volta rivers (Figure 2). The Koulagouna-Morago-Volta rivers flow along the foot of the north-facing Gambaga Escarpment (see Figure 1 of Sam *et al.*, this volume).

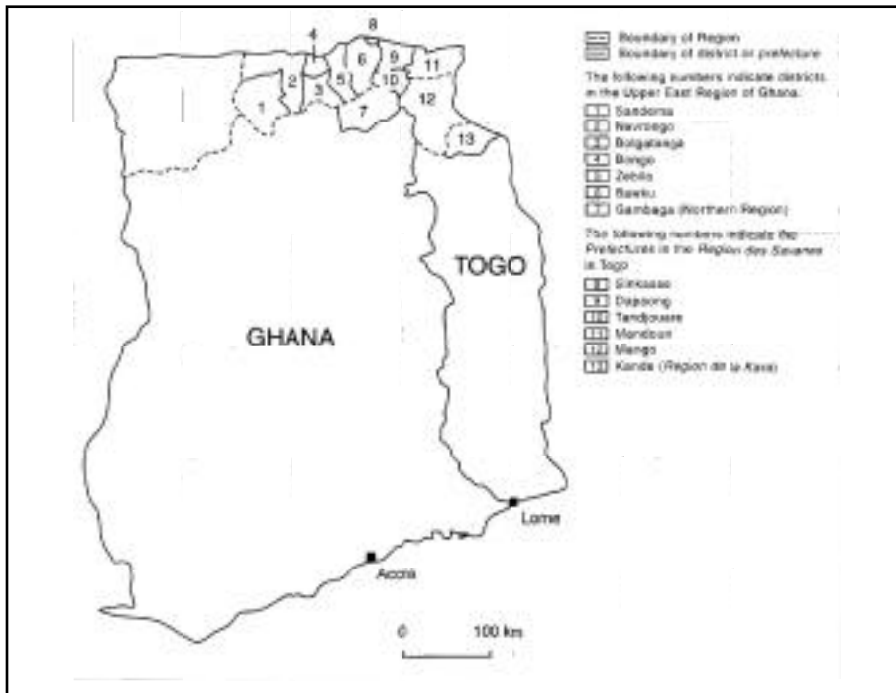


Figure 1. Map of the northern parts of Ghana and Togo showing where this study was conducted.

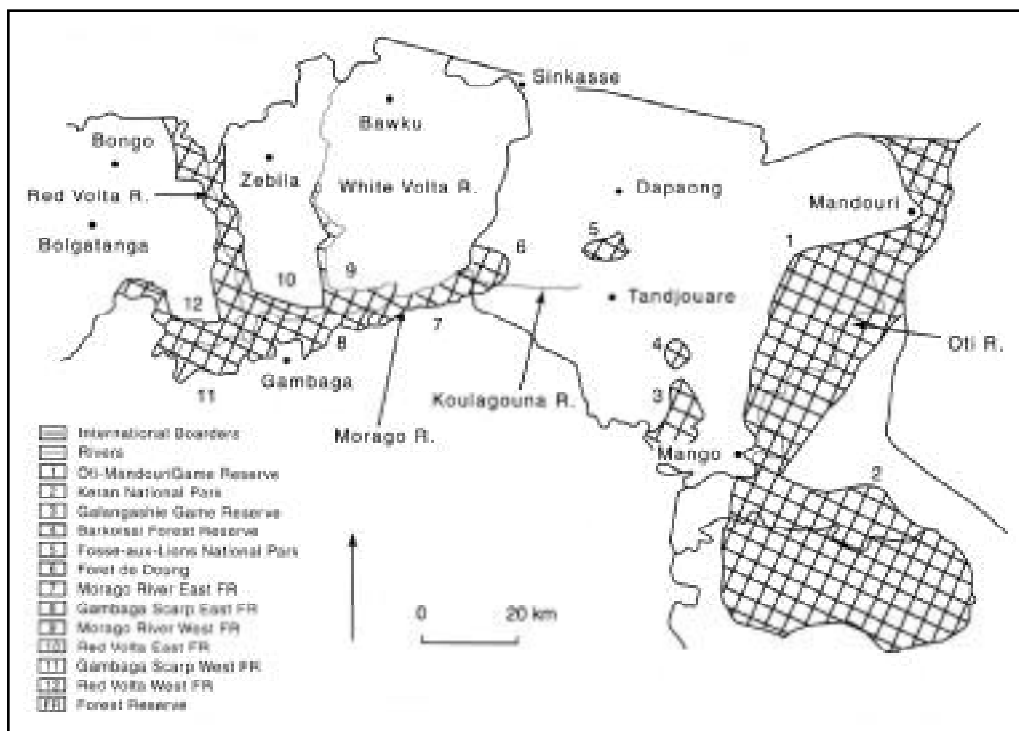


Figure 2. Map showing the most important protected areas (cross-hatched) for elephants in north-eastern Ghana and northern Togo.

The human population density of Ghana's Upper East Region is about 118 per km² (Sam *et al.*, this volume). Worked and fallow fields cover almost half the land area of that region in 1989 (DCA, 1992). Human population densities ranged from 25 to 201 per km² in the *prefectures* of northern Togo (data provided by la Direction de Statistique in Dapaong).

The rural populace practices rain-fed mixed cropping. The most important crops in the study area are millet, sorghum (guinea-corn), groundnuts, beans, rice, maize, and yams (DCA, 1992). Small amounts of other crops, such as vegetables, sweet potatoes, and cotton, are also grown.

METHODS

Data were collected by interviewing villagers. The villages were selected on the basis of pre-existing information about the distribution of elephants (eg. Sam [1994] and personal knowledge), features which suggested the probable presence of elephants, and from information given by the district administrations. Towards the end of the study the distribution of interviewed villages was examined and additional villages were selected to fill the gaps.

The interview in each village was an informal conversation with a group that usually consisted of the chief, his elders, and other villagers. The number of participants varied from four to about two dozen; in one case 70 took part. The interview was usually

conducted through an interpreter because few villagers spoke English or French. A standard list of open-ended questions was designed to uncover the history of elephant occupation of the area around the village, trends in elephant numbers, whether elephants are or had been permanently resident or seasonal migrants, the season when they appeared, whether they damaged crops, and how they were warded off. Attempts were also made to determine whether elephants formed part of the culture of the local people, and what attitudes the people had towards elephants.

The validity of the data collected depends upon the honesty of the respondents and their willingness to be questioned by outsiders. For the most part the interviewers were greeted warmly and villagers replied willingly to our questions. Sometimes they talked frankly about topics one would expect them to conceal.

RESULTS

Elephant distribution in Ghana

We visited 42 villages in Ghana (Table 1), and according to villagers elephants occurred in many parts of the Upper East Region early this century. But by Independence elephants had disappeared from most parts west of Bolgatanga Today they are found in two parts of the Region. They occur seasonally along the Sissili river in the extreme west and south-west (Figures 3 and 4).

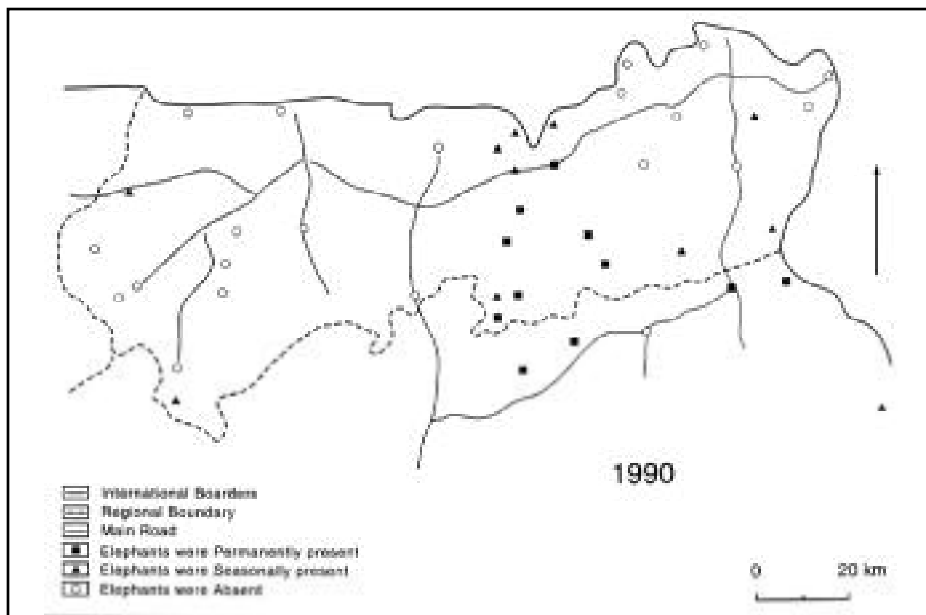


Figure 3. Elephant distribution in north-eastern Ghana in 1990.

Table 1. The communities that were interviewed in Ghana (n = 42).

District	Village	District	Village
Bawku East	Garu	Sandema	Doninga
	Sinebaga		Wupensa
	Worikambo		Bachonse
	Bugri		Chiok
	Zabzundi		Fumbisi
	Pulimakom/Widana		Weisi
	Nafkoliga		
	Binduri		Navrongo
Mognori	Kayoro		
	Nakong		
Bawku West	Tilli		Kologo
	Kusanaba		Naga
	Zongoiri		
	Widinaba	Gambaga	Samene
	Gogo		Gbangu
Sapeliga		Nakpanduri	
Bolgatanga	Nangodi		Nalerigu
	Sekoti		Gambaga
	Datoko		Nabulik
	Tolla		Kambatiak
	Akulmasa		Kinkagu
	Pwalugu		
Bongo	Bongo		
	Soe		

The Sissili river may form part of a movement corridor southwards from Burkina Faso towards Mole NP, Ghana's largest savanna park. Elephants also occur in an L-shaped area along the Red Volta and Morago river valleys (Figure 4). The banks of these rivers (except for part of the north bank of the Morago river) are protected by Forest Reserves which provide elephant habitat. Elephants move between Ghana and Togo along the Morago/Koulagouna river. Elephants are seen most frequently in the Red Volta valley during the wet season, especially as harvest-time approaches. They seem to move northwards into Burkina Faso for the dry season, and southwards again in the early wet season.

Eighteen villages complained of crop damage during the last ten years, and ten said that elephant numbers had increased during that time, especially during the last four or five years. Two villages close to the border attributed the increase to elephants moving from Togo

following political events there.

Elephant distribution in Togo

Twenty four villages were visited in Togo (Table 2). According to information provided by villages, both the number of elephants and consequent crop damage increased during the 1970s and 1980s due to added protection in the new National Parks and Reserves. Protected Areas covered 20% of the area of Région des Savanes (IUCN, 1987), and by 1990 elephants were common and permanently resident in the area between Forêt de Doung, Tampialim, Fosse-aux-Lions NP, and Pana (Figure 5). One hundred and thirty were counted from the air (Stalmans and Anderson, 1992), and there may have been as many as 200 in the dry season (MET, 1991). They moved regularly between Fosse-aux-Lions NP and Forêt de Doung and into Ghana.

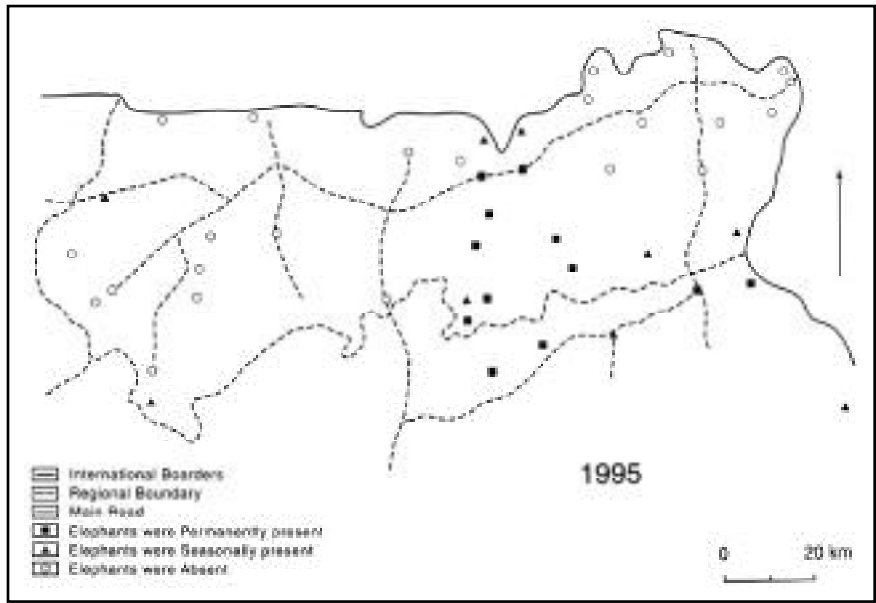


Figure 4. Elephant distribution in north-eastern Ghana in 1995.

Table 2. The communities that were interviewed in Togo (n = 24).

Prefecture	Village	Prefecture	Village
Oti	Takpamba	Tône	Warecambo
	Takpaveni		Pana
	Bakoissi		
	Gando	Kpendjal	Borgou
	Galangashie		Panserie
	Mogou		Koudjouaræ
	Mango		Donga
Tandjouaræ	Nandiki		
	Bombouaka	Sinkassæ	Timbou
	Nano		Sinkassæ
	Sissiak	Kæran	Ossacræ
	Tampialim		Naboulgou
	Nayergou		Kpessidæ

Elephants were present south of the Doung-Pana area, to Galangashie, Mango and the Kéran NP. Elephants were also seasonally present along the Oti river in the north-east, moving down the river valley towards the Kéran NP (Figure 5). They seem to have been absent from the northern part of the Région des Savanes.

By 1989 people were becoming so frustrated with the crop damage caused by elephants that they

encouraged hunters to come from Ghana to shoot them. Ghanaian hunters were selected because they were experienced and had powerful rifles. Then in 1990 to 1992 there was a prolonged political crisis and civil disturbance in Togo (Tanzidani, 1993). The opposition identified the country's protected areas as representative of the unpopular government and it encouraged the local people to invade the protected areas and kill the animals (Tanzidani, 1993). Once again, hunters were hired from Ghana to kill

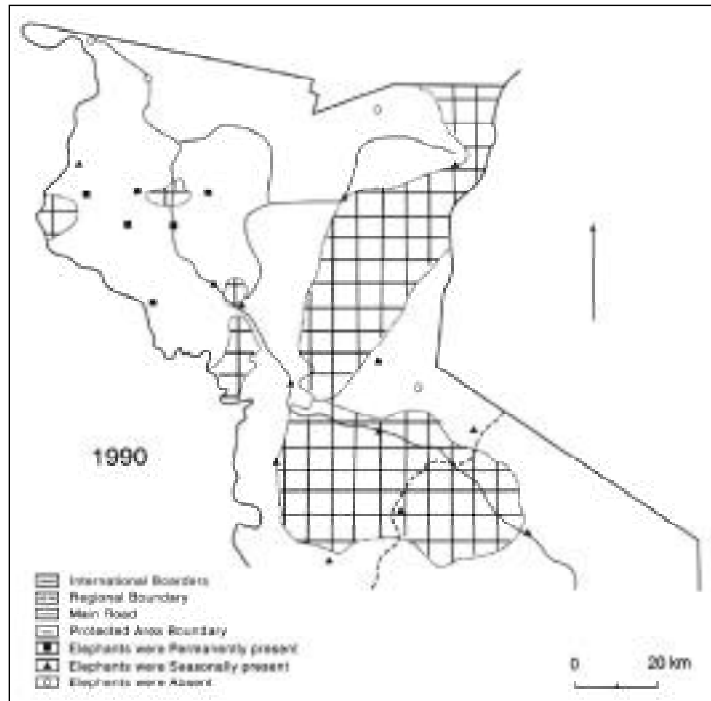


Figure 5. Elephant distribution in northern Togo in 1990.

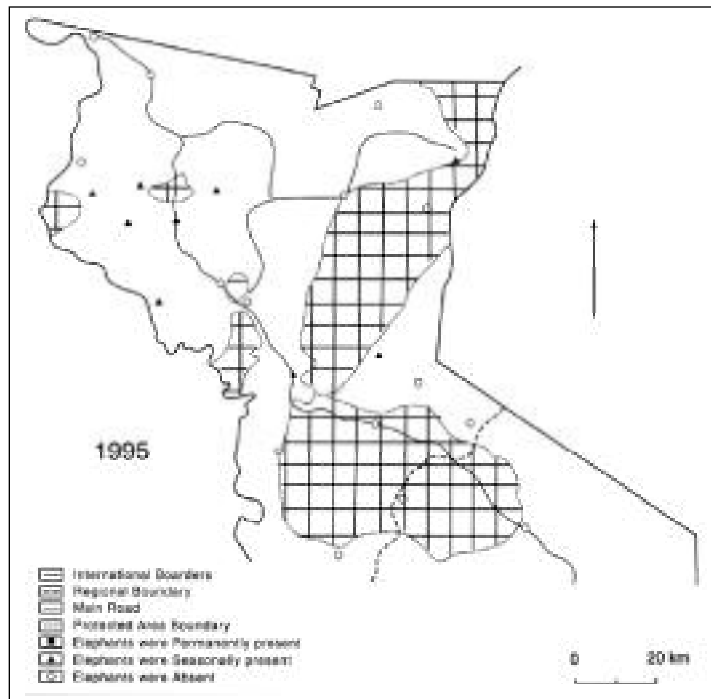


Figure 6. Elephant distribution in northern Togo in 1995.

elephants. One chief spoke of a “massacre of the elephants” with 200 killed over a two-year period which started during the Conference Nationale in July-August 1991.

Those elephants that survived fled to adjacent countries: Benin, Burkina Faso, and Ghana. Today elephants have disappeared from the Kéran NP, and also from the Galangashie and Barkoissi Reserves (Figure 6). In the Doung-Pana area, where formerly they were abundant, they are now seen only seasonally and in small numbers. They still seem to move seasonally along parts of the Oti river in the east.

There has never been a formal census of Togo’s elephants, but guesses or extrapolations of the total population before 1990 ranged from 100 to 400 (Burrill & Douglas-Hamilton, 1987; MET, 1991; Douglas-Hamilton *et al.*, 1992). If those figures were accurate, then the elephants killed between 1990 and 1992 represented a large proportion of the national population.

Migration corridor

The Red Volta-Morago-Koulagouna river system and the escarpment form the natural boundaries of a long corridor for elephants to migrate between Ghana and Fosse-aux-Lions NP in Togo (Figure 7). This was described by Stalmans and Anderson (1992) who saw

it and the Fosse-aux-Lions NP before the civil disturbances.

On the Ghana side, the area above the Gambaga escarpment is densely cultivated, except for the Forest Reserve on the escarpment edge. Elephants still use this forest, as their signs are seen regularly above the escarpment to the east of Nakpanduri (the Morago East Forest Reserve), and they sometimes climb from the White Volta into the hills near Gambaga and Samene. Migrating elephants usually move along the bottom of the valley, between the river and the escarpment, because it is part of the Forest Reserve and relatively undisturbed.

The corridor is protected from cultivation on the Ghana side by the Forest Reserve but the Togolese side is not so protected. Although the Forêt de Doung is sometimes marked on maps as a *forêt classée*, its present status remains unclear. In any case, the Forêt de Doung covers only the small part of the migration corridor near the frontier (Figure 7).

Near the bonier on the Togolese side, in the Forêt de Doung, a path has been worn by migrating elephants. Further east, there are natural bottlenecks to the corridor where promontories from the escarpment approach the river. One of these, about 10km from the border, could be partially blocked if a field on

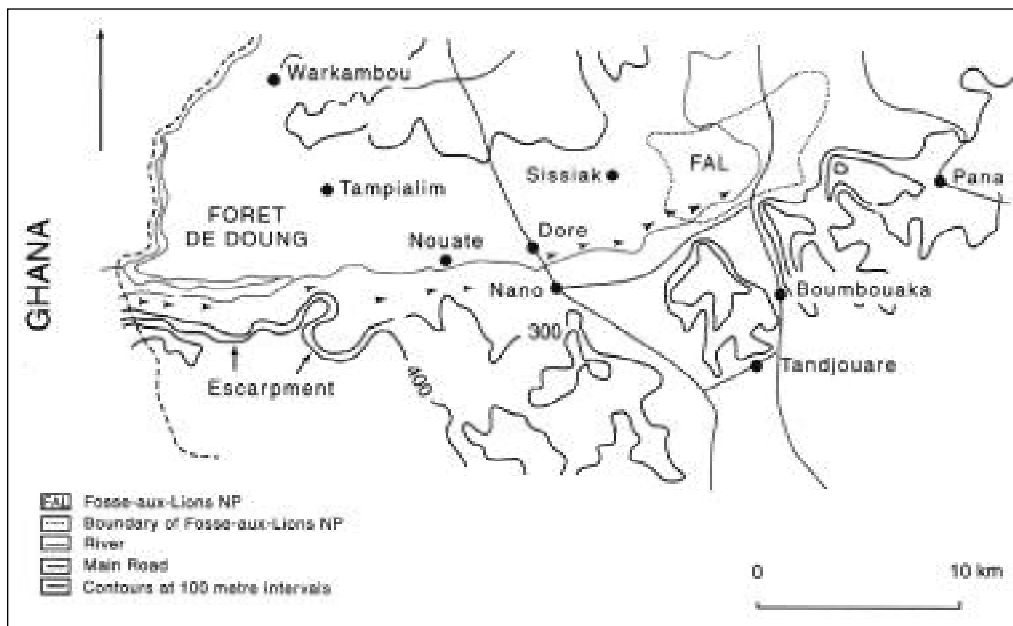


Figure 7. Map of the elephant corridor on the Togolese side. The arrows show the elephant migration route between Forêt de Doung and Fosse-aux-Lions NP.

that side of the river were expanded. Near Nouat, (Figure 7) there are a number of fields in the middle of one of these potential bottlenecks. Further east, at Kona, cultivation extends across the corridor from the river to the foot of the escarpment. From Kona to the Fosse-aux-Lions NP the corridor is a mosaic of cultivation and fallow.

Since the 1990 to 1992 crisis much of the Fosse-aux-Lions NP has been cultivated and settled. Immediately adjacent to the marsh in the heart of the Park is a huge farm that is not visible from the main Mango-Dapaong highway.

DISCUSSION

Elephant distribution and crop-raiding

During colonial times elephants were widespread in the Upper East Region but their range decreased as the human population grew. By 1990 they were restricted to the Sissili river and the L-shaped zone formed by the Forest Reserves along the Red Volta and Morago rivers. In contrast, it seems that elephants were becoming more common in northern Togo during the 1970s and 1980s due to the expanding network of Protected Areas (Figure 5). Since 1990 there has been a major change in elephant distribution in the study area: a net movement from northern Togo into north-eastern Ghana. Today elephants are not seen in the area south of Mango (Figure 6). The increased complaints of crop-raiding in the Red Volta area are a consequence of the collapse of the Protected Area system in Togo due to political disturbances.

For the most part, elephants play no role in the lives or culture of the rural people, except in a negative sense as a destructive and dangerous pest. Against the backdrop of poverty and declining natural resources (described in Sam *et al.*, this volume), the risk of crop losses caused by elephants is becoming intolerable, and the most important short-term threat facing elephant populations is the local people's hostility, an inevitable reaction to crop-raiding.

Remaining habitat

Much elephant habitat remains in Protected Areas on both sides of the border (Figure 2). On the Togolese side the Kéran NP and the Oti-Mandouri Game Reserve together form a block of about 3,000km². Both are occupied to some extent by farmers but negotiations are under way to persuade them to move out. Even if, as part of the compromise with the locals, the Kéran NP is reduced in size, the Kéran-Oti-Mandouri block will still be the largest contiguous elephant habitat in Togo.

On the Ghanaian side the forest reserves provide several functions. First, they protect the river banks (Figure 2). Second, they form elephant habitat covering approximately 900km². Third, they form a migration corridor between Burkina Faso, Ghana, and Togo. The Ghanaian side of the corridor is secure at present because Forest Reserve status prohibits cultivation. However, wood-cutting, grass-burning, grazing, or hunting could become threats if pressure for resources were to increase.

On the other hand, the corridor is seriously threatened on the Togo side and may already be blocked by cultivation. At the eastern end of the corridor, a large part of Fosseaux-Lions NP is now cultivated and settled. If Fosse-aux-Lions NP is no longer suitable for elephants, then there is little point in worrying about the Togolese part of the corridor.

Change in soil fertility is an important issue in the study area (Sam *et al.*, this volume). Farmland that has been continuously cultivated is becoming progressively less fertile (PNUD/FAO, 1991). This illustrates a potential future danger for all Protected Areas in both Ghana and Togo; as land is degraded through over-cultivation, the Protected Areas will become islands of fertile soil in a sea of unproductive land. Farmers will turn hungry eyes towards those fertile soils and it will be difficult to keep them out.

Rehabilitation of the Togolese protected areas

The rehabilitation of the Togolese Parks will face some serious problems if it can be affected. If the Togolese parks were improved enough that elephants moved back to Togo, then the numbers of elephants in the Red Volta area would decrease. However, the farmers on the Togolese side are grateful that the elephants have gone, and they will not be happy to see them return. They would argue that the crop-raiding problem had simply been transferred from Ghana back to Togo.

The growth of the human population and the resultant loss of habitat is the most important medium-term threat which elephants face in the study area. The occupation and cultivation of the Togolese parks in 1992 may have satisfied the hunger for land in the short term. The root problem - increasing demand but a shrinking supply of land - remains, and the day of reckoning for the human population has merely been postponed rather than cancelled. For when the people have cultivated all the conservation areas, then where will they go next?

CONCLUSIONS

Elephants move between three countries - Ghana, Togo, and Burkina Faso - but the traditional migration route between the Ghana border and the Fosse-aux-Lions NP is disappearing. Elephants also move up and down the Sissili and Red Volta valleys between Ghana and Burkina Faso. A study of their distribution and ecology is needed on the Burkina Faso side of the border, as well as an assessment of their movements between the two countries. At present there is no estimate of numbers of elephants, and a joint aerial census of the Ghanaian and Burkina Faso portions of the Red Volta and Morago valleys is essential.

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ELEPHANTS, HUMAN ECOLOGY AND ENVIRONMENTAL DEGRADATION IN NORTH-EASTERN GHANA AND NORTHERN TOGO

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RESUME

Une étude sur le statut des éléphants (*Loxodonta africana*) a été conduite au nord - est du Ghana et au nord du Togo en Avril - Juin 1996. L'objectif était de déterminer le statut des éléphants et d'évaluer le problème des dégâts de cultures (Okoumassou *et al.*, cc volume). Ce rapport a discuté la distribution des éléphants dans cette région et a décrit le conflit entre la population et les éléphants et leurs rapports avec les bouleversements politiques au Togo, la croissance de la population humaine, la dégradation des sols, et les changements liés à la chute de la pluviométrie. Une série d'études est recommandée pour mettre en place un plan d'utilisation de la terre.

INTRODUCTION

A survey of the status of elephants (*Loxodonta africana*) in north-eastern Ghana and northern Togo was conducted in April-June 1996. The objective was to determine the status of elephants and evaluate the crop-raiding problem. (Okoumassou *et al.*, this volume) discussed the distribution of elephants for the region. This paper describes the conflict between people and elephants and its relationship to political upheavals in Togo, the growth in the human population, soil degradation, and changes in rainfall. A series of studies is recommended which will form the foundation for a land use plan.

STUDY AREA AND METHODS

The study area (Figure 1) comprised the north-eastern part of Ghana (Upper East Region of Ghana and Garnbaga District) and the northern part of Togo (Région des Savanes and the *prefecture* of Kandé). See Okoumassou *et al.* (this volume) for details of the study area and a description of methods.

RESULTS

Trend in elephant numbers

An aerial census in 1991 estimated 130 elephants in the area between Fosse-aux-Lions National Park and the Forêt de Doung before the Park was invaded by local communities residing around the Park (Stalmans and Anderson, 1992). No censuses have ever been conducted on the Ghanaian side. Jamieson (1972) recognised the tracks of 12 different elephants and concluded that there were perhaps 25 elephants, with a possible maximum of 50. Sam (1994) used footprint measurements to identify groups, and descriptions of other groups, to estimate between 100 and 150 animals.

Mole NP is the Wildlife Department station that is responsible for elephant matters in northern Ghana. The elephant control files show few complaints from the Upper East Region during the late 1980s compared to the 1990s. Furthermore, when elephant control units were sent to the Region, they stayed longer during the 1990s.



Figure 1. Map of north-eastern Ghana and northern Togo.

Elephants have always moved between Burkina Faso, Ghana, and Togo (Okoumassou *et al.*, this volume). Villagers living near the border reported that elephants moved from Togo to Ghana when the Togolese protected areas were taken over by local people during the political disturbances of 1990 to 1992 (Okoumassou *et al.*, this volume). Of the 18 Ghanaian villages that said they had suffered crop-raiding in the last decade, ten said in 1996 that elephant crop-raiding had become more frequent during the preceding ten years, and several specified “during the last four or five years”. Only one said it had decreased. Thus, although there is no hard data to prove the point, it seems likely that elephant numbers have increased on the Ghanaian side of the border during the 1990s.

Relations between people and elephants

Sixty-six villages were visited, 42 in Ghana and 24 in Togo. Thirty-seven (or 56%) reported that elephants have damaged crops within the last ten years. Most farmers reported that elephants damaged crops around harvest-time, and noted that elephants usually take all food crops. Sometimes elephants open granaries, and occasionally break into compounds or houses to obtain stored grain.

A few elders said it would be a pity if their children

never saw elephants. But 84% of the villages (n = 49) claimed that elephants played no part in their lives or culture, other than as malevolent creatures that destroy their food supplies. Villagers often expressed their hostility towards elephants. On the other hand, 64% (n = 39) said that elephant dung or parts of elephants, such as the skin, are used as medicines in their villages. Elephantiasis, measles and skin rashes were most frequently mentioned ailments. They believe that dung has medicinal powers because the elephant eats a wide range of plant species. Since plants often contain pharmacologically active compounds, they believe that many medicines are therefore concentrated in the dung. Elephant dung is often sold in markets for this reason. The richer members of some ethnic groups used to make bracelets and amulets from ivory, but that practice seems to be dying out. The people of Pana (in Togo) differed from the others, as their clan reveres elephants because elephants are believed to be their ancestors.

Human population densities

The human population density of Ghana’s Upper East Region increased from 61 to 87 per km² between 1970 and 1984 (Anon, 1984). If human populations have continued to grow at the same rate, then numbers will have been about 118 per km² by 1996. The human population densities of the five prefectures in the Région

des Savanes ranged from 25 per km² around Mango to 201 per km² around Dapaong.

Soil fertility

Nine out of ten villages in Ghana and 21 out of 23 in Togo answered questions about soil fertility, ie. a combined percentage of 91%, reported that fertility had declined. Most explained the declining soil fertility by the shortage of land, which forces them to cultivate the same plots year after year instead of leaving them fallow. PNUD/FAO (1991) and DCA (1992) made the same point. Changes in cattle management mean that manure is no longer deposited on farmland, and fertilisers are too expensive.

In three villages no decline in soil fertility had been noticed (Weisi in Ghana; Penserie and Donga in Togo). Weisi lies in a sparsely populated area because it was a bad onchocerciasis zone. There is plenty of land and the people can still leave fields fallow. The people of Panserie were removed from their present location in 1980 when the area was declared a game reserve. The land lay fallow until their return 12 years later. Donga lies in the less populated part of north-eastern coiner of Région des Savanes.

The Regional Agriculture office was unable to provide information on soil fertility trends in north-eastern Ghana. In Togo, however, PNUD/FAO (1991) found that 23% of the soils surveyed in Région des Savanes were very degraded, 49% were medium degraded, and only 28% were not degraded. In particular, the area north of Dapaong, where the human density is high and land in short supply, was very degraded. The soils of the region are shallow and erosion has made large areas useless for cultivation (PNUD/FAO, 1991).

According to PNUD/FAO (1991), 65 to 80 people per km² is the density which the land can support in Togo (NB: it is not clear how this figure was calculated). Each person requires 0.5ha under cultivation plus 4ha of fallow (PNUD/FAO, 1991). These densities have long been surpassed in the Tône and Tandjouaré *prefectures* and also in Ghana's Upper East Region.

Game populations

Many elders commented on the transformation of the natural vegetation brought about by expanding villages. Forty-four out of 46 villages (ie. 96%) reported that wildlife populations had declined due to hunting and habitat loss. Among the antelopes

Jamieson (1972) saw on the Ghanaian side were roan (*Hippotragus equinus*), kob (*Kobus kob*), oribi (*Ourebia ourebi*), bushbuck (*Tragelaphus scriptus*), and red-flanked duiker (*Cephalophus rufilatus*), but 24 years later in the same area only oribi were seen. The elephant is the only large mammal species which has not declined on the Ghanaian side. This is largely because elephants are known to be protected by the government, and few hunters have powerful enough rifles to kill elephants.

Rainfall

Eight out of nine villages in Ghana and 22 out of 23 in Togo (ie. a combined percentage of 94%) reported that rainfall has decreased, and they also complained that the rains were less predictable. Many said that the wet season is shorter now, because the rains start later and end earlier. Consequently they must plant their crops in May or June rather than in April as in the past. One chief said that streams and shallow wells had dried up because the water table was falling.

In Upper East Region we obtained rainfall records for Navrongo (1932 to 1995) and Gambaga (1925 to 1959, and 1967 to 1976). In Région des Savanes only those for Mango (1969 to 1995) could be obtained. The Navrongo time-series (Figure 2) is the longest, covering 64 years. The running mean shows an apparent decline in rainfall between the early 1930s and the early 1990s (Figure 2). A linear regression of the records lying between the first and last peaks indicates a significant decline of 3.1mm per annum ($r = -0.318$, $n = 56$, $P < 0.05$).

There are a number of peaks and troughs in the Navrongo time-series. The running mean shows abundant rain in the early 1930s and for most of the 1950s. Then there were smaller peaks in the early 1970s and late 1980s. However, a Fourier Series analysis (Wilkinson, 1990) of both the raw data and the smoothed series does not indicate any rainfall cycles (Sam *et al.*, 1996). Therefore these are irregular fluctuations rather than cycles. The recent rainfall decline mentioned by villagers in 1996 is because the first half of the 1990s saw a downswing in the most recent fluctuation.

Thus we can break the Navrongo time-series into three components. The first is the long-term decline. The second is the irregular fluctuations which cause peaks and troughs. The third is the random year-to-year variation.

The relationship between net annual above ground productivity (NAAP, measured in gm per m²) and rainfall for sites with rainfall between 12

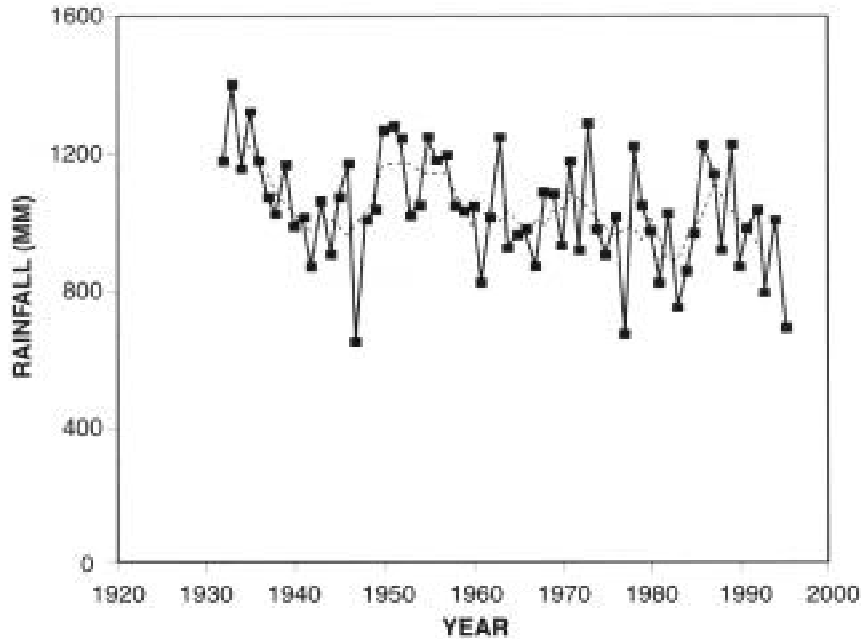


Figure 2. Rainfall records for Navrongo for 1932 to 1995 The broken line is the five -year running mean; it shows the trend in the average rainfall.

(R, in mm) is given by Rosenzweig (1968):

$$\log_{10} \text{NAAP} = 1.66 \log_{10} R - 1.66$$

and 1,318mm per annum. This equation reveals a non-linear relationship. For example, a decline in rainfall from 1,000mm to 900mm (ie. a 10% reduction) produces a 16% decline in plant productivity. The average plant productivity of the five most recent years is 25% less than that of the five preceding years.

Temperatures

Data on mean maximum and minimum temperatures were available for Mango (1969 to 1995) and Navrongo (1961 to 1995). For each series we compared the first and last five-year periods. Table 1 shows a warming trend on both sides of the border. The study area is warmer now than in the early 1960s or 1970s.

DISCUSSION

Environmental degradation

Rainfall

Elsewhere in West Africa there is evidence for a later start and earlier end to the wet season (Adejuwon *et al.*, 1990). A false start to the rains causes poor germination as farmers plant their seeds too early; an early finish means that late crops do not mature fully (Adejuwon *et al.*, 1990). However, the Navrongo and Mango data did not corroborate the farmers' assertion that the wet season was starting later. But both showed that in the last five years less rain fell in September, the end of the wet season.

The Navrongo time series confirmed the farmers' complaints of a long-term decline in rainfall, as well as the short-term decrease in the last few years. Rainfall has also decreased in southern Ghana in recent decades (Barnes *et al.*, 1997), and West Africa in general has seen a decrease, especially since 1970 (Hulme, 1992; Nicholson, 1993).

Table 1. Changes in mean temperatures for two meteorological stations.

(a) Navrongo	
Variable	Difference between 1961 - 1965 and 1991 - 1995
Monthly mean maximum	Higher in 11 months of the year
Monthly mean minimum	Higher in all months of the year
(b) Mango	
Variable	Difference between 1969 - 1973 and 1991 - 1995
Monthly mean maximum	Higher in 7 months of the year
Monthly mean minimum	Higher in 11 months of the year

Figure 2 shows fluctuations which are irregular in both period (that is, the time from one peak to the next) and amplitude. These are not cycles which are regular in period and amplitude, but rather irregular fluctuations. Such fluctuations can sometimes be generated by random variations in rainfall (Burroughs, 1992). The rainfall trend for the West African Sahel depicted by Bunting *et al.* (1976: Figure 3) for 1930 to 1970 is similar to that shown by the dotted line in Figure 2 for the same years. Bunting *et al.* (1976: page 62) concluded that the Sahelian fluctuations were “small in amplitude...and have no regular pattern” and “are to be expected from a random series”.

Such fluctuations have important implications for the human condition and the management of natural resources in northern Ghana and Togo. Rainfall affects crop growth, pasture growth, and the productivity of wild plants consumed by domestic and wild animals, including elephants. Changes in rainfall produce disproportionate changes in plant growth. A long-term decline in rainfall combined with the downswing of the rainfall fluctuation during the first half of the 1990s (Figure 2), implies lower plant productivity, at least around Navrongo. Therefore, during the first half of the 1990s the land could support fewer people, fewer domestic animals, and fewer wild animals than say 50 years ago. If soil fertility has also decreased, then as a result of changes in both rainfall and soil, the land can support fewer people than before.

Although Rosenzweig's (1968) equation applies only to wild plant productivity, a similar relationship should apply to crop growth. This is illustrated by the sharp drops in crop yields in Région des Savanes during 1988 and 1990 (see Figure 5 in PNUD/FAO [1991]). Less rain fell at Mango in those two years (88% and 78% of the mean respectively), yet yields of yams, groundnuts, and beans fell by about half. These irregular fluctuations will therefore produce lean years and fat years. Our study

coincided with a lean period.

Temperatures

Temperature changes may be associated with global warming (Houghton *et al.*, 1996), with the global ocean circulation and patterns of sea surface temperatures (Hulme, 1992), with desertification in the Sahel (Sinclair and Fryxell, 1985), with local landscape changes such as bush clearance, or a combination of these factors.

Ghana's human population has grown ten-fold during this century, while Togo's has grown five-fold since 1920 (Sam *et al.*, 1996). Much of the natural vegetation in northern Ghana has been cleared for villages and farms (Boateng, 1970). The replacement of the natural vegetation by cultivated land, which is bare for a large part of the year, will increase the albedo (the amount of energy from the sun that is reflected back to the atmosphere). When solar energy falls upon natural vegetation it is absorbed and used in evaporation and transpiration which has a cooling effect. Thus temperatures are higher over cleared land (Ripley, 1976).

Albedo, evapotranspiration and heat balance (the amount of heat stored by and moving to or from the soil, the vegetation, and the atmosphere) are all interlinked and affect the climate. The effects of land use on albedo, temperature, and rainfall depend upon soil type, soil moisture, the amount of plant litter covering the soil, the density of trees and shrubs, latitude, and season (Ripley, 1976; Charney, Stone and Quirk, 1975; Sinclair and Fryxell, 1985). All that can be shown at present is that the landscape of Upper East Region and Région des Savanes is changing as a result of increasing human populations, and that the rainfall and temperature records indicate that the local climate is also changing. These climatic changes will affect both agriculture and

pastoralism. They will also affect elephants. For example, decreasing rainfall means less forage available to elephants, and a falling water table will cause streams and water holes to dry up earlier in the dry season, or to dry up completely. The earlier drying of water holes will affect the behaviour and movements of elephants. Since people usually concentrate around permanent water sources, there will be more frequent contact between elephants and people.

Temperature changes also affect the behaviour and movements of elephants because they are sensitive to heat, especially the young (Barnes, 1983). Temperature also affects plant growth and therefore the amount of food available to elephants.

It is assumed that the trends towards a warmer drier climate will continue. While that could be the case if the changes are due to human impacts, it is possible that the changes are due to natural variations in the regional climate. In that case the future could bring a period of wetter years.

Crop-raiding

The geography of the area complicates management of the crop-raiding problem. The Forest Reserves along the Red and White Voltas and the Morago river (Figure 1) provide refuge for elephants in Ghana. Settlement is forbidden and human activities are limited; there is good forest cover, having a higher percentage canopy cover than outside; and they are close to water. Their elongated shape creates a long boundary per unit area of forest. Elephants can emerge from the forest at any point along the boundary, making it impossible to deploy the elephant control unit effectively, and fencing the forests would be prohibitively expensive.

On the Togolese side, the corridor between Forêt de Doung and Fosse-aux-Lions NP is also long and narrow and lies adjacent to cultivation. A proposal to fence the corridor (Stalmans & Anderson, 1992) was abandoned in 1990 to 1992.

“Elephant problems” are often symptoms of changes occurring elsewhere in the ecosystem. Such changes cause elephants to move from one place to another or to change their behaviour. It is suggested here that crop raiding has increased in the Red Volta valley because of a combination of factors. The political upheavals in Togo drove elephants out of the Togolese parks and some went to the Red Volta valley (Okoumassou *et al.*, this volume). The growing human population needs farmland, and the shortage of land causes the same plots to be cultivated year after year (PNUD/FAO, 1991; DCA, 1992). As the

productivity of the soil falls, more land is needed to feed each person, and there are more mouths to feed every year. Yet the supply of land is fixed and so there is less space for elephants. Inevitably this will lead to greater conflict with people.

Food aid is sometimes needed in the Upper East Region. Against a backdrop of poverty and declining natural resources the people in the Red Volta valley are even less able to bear the losses caused by elephants. Indeed, the presence of elephants imposes a cruel and intolerable burden upon them. Yet it is our sad conclusion that the local people have unwittingly helped to generate the problem by moving into areas formerly occupied by elephants, and taking more land as their villages grow.

RECOMMENDATIONS

Human ecology

The future of elephants in northern Ghana and northern Togo is inextricably entwined with the human condition and the state of the natural environment. A management approach based on ecosystems must be adopted to ensure a future for both people and elephants. Thus certain key questions of human ecology have to be addressed in order to secure the future of elephants:

- i) What is the rate at which the natural vegetation is being cleared for settlement and agriculture?
- ii) What is the rate of change of soil fertility? What is the rate of change of crop yields in relation to the number of years the land has been farmed? Yields vary with soil type, time the soil has been cultivated, and with rainfall, so research should be designed to account for all three variables. This question could be answered by a series of plots on farms, stratified by soil type, which have been under cultivation for different periods. The research activities would need to run for several years to account for year-to-year variations in rainfall.
- iii) What is the rate at which the human population is growing in each district *or* *prefecture*?

The answers **to** these three questions will tell us how many people the land can support, ie. the human carrying capacity. The following aspects of the physical environment must be evaluated:

- iv) Changes in the local and regional climate, by an analysis of records from many meteorological stations.

- v) Changes in stream flow and watertable levels.
- vi) Loss of topsoil through erosion.

The following aspects of the biotic environment must be evaluated:

- vii) The trend in firewood resources.
- viii) Grazing resources in relation to livestock.
- ix) The rate of loss of game populations (ie. the resources of wild meat).

This study was a short study, and the conclusions conform to the standard paradigm of increasing human populations degrading semi-arid environments. That interpretation has been challenged recently (eg. Beinart, 1996; Brockington & Homewood, 1996) and the suggested studies above will confirm whether or not this interpretation of the processes taking place in the study area is correct. Furthermore, only one set of long-term rainfall records was obtained for the entire study area and many of the conclusions are based upon that set. Figure 3 shows that there are differences between the three sites.

One would expect Gambaga to differ from the other two because it is an upland site. Mango is less variable than Navrongo but still shows the same decline during the 1990s. Ideally, one should use the average trend from a network of rain gauges. At one time Ghana had a national network, but it broke down during the recession of the 1970s and early 1980s.

Elephant ecology and land use

Estimates of elephant numbers are essential, as well as information on seasonal distribution. Burkina Faso, Togo, and Ghana need to collaborate in a study of movements between the different parts of the study area.

Burning, grazing, and wood-cutting inside the Forest Reserves will make them less attractive than farmland to elephants, so a balance must be found between human disturbance inside the Reserves and the need to keep elephants within their boundaries.

These studies must form the basis for a land use plan which stipulates how much land is to be reserved for natural vegetation and wildlife, not forgetting the need to protect water catchments.

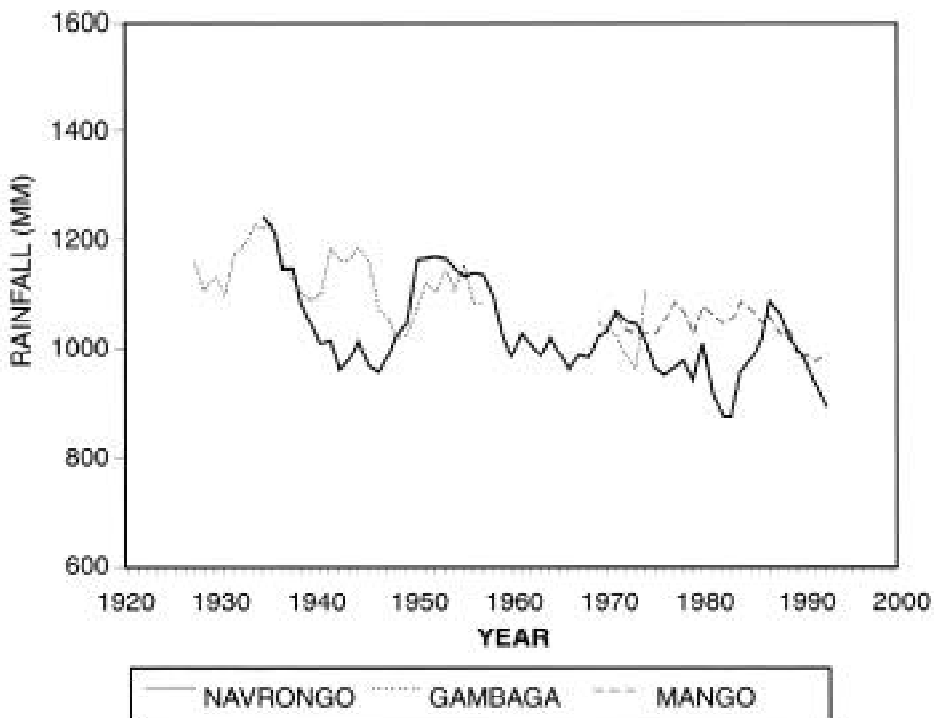


Figure 3. A comparison of the long-term trends of Navrongo, Gambaga, and Mango. The five-year running mean is shown for each site.

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MORTALITY FACTORS AND BREEDING PERFORMANCE OF TRANSLOCATED BLACK RHINOS IN KENYA: 1984-1995

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ABSTRACT

Between 1984 and 1995, 118 black rhinos (*Diceros bicornis michaeli*) were translocated into, and between, rhino sanctuaries in Kenya. The majority of these were surplus animals removed from existing sanctuaries, with fewer stragglers 'rescued' from non-viable situations. There was high mortality after release from non-human causes (16% of rhinos translocated), with intraspecific fighting being the major mortality factor (53% of all deaths). Immature females and adult males had lower survival rates and suffered higher fighting mortality than other age/sex categories, and fighting mortality was confined to animals introduced singly to new reserves, or in small groups. The total translocated sample showed a growth rate of 4% per year following translocation, increasing by 12% by the end of 1995. This was well below the potential rate of increase, with the breeding performance of translocated females being less than 50% of reasonable expectation. Several females were slow to calve after introduction, or had not yet done so. Female stragglers translocated to sanctuaries were slow to produce their first calves relative to animals moved from sanctuaries, but had similar breeding rates overall. A population-level analysis of a larger sample of translocated rhinos is needed to determine the main causes of poor breeding performance, and thus to help promote enhanced growth rates of new populations.

RESUME

Entre 1984 et 1995, 118 rhinos noirs (*Diceros bicornis michaeli*) ont été transloqués à l'intérieur et entre les sanctuaires de rhino au Kenya. La majorité d'entre eux était constituée de surplus d'animaux retirés des sanctuaires existants, avec moins de traînards sauvés de situations non viables. Après le lâché, il y avait une forte mortalité (16% des rhinos transloqués) liée à des causes non-humaines, les conflits spécifiques internes ayant été le facteur potentiel de mortalité (53% de tous les décès). Les femelles immatures et les mâles adultes avaient un taux de survie inférieur et ont souffert des mortalités liées aux grands conflits par rapport aux autres catégories d'âge et de sexe. Aussi, la mortalité portait sur les animaux introduits, particulièrement dans les nouvelles réserves ou en petits groupes. L'échantillon du total transloqué présentait un taux de croissance de 4% par an suivant la translocation, une augmentation de 12% avant la fin de 1995. Cela a été bien en dessous du taux d'augmentation avec une performance de reproduction des femelles déplacées qui a donné moins de 50% du résultat raisonnable. Plusieurs femelles étaient lentes à vêler ou n'étaient pas encore dans cette situation. Les femelles traînards déplacées dans les sanctuaires étaient lentes dans la production de leur première vêler en relation avec les animaux déplacés des sanctuaires, mais avaient dans l'ensemble, un taux de reproduction similaire. Une analyse du niveau de la population d'un grand échantillon de rhinos déplacés est nécessaire pour déterminer les principales causes de la pauvre performance de reproduction en vue d'aider à promouvoir l'accroissement du taux de croissance des nouvelles populations.

INTRODUCTION

Translocation has been a key component of successful rhinoceros conservation programmes in Africa (Hitchins *et al.* 1972; Cumming *et al.* 1989; Brooks 1989). Together with adequate security and protection, the translocation and successful introduction of black rhinos (*Diceros bicornis*) to new reserves have proved essential to developing viable populations of this

species. Since 1984, Kenya has focused its rhino conservation effort on the intensive protection and breeding of its remaining animals in relatively small protected areas, or sanctuaries (Jenkins, 1983; Brett, 1990; KWS, 1993; Leader-Williams *et al.* 1997). The goal is to breed up and maintain a minimum total population of 2,000 black rhinos (*D. b. michaeli*) in their natural habitat, currently accepted as a minimum

number required for a genetically viable metapopulation of this subspecies (Du Toit *et al.*, 1987; Brooks, 1989). Kenya's present rhino conservation plan (KWS, 1993) has four objectives:

- to secure and protect all remaining rhinos;
- to capture and translocate all isolated, non-breeding or non-viable rhinos or rhino groups into sanctuaries for their own protection and to contribute to breeding;
- to remove any recognised surplus of rhinos in sanctuaries approaching or exceeding their carrying capacities on a basis of maximum sustainable yield;
- to translocate surplus rhinos to stock new sanctuaries and unfenced release areas located in larger areas of secure habitat.

Kenya's total population of about 440 black rhinos is fragmented into more than 15 sub-populations, none numbering more than 70 animals (Brett, 1994; Oloo, 1996). Without intensive management involving the continuous monitoring of population size and structure, and the periodic introduction and exchange of unrelated rhinos, most or all of the these populations are not viable in the long term (Dobson *et al.*, 1991). The recommendations of a Population and Habitat Viability Analysis (PHVA: Foose *et al.*, 1993) and additional

population modelling (Lacy, 1987; Dobson *et al.*, 1991) sanctuaries by the end of 1995.

Translocation was originally used in Kenya largely for the removal or rescue of individual rhinos from non-viable locations for subsequent introduction into protected areas (eg. Hamilton & King, 1969). Over 100 black rhinos were translocated to reserves in Kenya between 1959 and 1984, all animals which had been captured in areas vulnerable to poaching and/or being occupied by human settlement. More than half of these rhinos were used to stock two small reserves (Nairobi National Park(114km²) and Solio ranch (56 km²) with rhinos between 1963 and 1980 (Hamilton and King, 1969; KWS, 1993). These populations prospered, and after 1986 each had substantial surplus numbers available for subsequent translocation and progressive stocking of newly developed sanctuaries, for which each had been such successful models. The Nairobi and Solio populations have now produced three and five times their respective founder populations (Table 1). Consequently, since 1984, most rhinos translocated have originated from these sanctuaries. Increasingly, the management of remaining wild populations for improved population performance is now based upon translocation between protected areas (KWS, 1993). The Kenya rhino programme has shown some success: between 1986 and 1990 rhino numbers in sanctuaries increased at

Table 1. Supply of Rhinos for translocation (1984-1995), with (a), surplus Rhinos from sanctuaries, and with (b), straggler/outlier Rhinos (isolated, non-breeding and/or vulnerable animals)

Source	Number of founders of donor populations (years of stocking)	Number of rhinos translocated	Population total (1995)	Population change: number of Rhinos	multiple
(a) Surplus from sanctuaries					
Solio Ranch	22(1970-80)	61	50	+81	5.05
Nairobi NP	37(1963-80)	26	64	+53	2.43
Exchanges (between sanctuaries)	10				
Subtotal		97			
b) Stragglers*					
		21			
Total		118			

* Captured in remote areas of Samburu, Laikipia and Nyeri Districts and the periphery of Tsavo National Park.

approximately 5% annually (Brett, 1990,1991; Gakahu, provided the basis for the adoption of 20 rhinos as the minimum number of founders of new populations, the managed migration of one to two unrelated rhinos between populations per generation, and a short-term translocation programme to complete the minimum

stocking of existing 1989; KWS, 1993).

This paper reviews the results of Kenya's recent 12-year translocation programme (1984-1995) and examines the performance of source and translocated sanctuary populations. It determines the major causes

of mortality in translocated populations, and makes a preliminary assessment of the breeding performance of translocated individuals. The aim is to identify factors affecting the survival and breeding output of translocated individuals which could be used to derive criteria or guidelines on translocations for wildlife managers implementing rhino conservation plans.

METHODS

Supply and destination of translocated rhinos

A total of 121 rhinos were captured for translocation during the 12 year period under examination. Of these 111 different rhinos were introduced into new reserves (118 translocations completed). Eight rhinos died during the capture or translocation process (6.6% of all captures) and consequently were never released into a new reserve, and two others were moved to isolation in paddocks. The majority of rhinos translocated over this time (82%) were surplus animals from sanctuaries exceeding their respective estimated Ecological Carrying Capacities (eECC) (Table 1), the majority originating from Solio ranch and Nairobi NP. The remaining rhinos translocated (18%) were captured in situations where they were isolated, vulnerable to poaching and/or out of breeding contact with other rhinos (termed 'stragglers' or 'outliers': Leader-Williams *et al.*, 1997). There was no significant bias of the sample of translocated rhinos with respect to sex (57 males: 61 females), and there were similar numbers of adult and immature animals moved (61:57).

The rhinos supplied were translocated to nine different reserves (Table 2). With the exception of eight animals added to three already existing rhino populations, all rhinos were translocated as founder stock for six new populations (five rhino sanctuaries and one intensive protection zone (IPZ: Leader-Williams *et al.*, 1997), all developed after 1984. Each of these areas received a minimum of 20 founders, with the exception of the ill-fated 4km² sanctuary in Meru NP. Here, the first two rhinos translocated were poached within a year of introduction, and the sanctuary was abandoned soon afterwards.

Approximately one quarter of all rhinos were translocated and released singly (including most of the 21 straggler rhinos captured). Others were released in pairs, and groups of three, four, seven and eight. A group release was made if all rhinos were released into the recipient reserve from holding bomas in as many days

(eg. seven rhinos released within one week). Translocations to all recipient reserves were spread over the 12-year period (Figure 1), largely due to the lack of resources needed to carry out expensive operations, and other logistic constraints. All rhinos were captured by chemical immobilisation, and either moved immediately to destination reserves, held at the capture site in holding bomas and/or held in bomas at the release site in the recipient reserve prior to release. Holding periods at capture or release sites varied from a few days to over 12 months.

Long term daily monitoring of sanctuary populations provided life history data on all individually identified rhinos and the sex/age composition of each rhino population, including all births, deaths and causes of mortality. All translocated rhinos were ear-notched at capture to assist subsequent individual identification. Where precise ages were not known from life history records, ages of translocated animals were estimated at capture by examination of tooth wear (Hitchins, 1978; Du Toit, 1986), or judged adult or immature using the field criteria developed by Hitchins (1970), and modified by Emslie *et al.* (1993), where females become adult at seven years of age, and males at eight. All rhinos translocated were subject to intensified surveillance in the first few months after release.

In order to examine individual and collective mortality and breeding of rhinos after translocation, data were compiled into a database for all black rhinos which were introduced to new reserves between January 1984 and December 1995. The database comprised a matrix with row entries for each individual rhino for each year following their translocation, a total of 543 rhino years. Data on mortalities and births were entered for each rhino, including the causes of mortality, and the sex and survivorship of calves born. Additional column entries were data selected as possible factors influencing translocation success, including attributes of the individual rhino selected (eg. sex and age), of time elapsed after translocation, and of the translocation procedure (eg. size of group of rhinos released together).

RESULTS

Performance of recipient populations

The total sample of translocated rhinos had increased by 11.7% at the end of the 12-year study period, equivalent to a 4.1% increase per year following translocation. At the end of 1995, there were 88 survivors (79%) out of the original 111 rhinos introduced to new reserves. Breeding performance was highly variable, with only

Table 2. Reserves receiving translocated rhinos (1984-95) in (a), stocking of new rhino sanctuaries, or (b), reinforcing existing rhino populations.

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- ^a Intensive Protection Zone (unfenced area of high security for Rhinos within a protected area (eg. Tsavo East NP))
- ^b The Lewa downs sanctuary was extended to 40 km² in 1987, and further enlarged to cover the entire ranch and a neighbouring forest reserve in 1984
- ^c Kenya Wildlife Service (National Park)
- ^d The Ngulia sanctuary was extended to 20 km² in 1987 and to 65km² in 1990 -91
- ^e Estimated Ecological Carrying Capacity of reserve for Rhinos (Foose et al., 1983; KWS, 1993)
- ^f Excludes one Rhino removed from Lake Nakuru NP and four from Lewa Downs

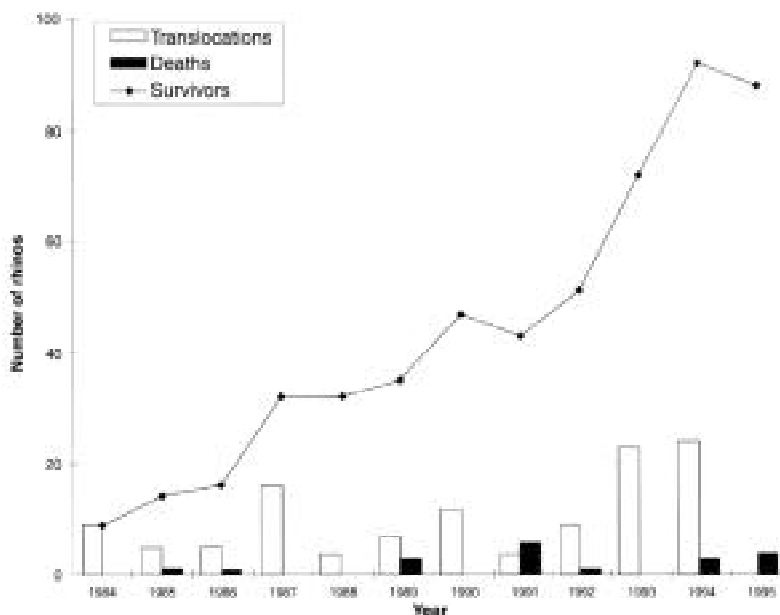


Figure 1. Distribution of the number of rhinos translocated, and the number of deaths and survivors among translocated rhinos by year (1984-1995).

two populations (Lake Nakuru and Ngulia) showing significant population growth (41% and 45% respectively), while two reserves (Lewa Downs and Ol Pejeta) have had significant mortality, equalling two populations (Lake Nakuru and Ngulia) showing or exceeding the number of calves born (Table 2). The Tsavo East IPZ has had insufficient time since minimum stocking to show appreciable population growth, and the founder stock has since been doubled by further translocations of surplus rhinos from Nairobi NP since 1995.

Causes and timing of mortality

Intraspecific fighting with resident rhinos was the major cause of mortality among translocated rhinos, accounting for 12 out of 23 deaths, and more than half of the 19 'natural' deaths (those not directly caused by humans) (Figure 2). The next most common cause of death was falling over cliffs, accounting for three rhinos in the Lewa Downs reserve. Other 'natural' deaths included one rhino that fell over a fallen tree trunk, one killed by an elephant (Figure 2), and another death from old age. Three other deaths were from unknown causes; in two of these cases, fighting was suspected.

Most 'natural' deaths occurred in the first five years after introduction (Figure 3), particularly in the case of fighting mortality, which was restricted to the first two

years. Closer examination of the timing of fighting mortality after release (Figure 4) revealed an initial peak of deaths within the first three months (25%) related to the translocation process, and another peak between six and 12 months in residence. In all cases where combatants were identified (eight out of 12), resident adult males killed translocated rhinos.

There was a slight bias of all deaths in the translocated sample towards adult males and immature females ($X^2=7.83$ $df=3$, $p<0.05$). A similar, but not significant bias was found with deaths from fighting (Figure 5). The sex and age composition of groups of rhinos released in new reserves, and the incidence of mortality with group size show that most deaths occurred to rhinos released in small groups (four rhinos or less). Fighting deaths were only found in small groups, particularly with rhinos released singly (Figure 6). Although it appears that there was a sex and age bias in mortality of small groups (eg. all adult males killed in fights were released singly: Figure 6) this was due to a significant bias in the sex/age composition of small groups translocated towards adult males and immature females (eg. singles and pairs of rhinos: $X^2=8.44$, $df=3$, $p<0.05$).

Breeding performance of females

A total of 44 calves were born to translocated females, of which 36 survived to the end of 1995 (Table 1 and Figure 7). Of the 59 females translocated (30 adult, 29

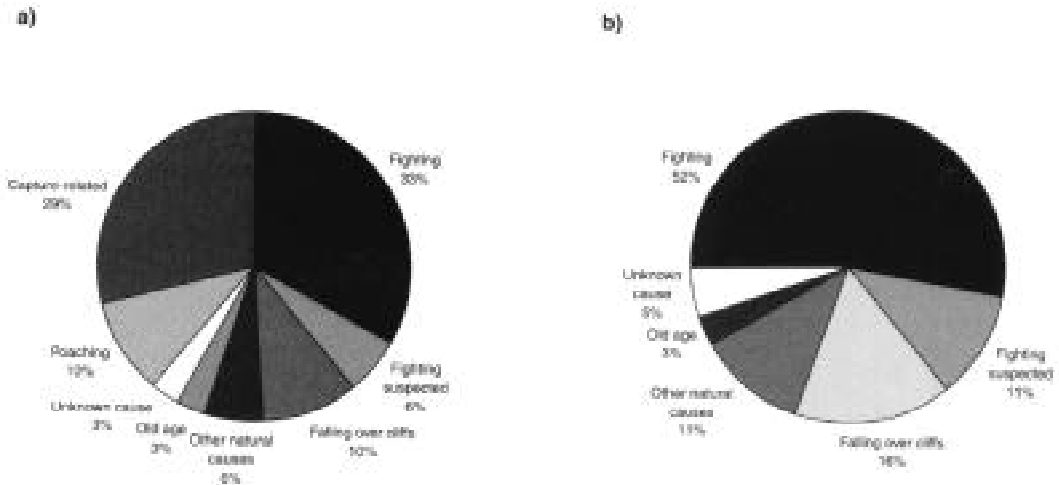


Figure 2. Relative proportion of causes of mortality to rhinos which were captured, translocated and introduced to new reserves:

- (a) all deaths (n=23);
- (b) 'natural' deaths (n=19, excludes human-related deaths: 3 poached, 1 during capture).

immatures), 33 had sufficient time in residence in recipient reserves to produce at least one calf (ie. more than one gestation period of 16 months: Goddard, 1967, and assuming that on average young females produce their first calves at the age of seven), a total of 227 rhino years of potential breeding. Four females had calved out of the 12 immature rhinos which became adults after translocation. Seven of the latter had sufficient time in residence to have calved.

A total of 25 females had calved by the end of 1995(76% of potential mothers), of which 21 were translocated as adults, and four as immatures. The mean time spent by females as adults after introduction to new reserves was 6.9 ±3.2 years. The distribution of calves born within a year after their mothers' introduction is shown in Figure 8. Eight calves were conceived in donor reserves (ie. before translocation), and their mothers were pregnant when released.

Adult females (including animals pregnant at translocation) took an average of 3.4 ±2.2 years to produce their first calves in the new reserve (n=21), with non pregnant animals calving 4.6±2.1 years on average after translocation (n=13). At the end of 1995, eight females had spent an average of 3.6 ±1.6 years as adults in residence, and had still not calved. Of these, two appear to be infertile (no calf after 6 years). Only a small number of females were of known age at translocation, and of those which had calved, the

mean age at first calving was 8.7 ±1.0 years (n=6, range 7-10).

Adult, not pregnant females who were translocated had similar calving rates in recipient reserves whether they were captured as stragglers (0.18 calves/year, n=7) or as surplus rhinos moved from other sanctuaries (0.19 calves/ year, n=6), with a comparable proportion of females breeding (80 vs. 67%) in each case. However, stragglers took significantly longer than ex-sanctuary females to have their first calf (5.4 vs. 3.6 years; z=1.71, p<0.05).

There was poor survivorship of calves whose mothers were translocated while pregnant (ie. calves conceived in previous locations). Of all four calves dying in the first week after birth, three were born to mothers translocated while pregnant. Half of the eight calves conceived before translocation of their mothers did not survive their first year.

Overall there was no bias in the sex ratio of calves born to translocated rhinos (22 males, 21 females, 1 unsexed). However, sex ratios of calves born in particular sanctuaries did show a marked, but not consistent bias. For example, male calves exceeded female calves by approximately 2:1 in the Ngulia and Lake Nakuru sanctuaries (6:3 and 9:5 respectively) but the reverse was found for calves born at Lewa Downs (4 males: 8 females).

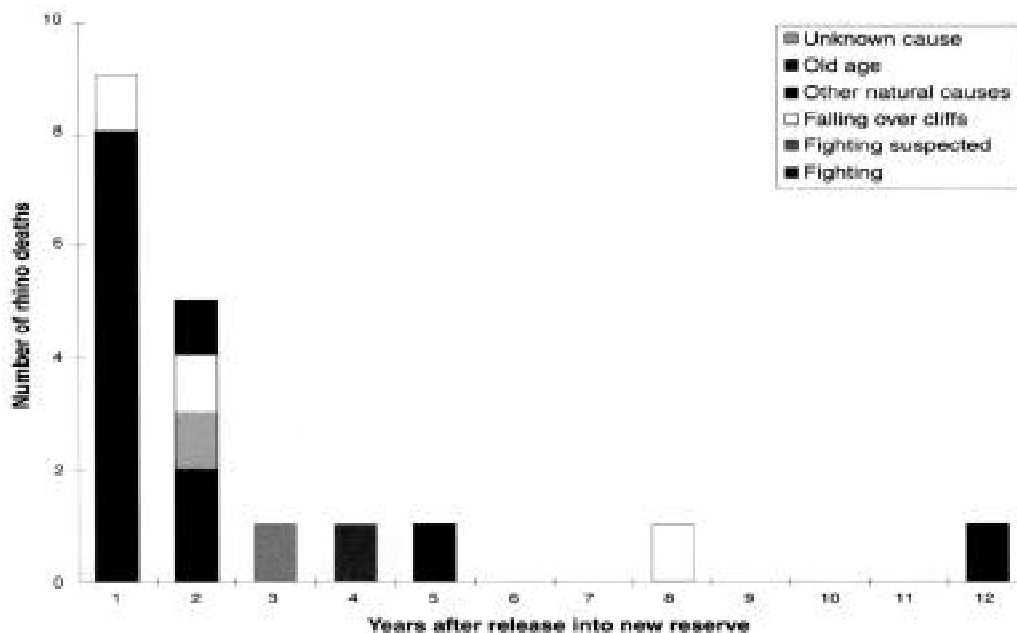


Figure 3. Distribution of mortality of rhinos with number of years after introduction to new reserves and cause of death.

DISCUSSION

Mortality factors

Intraspecific fighting of translocated rhinos in the first two years after introduction to new reserves in Kenya was the major mortality factor affecting all sex and age groups. High levels of fighting mortality in translocated populations have also been recorded in southern African populations since 1989 (Adcock, 1995, 1996), accounting for 41% of natural deaths. Overall mortality of translocated rhinos has been similar (24% of 148 translocated rhinos vs. 21% for Kenya: 1984-95). Intraspecific fighting is clearly a major problem facing rhino managers in translocating animals to form new populations, and in particular, in introducing rhinos to established populations. This factor clearly needs to be reduced in order to promote the rapid growth of translocated populations.

In past rhino translocation programmes in Africa, mortality related to disease, dispersal, capture and stress was more prevalent (Clausen, 1981; McCulloch and Achard, 1969; Hamilton and King, 1969; Booth *et al.*, 1981), and these have now been much reduced through improved capture methodology and translocation management (Kock, 1993; Rogers, 1993). However, accidental death, the other significant mortality factor

identified in this study, may be an inevitable toll on rhinos, translocated or otherwise. The black rhino's vulnerability to falling over cliffs and getting stuck in water holes was always a feature of former, very large wild populations. For example, after poaching, these were the major mortality factors in over 700 rhino mortalities recorded by Tsavo East NP wardens D.L.W. Sheldrick and F.W. Woodley between 1949 and 1974 (KNP, 1949-74; see also Hitchins, 1962; Hitchins & Anderson, 1983). A further two cliff deaths occurred on Lewa Downs in 1995, involving the calf and grand-calf of one of the first adult females translocated from Solio in 1984. Published accounts of predation by lions (*Panthera leo*) and spotted hyaenas (*Crocuta crocuta*) on black rhino and their calves have been little more than anecdotal (Sillero-Zubiri & Gotelli, 1991; Goddard, 1967; Berger *et al.*, 1993); no cases of predation have been reported on this translocated sample, or their calves.

Mortality of rhinos during capture and translocation in Kenya during 1984-95 was relatively low (<10% of translocations; compare with McCulloch and Achard, 1969; Hitchins *et al.*, 1972; Hall-Martin, 1982; Hall-Martin & Hillman, 1983; Hitchins, 1984), but difficult to compare with recent figures for other range states (eg. South Africa, Namibia and Zimbabwe: Adcock, 1995, 1996; Kock, 1993), where fighting mortality within the first three months after introduction ('post-release fighting') is judged to be 'translocation-related', and

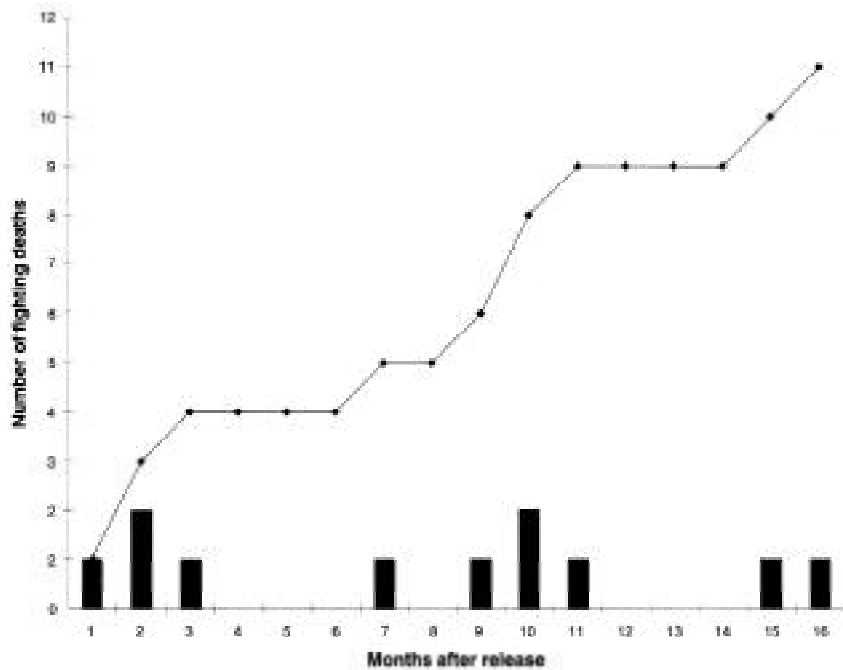


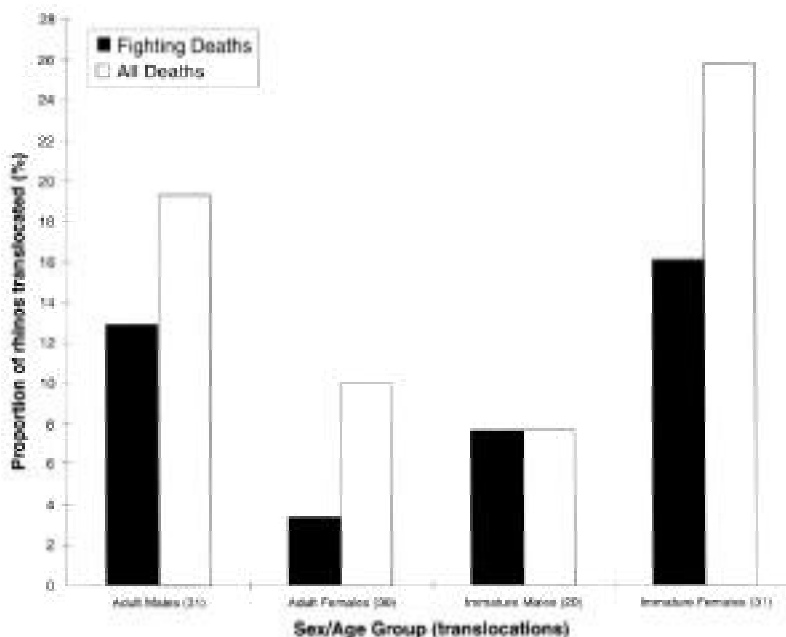
Figure 4. Distribution of individual and cumulative fighting mortalities in the first 16 months after introduction to new reserves.

subsequent fighting mortality recorded as 'natural'. Although a quarter of all fighting deaths to translocated rhinos in Kenya were recorded within the first three months of residence (Figure 4), fighting mortality occurred through the first 16 months of residence, indicating that it may take some time before the repercussions of the introduction of a strange rhino are felt in terms of the probability of a potentially lethal encounter with a resident

A recent statistical analysis of this data set (Brett *et al.*, unpubl) examined the effects of 30 different explanatory variables on the probability of individual survival and fighting mortality after translocation, using generalised linear modelling. The explanatory variables tested included attributes of the rhino translocated (eg. sex), of the recipient rhino population (eg. rhino density), of the recipient reserve (eg. estimated Ecological Carrying Capacity (eECC)), of time (eg. years since release) and of the translocation procedure (eg. release group size). Although individual survival was found to be primarily related to attributes of the recipient reserve (eg. reserve eECC) with some effect of the age group of the introduced rhino), the best model of the probability of fighting mortality was related to one factor: the size of the group of rhinos introduced together. It was expected that rhino density, in absolute terms and as a proportion of eECC, would have a strong effect on post-

translocation mortality, perhaps associated with overstocking in some recipient areas. These attributes, however, were found to be of secondary importance. Clear recommendations for rhino managers were derived from this analysis: to improve individual survival after translocation; move rhinos to reserves with excellent habitat (high eECC density) at a relatively low rhino density, and in large groups; and, select adults for translocation, and adult females if available.

In Kenya and elsewhere in Africa, sub-adult rhinos (four to seven years old) have often been selected preferentially for translocation, and younger animals (two to three years old) still with their mothers have also been included. Forty two percent of the translocated sample studied here were of the sub-adult category; these rhinos are more convenient to move (since they have no dependants), would normally be dispersing in order to establish themselves in a new range in the natal area, and have their whole breeding life ahead of them. These results suggest that immature rhinos (particularly females) are least likely to survive after translocation (Figure 5). This may be because they are least able to look after themselves after release into an unfamiliar area and population, often seeking out the company of other rhinos, which can get them into dangerous situations if they approach an adult male. The



Figures. Relative proportion of mortalities and fighting deaths suffered by different sex and age groups translocated.

poor survival of immature females in Kenya and southern Africa (where one to four year olds were at highest risk: Adcock, 1995, 1996) may also be linked to lethal encounters with resident males who try to mate with them.

Another clear finding of this study and of Brett *et al.* (unpubl) was the preponderance of deaths (including all fighting deaths) suffered by animals released singly, or in small groups (four or less: Figure 6). The consensus of rhino managers in eastern and southern Africa is that large numbers of rhinos should be moved into a vacant reserve area within a relatively small time, giving little opportunity for any resident animals to assert themselves, or to become aggressive to newcomers (Brooks, 1989; Zimbabwe DNPWLM, 1992; KWS, 1993). Due to financial and other constraints, it is rarely possible to stock a new reserve with more than 20 rhinos in one operation, and thus other variables (eg. the age and sex of translocated rhinos, the density and eECC of recipient reserves) may assume increased importance in translocation decisions.

Population performance and breeding output in females

The translocation of black rhinos into sanctuaries over the last 12 years has resulted in a small overall population increase, and has also fulfilled the guidelines adopted for genetic and demographic management of the Kenya

black rhino metapopulation (KWS, 1993; Foose *et al.*, 1993). In itself, the removal of 21 stragglers from highly vulnerable situations, and of 87 surplus rhinos from overstocked sanctuaries (Table 1) was essential for the immediate survival of those stragglers (and any future breeding on their part) and the future health of key breeding populations (eg. Solio and Nairobi NP).

However, the reproductive performance of this translocated sample was below expectation. Compared with a modest prediction of each adult female having a mean calving interval of three years (Goddard, 1967, Hall-Martin, 1986), the conception and calving output in recipient reserves was less than half (45%) of an expected minimum total (78 calves). The overall annual growth rate of translocated populations (mean of 2.9%) was well below that of the two source populations Solio (4-10% annual growth) and Nairobi (10% annual growth; KWS, 1993; Leader-Williams, unpubl). Reduced performance of translocated rhinos has also been noted with similar sizes of translocated samples, populations and reserves in southern Africa (Adcock, 1995, 1996).

Responsibility for at least some of the relatively poor initial performance of these translocated populations lies with the low output of some adult females, with around a quarter not having calved, and two animals with nothing to show after six years in residence. Even those that did calve

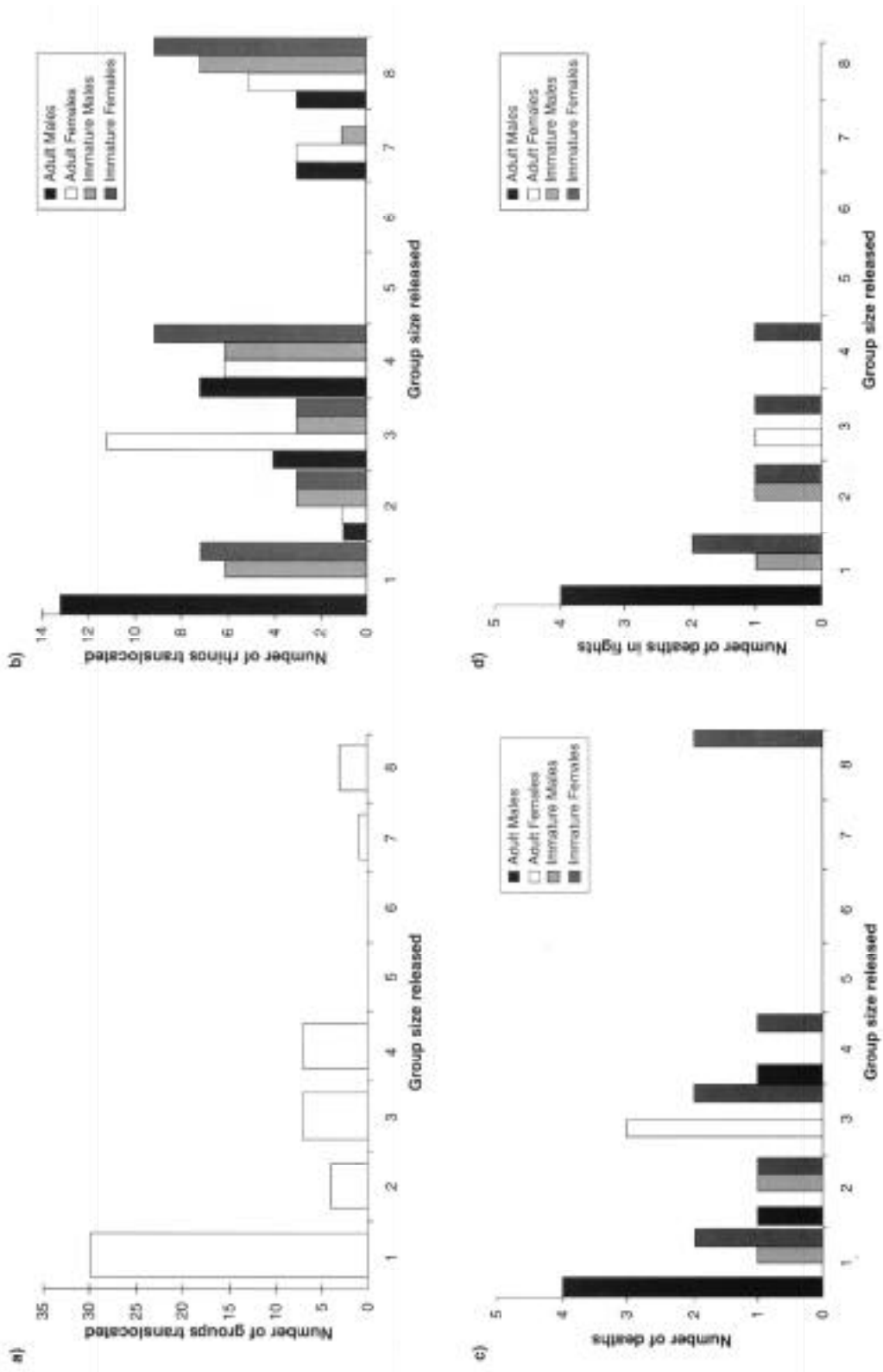


Figure 6. Sizes of groups of rhinos translocated and released into new reserves: (a), frequency; (b), sex and age group composition of groups; (c), mortality by sex and age group; (d), fighting mortality by sex and age group.

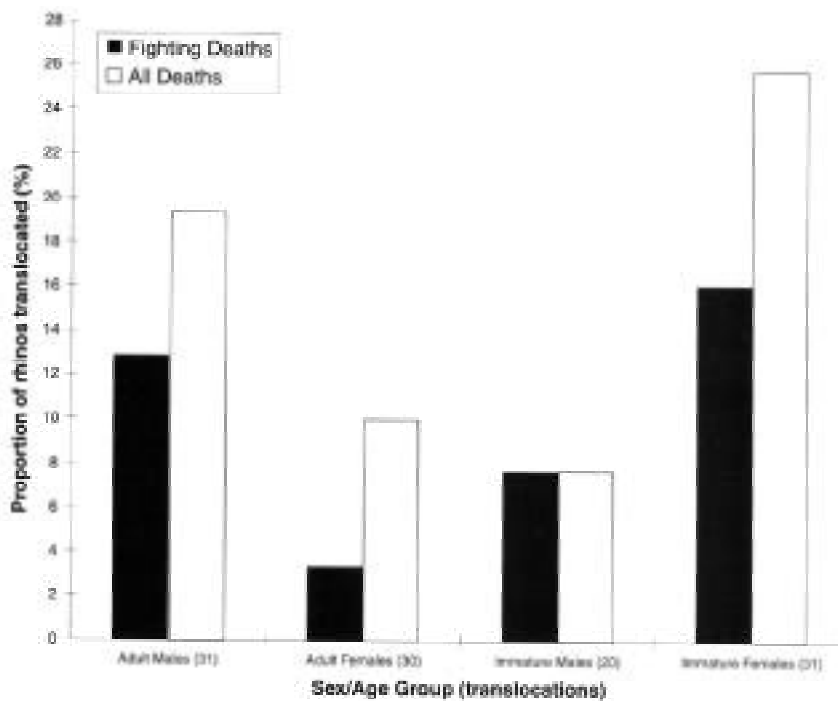


Figure 7. Distribution of the number of calves born to translocated rhinos, and cumulative surviving calves by year (1984-1995).

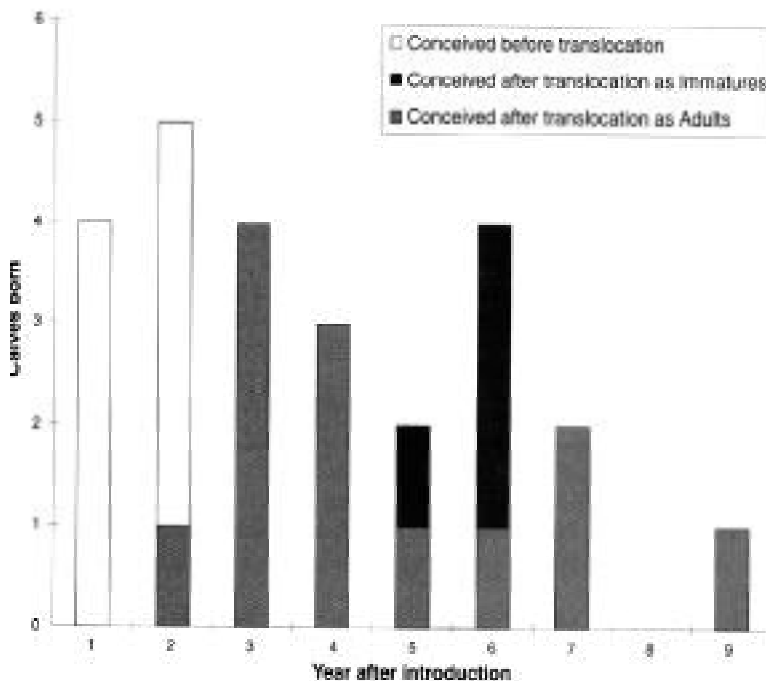


Figure 8. Distribution of calves born with the number of years after introduction of their mothers to new reserves.

after translocation (when not in calf) took around 40 months to conceive. In addition, young known-age females were slow to conceive for the first time, doing so well after the earliest possible time (4-5 years old: Goddard, 1967, 1970). It is possible that stress and lowered nutrition status after introduction to a new reserve, and disruption of established relationships of adult females with breeding males in previous reserves have some effect in delaying conceptions after translocation. The relative delay in production of first calves in a new reserve for straggler females, compared with ex-sanctuary animals, is also understandable, particularly considering the long periods of isolation that some straggler females have endured as the last remnants of formerly large populations which had been severely reduced through poaching (eg. Tsavo NP). However, lack of breeding (or any) contact with other rhinos, does not necessarily result in reduced subsequent fertility. The last animal captured in the southern area of Tsavo West NP in 1993, a particularly aggressive female which had probably been isolated for at least six years, took only a year to conceive after introduction to Ngulia sanctuary, and calved in 1995.

Although the sample was small, the indication that there was reduced survival of calves whose mothers had been translocated while pregnant gives cause for some concern about the wisdom of routinely translocating pregnant females. This was evident in poor calf survival rather than early abortion, perhaps due to lowered nutritional status and reduced milk production of lactating cows. Visual diagnosis of pregnancy is problematic in black rhinos, with only the presence of a swollen udder just prior to parturition giving a reliable (but not early) warning. If additional data to these confirm that the translocation of pregnant females constitutes a significant risk to unborn calves, a reliable field-based test of diagnosis of pregnancy using urine or faeces could assist selection of females for translocation and thus improve overall calf survival.

The marked bias in sex ratio of calves born in some sanctuaries demonstrates the potential for early demographic upset in small breeding groups of rhinos. Extreme sex ratio bias in the Lewa Downs population prior to 1992, and the loss of single adult breeding males resulted in complete cessation of breeding for several years. The results of recent simulations of Kenya rhino populations (*Dobson et al.*, 1991, *Foose et al.*, 1993), found that demographic instability is more of an initial problem for small populations than loss of genetic variation or inbreeding in causing early extinction.

Using this data set and the same methodology as that of Brett *et al.* (unpubl), an additional analysis of potential effects on the probability of conception and calving in

individual females found that none of 30 explanatory variables tested had any effect except calendar year. The sex/age composition of founder stock for new reserves may be an important influence on breeding output in the first five years after introduction. Obviously a bias in adult sex ratio of founder stock towards females should result in an early high yield of calves. The founder stock of the Solio reserve was strongly female-biased (8 males:14 females) and early and rapid population growth resulted (Table 1). Recent modelling of southern African black rhino populations (Hearne & Swart, 1991) has suggested that translocating adults is also more favourable to total population growth due to the immediate enhancement of fecundity in a new lower density reserve; these authors recommended the translocation of as many adults from the source population as it can tolerate. Clearly the selection of the age and sex composition of translocated founder groups of rhinos should be adapted to the sex/ age composition of donor populations and should avoid any negative effect on the future breeding potential or viability of the latter.

This study is a first step in finding factors which may promote early and fast growth of translocated populations. A population-based analysis is now required, looking at the composition and subsequent performance of different founder populations, and the reasons why some populations perform much better than others (Table 2). Pooling of data on translocated rhino populations in Kenya with those from other range states (eg. Zimbabwe, Namibia, South Africa) would clearly improve such a study. Meanwhile, the survival of individuals in the few years after release into new populations provides a useful advance assessment of translocation procedure, in particular the choice of rhinos for translocation to suit conditions in recipient reserves (Brett *et al.*, unpubl). Given the relatively short post-release periods examined here (an average of 4.9 years per translocated rhinoceros), the overall success of the 1984-95 translocation programme awaits future evaluation in terms of the sustainability of translocated populations.

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I am grateful to Alexandra Dixon and the Zoological Society of London, Suzuki Cars and Ian Catford for financial support, and to the co-operation and collaboration of the Kenya Wildlife Service. Steve Albon, Nigel Leader-Williams and Georgina Mace assisted with the analysis, and three anonymous referees are thanked for their valuable comments. I thank Tim Oloo for his assistance in gathering data from rhino sanctuaries in Kenya, and also wardens John Kagwi, Evelyn Wanjohi, Richard Kech, Oliver Munyambo, Joe Mwangi, Pius Mulwa and Charles Gatawa, and

representatives of private land rhino sanctuaries in Kenya. Finally, it is worth recording that none of the new rhino sanctuaries and populations mentioned here would have been developed without the work of former Kenya National Parks and KWS senior wardens Peter Jenkins and Bill Woodley, and their commitment to black rhino conservation in Kenya.

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FLOOD HAVOC IN KAZIRANGA

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RESUME

Le parc national de Kaziranga, au nord - est de l'Inde est bien connu comme abritant La plus importante population du rhino indien, *Rhinoceros unicornis* dont les effectifs représentent 60% de la population de l'espèce au niveau mondial (Choudhury, 1985 et 1997). Le Parc couvre une superficie de 473km² (429km² de superficie initiale, et 44km² de superficie additionnelle en 1996) de plaines inondables de la rivière Brahmaputra. La population des rhinos est estimée à environ 1100 individus. Situé sur la plaine inondable d'une importante rivière, le Parc tout entier est soumis à des inondations annuelles. Cependant, l'eau atteint occasionnellement des niveaux très élevés, entraînant un envahissement de la majorité du Parc par les eaux d'inondation.

En 1988, une inondation dévastatrice a ravagé le Parc, causant une perte importante de faune et de flore. Une inondation similaire à celle de 1988 s'est produite en 1998, causant la mort d'un grand nombre d'espèces dont le rhino indien. Pour évaluer la situation sur le terrain, le Parc a été visité en Septembre (pendant l'inondation), Octobre et Décembre 1998 (après l'inondation). Ce qui est présenté dans cet article, est un rapport sur les inondations et des mesures suggérées pour remédier à la situation.

INTRODUCTION

The Kaziranga National Park in Assam, north-eastern India, is well known for having the largest population of the India rhino *Rhinoceros unicornis*, accounting for about 60% of the species' world population (Choudhury, 1985 and 1997). The Park covers an area of 473km² (429km² original area and 44km² added as first addition in 1996) of the floodplains of the Brahmaputra river. The estimated rhino population is approximately 1,100. Being located on the floodplain of a major river, the entire Park is subjected to annual flooding. Occasionally the water level rises to abnormally high levels, causing the majority of the Park to become submerged under flood water.

In 1988, a devastating flood ravaged the Park, causing extensive loss of flora and fauna. A similar flood occurred in 1998, resulting in the death of a large number of species including the Indian rhino. To assess the situation in the field, the Park was visited in September (during the floods), October and December 1998 (post-flood). Presented in this paper is a report on the floods and suggested remedial measures.

THE FLOODS OF 1998

The 1998 floods came in three different phases. The first phase started on 25 June and continued until 3 August, and wildlife populations took shelter in the

highlands with negligible casualties. The water level receded slightly in July with ups and downs. The second phase began on 13 August and continued until 29 August 1998. After this phase, the water level receded to slightly lower levels than those of the first phase. The third and worst phase started on 3 September. The water level began rising slowly on 31 August, with peak flood water levels being reached on 5, 6 and the morning of 7 September, which caused the most harm to wildlife populations. The water level started receding slowly from the highest point on 7 September and by 10 September most of the highlands and major roads inside the Park had reappeared. By 12 September the water level had subsided by more than a metre. During the worst stages of the flood, the bulk of the highlands were submerged and more than half the anti-poaching camps were damaged. The road network was breached in places and most of the wooden bridges were also damaged.

The third phase of the 1998 flood was slightly lower than 1988 levels at the 'Second tower' near Mihimukh, although it was reported that in some areas, eg. Agorotoli, the water level exceeded 1988 levels by a few centimetres. National highway (NH) 37 was flooded at four or five places between Kohora and Burhaphahar. The road was closed for vehicular traffic from the evening of 5 September to the morning of 7 September.

As is usual during flood periods, wildlife took shelter on

Photo Credit: Anwaruddin Choudhury



Carcass of a rhino (*Rhinoceros unicornis*) that died due to drowning in Kahora range area.

the artificial high grounds (totaling 69) and roads, while a few moved towards Kukurakata Hill RF, Burhapahar hillock, Panbari RF, Bagser RF, the northern range of Karbi Plateau and the adjacent tea, coffee and rubber gardens. But during peak days of the flood in the third phase, when almost all the artificial high grounds were underwater (as well as the entire Park), the majority of wildlife populations moved out of the Park in a panicked state. During this time, the wildlife had to cross the busy NH 37 as well as pass through human settlements. This resulted in large-scale loss of wildlife which were either hit by vehicles or killed by the villagers and plantation labourers. In northern areas of the Park, some animals tried to cross the

Brahmaputra river but were mostly drowned or killed by poachers. Species such as the Hog deer *Axis porcinus* suffered most, while species such as the Swamp deer *Cervus duvauceli*, Wild buffalo *Bubalus arnee* and rhinos could remain on partly submerged roads and high roads for a few days. The carnivores were not affected as they moved into trees and shrubs.

Rhinos that drowned are listed in Table 1, and those rhinos that died of other causes during the flood are listed in Table 2. The estimated damage to infrastructure of the Park is approximately US\$385,000 and the details are in Table 3.

Table 1. The casualty of Indian rhinos during the floods (all drowning) of 1998 (between 1 June and 30 September).

1st phase	2nd phase	3rd phase	Total
5	5	29	39

Note: One rhino calf was rescued

Table 2. The casualty of Indian rhinos due to other causes during the floods of 1998 (between 1 June and 30 September).

Infighting	Killed by tiger	Poaching	Old age	Total
1	1	8	8	18

Note: Of the eight rhinos poached, only one incident was inside the Park.

Table 3. The estimated loss/damage of infrastructure during the floods of 1998 (between 1 June and 30 September).

Roads and patrolling paths - 200km	\$119,050
Bridges -25	\$112,380
Camps-64	\$76,190
Raised platforms - 30	\$71,430
Country-boats & ferry boats -70	\$5,950
Total	\$385,00

Source: Forest Department, Assam.

DISCUSSION

Although floods often occur in Kaziranga, wildlife populations are still adversely affected due to the lack of sufficient high ground because of the clearing of natural vegetation in the fringe areas with slightly higher grounds for human settlement and cultivation and cash crop plantations (mainly tea, also coffee and rubber). The drowning of 39 highly endangered rhinos is an indication of loss. The death of a large number of Hog deer and other prey species also reduces the prey base for the Tiger *Panthera tigris*, thus increasing the

possibility of an upward swing in Tiger predation of rhino calves. Due to prolonged submergence, most of the grassland area was damaged, and either the grasses have died or were covered with mud, thus making it difficult for the animals to feed for about a month. The main advantages of floods are clearing of wetlands or weeds such as the exotic water hyacinth, situation in the grasslands (which provide nutrients) and accretion of new *chapories* (riverine islets and tracts).

Construction of more high grounds inside the National Park seems to be the only viable alternative. Declaration

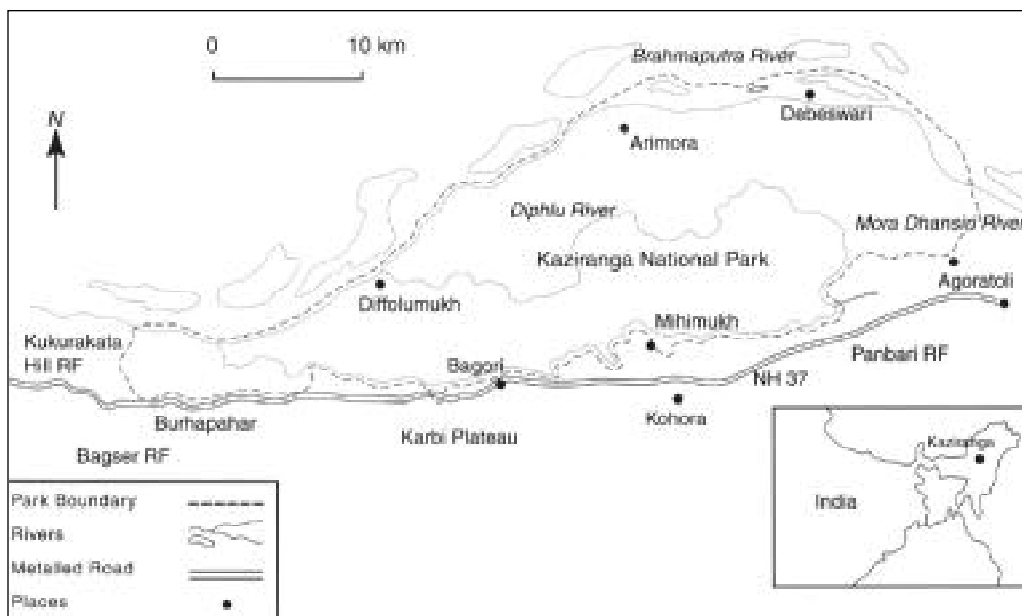


Figure 1. Map of Kaziranga National Park showing the places mentioned in the text

Photo Credit: Anwaruddin Choudhury



Kaziranga flooded, with almost the entire Park under water during the last phase.

Photo Credit: Anwaruddin Choudhury



A damaged bridge with Mr D. Boro, the Range Officer in central Kaziranga.

of protected areas in the Karbi Plateau will help protect a large number of marooned wildlife in future, but it is impossible for all wildlife to move into this area, especially those in the northern area of the Park. The Indian army has constructed ten high grounds in Burhapahra range area while the Karbi Anglong Autonomous Council has agreed to set up a wildlife sanctuary. The Government of Assam has released some funds for repair of roads and bridges, while NGOs, especially The Rhino Foundation based at Guwahati, provided some immediate post-flood needs such as tarpaulins and hurricane lanterns for the anti-poaching camps, and batteries for torches for night patrolling.

RECOMMENDATIONS

1. More high grounds should be constructed in the northern areas, between Diffolumukh and Debeswari.
2. The movement of vehicular traffic along the NH 37 should be regulated during the floods, especially at night.
3. Strong measures should be taken to check erosion by the Brahmaputra River in Agoratoli range area. An estimated 20km² has eroded away during the last few decades (Choudhury, 1997).

WILL NEW COMMUNITY DEVELOPMENT PROJECTS HELP RHINO CONSERVATION IN NEPAL?

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RESUME

La conservation du rhino au Népal a connu un succès remarquable. La plus grande population de rhinos à corne unique a connu une croissance d'environ 95 animaux en 1968 jusqu'à un effectif de 550 individus avant la fin de 1997. Le Département des Parcs Nationaux et de la Conservation de la Faune (DPNCF) est entrain de démarrer un projet pour accroître les bénéfices des populations vivant à côté des Parcs Nationaux du Royal Chitwan et Royal Bardia. Cependant, l'argent alloué à ces Parcs par Le Royaume du Gouvernement du Nepal, a diminué récemment. Si ces budgets continuent de baisser, le braconnage pourra s'accroître. Ce rapport examinera les raisons du succès de la conservation du rhino du Nepal de 1994 à 1997 et décrira les nouveaux projets initiés pour faire bénéficier les villageois vivant autour des deux parcs, à partir des rhinos comme les autres espèces de faune sauvage.

INTRODUCTION

Rhino conservation in Nepal has been a notable success. The greater one-horned rhino population increased from about 95 animals in 1968 to an estimated 550 by late 1997. The Department of National Parks and Wildlife Conservation (DNPWC) is now starting a project to increase benefits to the people living near Royal Chitwan and Royal Bardia National Parks. However, the money allocated by His Majesty's Government of Nepal to these Parks has declined recently. If these budgets continue to fall, poaching may increase. This paper will look at the reasons for success of Nepalese rhino conservation from 1994 to 1997 and will describe the new projects intended to benefit villagers living around the two Parks as well as the rhinos and other wildlife.

ANTI-POACHING ACTIVITIES

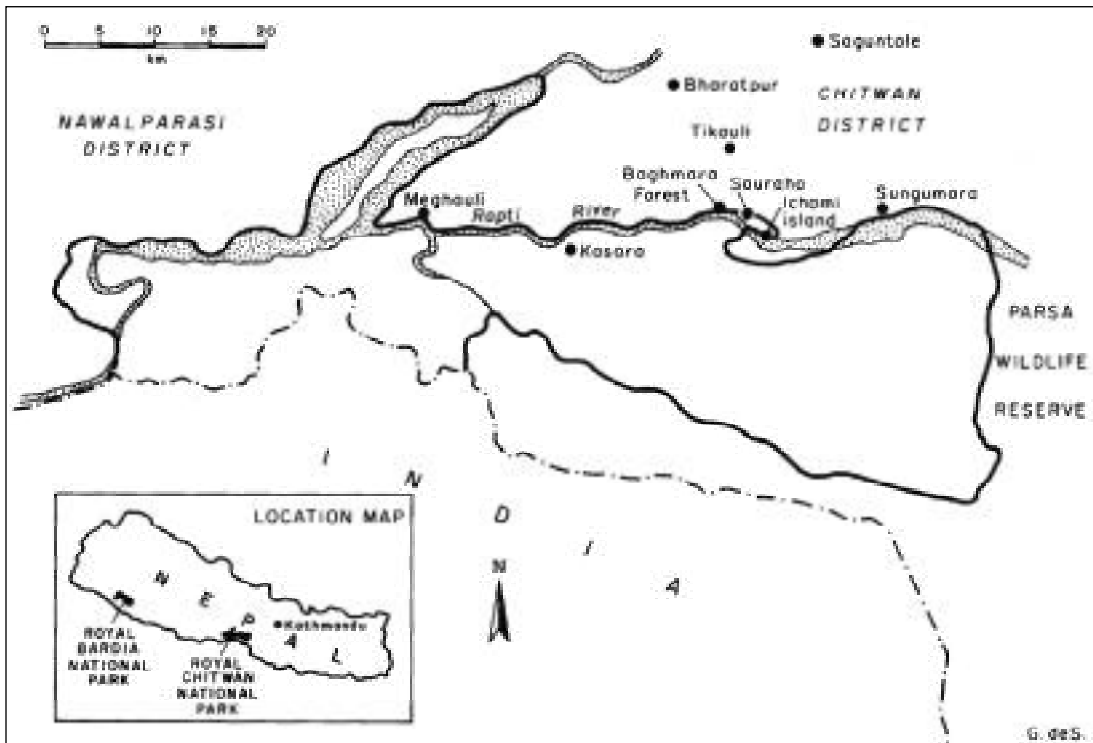
Although there was serious rhino poaching in the early 1990s (Marlin and Vigne, 1995), there were few poaching incidents from 1994 to 1997 (see Table 1). No rhinos have been poached in Bardia since November 1993 and the population rose to 44 in the Park by December 1997. From 1995 until the end of 1997 only five rhinos were illegally killed in the Chitwan area, which is quite low considering the 1997 population estimate of 500; inside Chitwan Park not a single rhino was poached in 1995 or 1996, although one rhino was speared and killed on Ichami island (see map) in early 1997.

Outside Chitwan Park, in 1995 an unsexed rhino was shot and killed just north of the boundary at Lankaline.

Table 1. Numbers of known rhinos illegally killed in Nepal from 1994-1997

Year	Inside Royal Chitwan National Park	Outside Royal Chitwan National Park	Inside and Outside Royal Bardia Park	Total
1994	0	0	0	0
1995	0	1	0	1
1996	0	1	0	1
1997	1	2	0	3
Total	1	4	0	5

Sources: Department of National Parks and Wildlife Conservation, and District Forest Office, Chitwan District, unpublished statistics.



Royal Chitwan National Park

In 1996 a female rhino was killed by a bullet just north of the Park at Sungumara. In April 1997, a female rhino was poached north of the Park at Sagnantole, north-east of Bharatpur in Chitwan District. A gang of eight people chased this rhino until it fell down a hill and died. The villagers removed the small horn - perhaps weighing 300g - and sold it to a person in a village in Chitwan District for 20,000 rupees (\$345) which is the equivalent of \$1,148 per kg. The poachers were later caught and jailed (anonymous Forest Officer, Chitwan District, pers. comm.). Later in the year a mother was shot and killed, again at Sagnantole. Her calf was taken by the Parks authority and is being hand-reared at Sauraha on the northern boundary of the Park by the King Mahendra Trust for Nature Conservation (KMTNC) and the Parks jointly.

Rhino poaching has remained low since 1994 for a number of reasons. The price of rhino horn has not increased on the world market in US dollars so there has not been a greater incentive to seek out and kill rhinos (nevertheless, the value for horn remains extremely high). Another reason is that penalties (fines and imprisonment) were increased in 1993 (Martin, 1996). These penalties have been enforced and have certainly deterred some potential poachers. The number of rhino poachers arrested in and around Chitwan

declined from 37 in 1993 (Martin and Vigne, 1995) to 15 in 1994 to only five in 1997 (see Table 2).

The last gang going after rhinos was caught near Royal Bardia National Park in late 1993 and six people were arrested.

A third reason that rhino poaching has remained low is that the intelligence network, including paying informers, continues to be effective. However, payments for rewards for Chitwan and Bardia, which are distributed solely by the Nepal branch of the International Trust for Nature Conservation (ITNC), declined in 1996 and 1997 compared with the previous two years. This was largely because the Park Wardens and District Forest Officers (DFOs) of Chitwan and Nawalparasi Districts did not feel the need to request more money, due to the decline in poaching. In 1996 ITNC paid 48,000r (\$853) - half to the Chief Warden of Bardia, a third to the DFO at Nawalparasi District and the rest to Chitwan Park. In 1997 ITNC only paid 2,000r (\$34) due to lack of requests from the government authorities (Dinesh Thapa, officer in charge of dispersing funds from ITNC in Nepal, pers. com.). It is relevant to note that rhino poaching was higher in 1997. Both the present Director of Nepal's Parks, Uday Sharma, and the previous Director, Tirtha Maskey, credit

Table 2. Number of rhino and tiger poachers in custody from 1 994-1997

Year	Rhino poachers caught in and around Royal Chitwan National Park	Rhino poachers caught in and around Royal Bardia National Park	Tiger poachers caught in and around Royal Chitwan National Park	Tiger poachers caught in and around Royal Bardia National Park
1994	15	0	0	0
1995	3	*1	12	0
1996	6	*1	2	0
1997	5	0	3	0
Total	29	2	17	0

*Poacher killed in encounter with Park guard.

Source: Maskey, 1998.

the paying of this intelligence money as one of the most important factors in reducing both rhino and tiger poaching in Nepal (pers. corn.).

A fourth reason for the success in rhino conservation has been the greater participation of non-government organizations (NGOs) in anti-poaching activities. Before 1991 there were no anti-poaching units as the presence of the army stationed inside Chitwan and Bardia was considered to be deterrent enough. Since then, however, anti-poaching units have been introduced, funded mainly by ITNC and WWF Nepal. By January 1998 there were five such units inside Chitwan under the control of the Chief Park Warden, and two units posted outside the Park in Nawalparasi District and in Chitwan District under the control of the DFOs. Each unit inside the Park has about five men: one senior game scout, three game scouts and one or two informers (working outside the Park). The game scouts are part of the Park's regular staff, while the informers are recruited from the nearby villages. The units patrol on foot or on elephants. The two anti-poaching units in the districts together employ 11 people with about half of them involved in intelligence in the villages. Along with the one battalion of men from the Royal Nepal Army who are trained inside the Park to deter poachers and other illegal activities (such as cattle grazing and tree felling), the seven new anti-poaching units in and around Chitwan are very effective.

Three anti-poaching units were established in Royal Bardia National Park by early 1998. Each unit has a ranger, senior game scout, four game scouts and an informer. Together with the Army's two companies

stationed within Bardia to protect the wildlife, the overall anti-poaching activities have greatly improved. No rhinos have been poached since 1993, although other species continue to be poached. In 1996 sambar, chital and nilgai were illegally killed, while many people poisoned fish and trespassed in the Park with cattle; on one day alone 45 people were caught collecting illegal firewood. There were also eleven occasions when poachers' shots were heard or poachers carrying guns were seen (Bhatta, 1997).

Improved patrolling is helping to reduce poaching in general in Chitwan and Bardia, and more co-operation among the staff of the Army, Forest Department and the Parks is an important fifth reason for the decline in rhino poaching. This co-operation must continue for the morale of the various government departments' staff protecting the rhinoceros to stay high, and for dedication to rhino conservation to remain strong.

A sixth aspect contributing to the greater protection of the rhinos has been new public relations campaigns. For example, the DNPWC has put up posters in schools and other public places in the Bardia area stating that rewards will be paid up to 10,000r (worth \$172 in 1997) for information on poachers and traders in wildlife products. The Chief Warden of Bardia, P.B. Shrestha, thinks that this has been very effective for Bardia (pers. corn.). NGOs, especially WWF Nepal and KMTNC have been producing publications and posters and starting other conservation awareness projects to raise the consciousness of the Nepalese on the importance of conserving their rhinos, as well as other species, and the habitat.

Photo Credit: Esmond Martin



Photo Credit: Esmond Martin



When an elephant driver sees a rhino urinating in Chitwan National Park, he will often collect the urine. People living around Chitwan believe it reduces chest congestion and asthma.

While these factors combined have been responsible for reducing rhino poaching in Nepal overall, perhaps the most important has been maintaining sufficient budgets, thus allowing a high density of manpower in the Parks. This manpower for such relatively large areas is what makes Nepal (and India) unique. Numbers of personnel in Chitwan and Bardia have remained the same for years now and appear to be sufficient to deter rhino poaching. Chitwan's Park staff numbered 256 in 1993 and 242 in late 1997. There are 800 Army staff sanctioned for Chitwan with about 600 actually in the Park at any one time. The total number of staff works out at nearly one man per square kilometre, a very high density for an area of 932km². In Bardia, the number of Park staff has remained almost identical over the past few years with 132 positions allocated in late 1997 and 126 actually filled. There are about 500 Army personnel in Bardia with approximately 400 on the ground at any one time. This gives Bardia about one person per 2km², again a very high density for an area of 968km².

Both Parks are suffering from declining budgets, however. Concerning rhinos, this is especially serious for Chitwan, having such a large and thus potentially vulnerable rhino population. Chitwan's Park budget was \$219,488 in 1994/5 and only \$117,672 in 1997/8 (see Table 3). These figures exclude the Army budget which is more than twice as large and has probably been stable for some years. Various NGOs, especially WWF Nepal and KMTNC have supplemented Chitwan's budget. For example, WWF donated 1,024,000r (\$17,000) in the financial year 1997/8 for the seven anti-poaching units in and around Chitwan Park, plus money for operation costs for the units in Chitwan and Nawalparasi Districts, as well as radio sets and fuel for the Park (U.R. Bhuj, WWF Nepal, pers. comm.).

Ironically, while Chitwan's Park budget has declined, there has been a huge increase in the revenue collected from the Park since 1988 (see Table 4) due to the growth in the number of visitors (see Table 5).

The amount of revenue earned by the Park in the financial year 1996/7 (65% from entrance fees, 16% from elephant rides, 9% from royalties from seven lodges inside the Park, and 10% from other activities) is over five times greater than the budget expenditure. In order that rhino conservation continues to flourish, the government must expand the DNPWC budgets for both Chitwan (see Table 3) and Bardia (see Table 6).

COMMUNITY DEVELOPMENT PROJECTS AROUND ROYAL CHITWAN AND BARDIA NATIONAL PARKS

Several government officials and private conservationists believe that rhino conservation is improving in Nepal due to recently introduced community development projects around Chitwan and Bardia. G.P. Upadhyay and P.B. Shrestha (Chief Park Wardens of Chitwan and Bardia respectively) believe this is so, as does T. Maskey, the previous Director of DNPWC. Is there any convincing evidence yet to prove the assumption?

Community participation projects have been in place since the 1980s. In 1994 a major project was initiated by the Government of Nepal with assistance from the United Nations Development Programme (UNDP) called the Parks and People Project. The project aimed to assist people living around the five parks and reserves in the Terai region of southern Nepal. User groups, consisting of people from the surrounding communities, initiated and supervised the community-based activities. IJNDP funding was given for the first three years. By June 1997 33 user groups had been set up for the Chitwan area alone and there were 37 by early 1998.

The community projects around Chitwan Park are especially relevant to rhinos as Chitwan contains 91% of Nepal's rhinos and there are over four times as many people in the buffer zone around Chitwan as compared with Bardia. Pressure on the Park's resources will increase

Table 3. Department of National Parks and Wildlife Conservation budget for Royal Chitwan National Park, 1994/5 to 1997/8.

Year	Nepalese rupees	US dollars
1994/5	10,893,200	219,488
1995/6	9,748,400	183,241
1996/7	7,036,000	123,072
1997/8	7,065,000	117,672

Source: Royal Chitwan National Park, unpublished statistics.

Table 4. Revenue raised in Royal Chitwan and Royal Bardia National Parks for various years.

Year	Royal Chitwan National Park		Royal Bardia National Park	
	Rupees	US dollars	Rupees	US dollars
1972/3	1,729	?	n/a	n/a
1982/13	1,167,250	c84,891	64,092	c4,661
1987/8	3,370,140	148,792	115,149	5,084
1988/9	4,795,565	188,431	*1,121,708	*44075
1989/90	13,449,911	476,103	*2,746,037	*97,205
1990/1	20,105,000	560,028	*3,171,006	*88,329
1991/2	27,157,144	636,510	*4,039,610	*94715
1992/13	39,680,500	866,386	1,233,249	26,927
1993/4	36,071,299	735,249	1,884,669	38,416
1994/5	41,527,368	836,739	1,320,650	26,610
1995/6	46,878,346	881,172	1,683,630	31,647
1996/7	48,290,662	844,685	2,411,218	42,176

*The increased revenue is due to timber sales.

Sources: Royal Chitwan and Bardia National Parks, unpublished statistics.

Table 5. Number of Tourists to Royal Chitwan National Park and Royal Bardia National Park, 1993/4 to 1996/7.

Year	Royal Chitwan National Park	Royal Bardia National Park
1993/4	58,924	871
1994/5	64,749	1,042
1995/6	83,898	1,855
1996/7	96,062	3,111

Source: Royal Chitwan National Park, unpublished statistics.

Table 6. Department of National Parks and Wildlife Conservation budget for Royal Bardia National Park, 1995/6 to 1997/8.

Year	Nepalese rupees	US dollars
1995/6	*16,634,000	*312,669
1996/7	8,290,000	145,006
1997/8	8,102,500	134,952

* The budget is high because extra money was allocated to buy more land for blackbucks.

Source: Royal Bardia National Park, unpublished statistics.

unless the local villagers improve ways to produce their own sources of food, firewood and fodder; such eco-development projects are essential as the human populations grow. Furthermore, rhinos do cause direct harm to the villagers, as well as villagers to rhinos, so some schemes are especially important in order to protect people and rhinos from killing or injuring each other.

Between April 1996 and April 1997 (Nepalese year

2053) two people were killed by rhinos and two more by other mammals in the 750km² buffer zone around Chitwan Park inhabited by 300,000 people. The government policy is to pay compensation for loss of human life on an individual basis. More than 80% of the incidents in which people are seriously injured by wild animals involves the sloth bear while the next most dangerous animal is the rhino, followed by the leopard, wild boar and tiger respectively (Silwal, 1997). Wild animals also attack livestock. Of

the estimated 20,000 livestock within the buffer zone, 1,050 were injured or killed in this same year, especially by leopards, costing the farmers about 2,000,000 (\$35,000) in losses. Wild animals also cause much damage to crops in the buffer zone around Chitwan: an estimated 40 tonnes of grain and 0.87 tonnes of vegetables were destroyed between 1996 and 1997. Rhinos generally cause the worst damage, followed by deer and wild boar. Rhinos are most destructive from July to January, eating and trampling wheat, maize, mustard and other crops (Silwal, 1997). As the government does not offer compensation for crop damage, resentment towards wildlife is common.

In order to reduce the damage done by wild animals to people, livestock, crops and also to structures, the Parks and People Project set up an "Animal Preventative Infrastructure Scheme" around Chitwan Park. Villagers have dug trenches, erected barbed-wire fences, grown barriers of spiny plants, especially *Acacia arabica*, between the trenches and fences and have set up stall-feeding for their livestock to keep them safely confined. This scheme was started around Chitwan in May 1997. By December 1997 18.1km of barriers had been erected, mostly around Meghauri (at the airfield on the west side of the Park) and Kasara (on the north boundary

where the Park headquarters are located). IJNDP paid for the materials and the user groups supplied the labour. By February 1998, this barrier was keeping out all the deer, 75% of the wild boar, but only half the rhinos. The scheme has been so successful that the villagers plan to construct another 40km of barriers in 1998 on the north boundary of Chitwan (B.B. Silwal, Buffer Zone Development Officer for Royal Chitwan National Park, pers. comm.). The barriers are protecting wildlife and people alike and are significantly reducing the antagonism towards wild animals.

The Parks and People Project has also been improving the skills of the villagers around Chitwan and elsewhere in the Terai in order to reduce their need for Park resources. For example, people are being trained in farming, beekeeping and stove-making. Conservation education programmes are being initiated, community forests established, and several eco-tourism ventures have started, such as with the Tharu villagers around Chitwan Park who are being trained to make bamboo and metal handicrafts to sell to tourists. In order to increase the people's income further, some are being taught bookkeeping and the Parks and People Project has established a savings and credit programme. Other projects are improving the physical infrastructure (such

Photo Credit: Esmond Martin



The policy of allowing villagers into Bardia National Park to collect thatch and reeds for houses has been very popular. In the mid 1990s the grass-cutting season was shortened from 15 to 10 days to reduce disturbance to wildlife.

as roads and schools). The villagers are also helping in Park management in order to reduce conflict between villagers and wild animals (Parks and People Project 1997). Some schemes are obviously more relevant to rhino conservation than others with the barriers helping rhinos the most.

of 1995 and consisted by then of forests, grasslands, waterbodies, nature walking trails and an elevated platform (machan), from which to view animals at night. By late 1997 the area was home to 20 rhinos as well as leopards, tigers, deer, wild boar and 125 bird species which had crossed over from Chitwan Park.

Photo Credit: Esmond Martin



In Chitwan and Bardia Parks, villagers lightly burn some areas to help them collect the reeds. It also makes it easier for tourists to see rhinos.

Besides this UNDP-initiated project, local NGOs are involved in community development schemes around Chitwan Park. One of the most successful is an eco-tourism project which was set up in the previously degraded Baghmara Forest on the northern border of Chitwan Park and a few kilometres from the main tourist area, Sauraha. The KMTNC and USAID were the principal implementers of the project. In 1989, the KMTNC organised the planting of fast-growing trees on 32 hectares of severely overgrazed land within the 400-hectare area of Baghmara Forest. By the end of the first year a user group was formed to manage this plantation. Over the years more of the land was replanted with trees, and grass areas were developed. Villagers constructed fences and trenches around Baghmara with help from the Trust and the Park authorities. In June 1995, the District Forest Office formally handed over the whole of Baghmara Forest to the local user group committee to manage for themselves as the Baghmara Community Forest. It was opened for tourism at the end

As the Baghmara Community Forest is so close to the lower-priced and biggest tourist centre in southern Nepal (Sauraha) and because the entrance fee for foreigners (excluding Indians) is only 100r (\$1.72 in 1997) compared with 650r (\$11.19 in 1997) for the Park, many foreigners are visiting Baghmara. From November 1995, when it opened, to the end of 1997, the income from tourism was 1,700,541r (\$29,280), just over half of which was from elephant rides alone, and the rest from a fee of \$10 for a night on the machan, canoeing charges and jungle walks (KMTNC, 1997 and Khatri, 1998).

As well as the tourist revenue earned by the user groups for the community, Baghmara supplies grasses and firewood to its community (584 households consisting of 3,615 people). In 1997 the community collected grasses making up 31%, and 657,860kg of firewood making up 23% of their requirements (KMTNC, 1997).

The Baghmara Community Forest has directly benefited rhinos. Fewer of the villagers now illegally enter the Park as they have access to their own supply of fodder and firewood in Baghmara. This has reduced disturbances to the rhino and other animals in the Park. Furthermore, there are fewer wild animals raiding crops due to the new bafflers between the Forest and the arable land. Farmers are therefore less antagonistic towards rhinos and are less likely to be involved in rhino poaching. The 20 rhinos presently in the Forest are benefiting from the newly enriched habitat and they are well protected by the villagers, being of financial gain to them through tourism. Three rhino poachers came into the Forest with two chains to snare rhinos in late 1997 but they were caught by the villagers and handed over to the authorities (Top Khatri, Project Director, KMTNC, Sauraha, pers. comm. and Khatri, 1998).

A significant change promoting community development took place in the mid-1990s. The government gazetted the buffer zones around parts of Chitwan and Bardia Parks in 1996 to be managed by the communities living within the buffer zones, not by the Forest Department as before. In early 1998 the local people and Parks Department established the Bardia Buffer Zone Development Council. The Council, consisting of the Chairman of each user group, will develop an operation plan for the 460km² buffer zone around Bardia Park where about 77,000 people live. When approved by the Chief Warden of Bardia, perhaps 50% of the total Park revenue will go to this Council for projects. In Chitwan the Buffer Zone Development Council was being formed in early 1998, consisting of members of the 37 user groups, the District Development Committee and the Chief Warden of the Park. One new policy development by the Council was that the user groups in the buffer zone of Royal Chitwan National Park were allotted some compensation for livestock losses and human injuries. The group members decide on the amount of compensation for individual cases. So far (up to November 1998) members in Chitwan have not paid for losses occurring within the Park forests, but have paid for those that occurred outside the Park boundary (U.R. Sharma, pers. comm.). Most importantly, the Council will approve projects for the 750km² buffer zone (with its 300,000 people) and finance them with 50% of the total Park revenue (G.P. Upadhyay, and T. Maskey, pers. comm.). Using Park revenue as the major funding source for community development is a new phenomenon in Nepal and will, it is hoped, bring the villagers more money for projects.

These projects will receive potentially a large amount of money, as the Parks generate substantial tourist revenue. For Chitwan, 120,000,000r (\$1,935,480) has been collected (Chitwan's total tourist revenue for 1996 and 1997) and was put into a special account by early 1998.

If 50% is earmarked for the new buffer zone projects, nearly \$1,000,000 will be available initially (T. Maskey, pers. comm.) and perhaps \$500,000 per annum could be allocated for the next few years! By early 1998 it was not yet known what projects would be funded and which specifically would help rhinos. The buffer zone projects are in their infancy, and their planning and management will be fundamental to their success.

CONCLUSION

The Nepal government authorities — Parks, Army and Forest Department — have successfully conserved rhinos for many years. There were extremely few rhinos poached from 1994 to 1997. The government spends over \$500 per square kilometre each year on anti-poaching activities (especially for manpower on the ground) for both Chitwan and Bardia Parks, one of the largest amounts per unit area in the world. Furthermore, Chitwan Park, with 91% of the country's rhinos, has about one person per km² in the Park protecting rhinos, again one of the highest concentrations in the world. Bardia Park has about one person per 2km², also very high. The intelligence system, financed by NGOs has been very effective and the new anti-poaching units, also with NGO assistance, are proving successful. The recent severer penalties for poaching rhinos and trading in the horns have also helped rhinos greatly since the mid-1990s. Education of the villagers about conservation is continual and beneficial in improving relations with the Parks. Overall, the high morale, level of honesty, co-operation and motivation of those involved in rhino conservation may be the most important factors. These conservation measures have proved to be successful in Nepal.

Community development around Chitwan and Bardia Parks is a relatively new conservation strategy, although the idea has been mooted for years. Projects were funded by the government, the United Nations and NOOs in the late 1980s and early 1990s, especially around the main rhino area of Chitwan Park. Bafflers and the development of Baghmara Community Forest have already benefited rhinos. In the late 1990s the Parks Department takes over the major funding of community development around Chitwan and Bardia Parks and is developing more schemes in the buffer zones, gazetted for community management in the mid-1990s.

There are, however, certain inherent problems with community development schemes that need to be carefully monitored and managed. One major problem with community management of buffer zones is that they attract outsiders because of the new resources. The arrival of more people puts increasing pressure on park boundaries

Photo Credit: Esmond Martin



Many parts of the rhino are for sale in Nepal as medicine, including the umbilical cord here offered for sale in Kathmandu.

with their needs for water, firewood, grazing, fodder, medicinal plants, fish and meat. This problem has occurred in community projects already being implemented in Africa. The user groups around Chitwan and Bardia must find a way of limiting new people entering the area to prevent the natural resources within the buffer zones and Parks from being over exploited.

There is also a danger that the villagers will consider the new funding simply as a 'government hand-out', raising undue expectations, rather than as money available directly through their own wildlife conservation efforts in the Parks and buffer zones. It is important for the local community to plan and decide what projects are required to reduce conflict between wildlife and people, how much money is necessary to implement the projects, and who will receive and supervise the funds to avoid corruption and mismanagement. The present system of electing people to the user groups and then organising a Development Council, which will liaise closely with the Forest and Parks Departments, is good in theory and it is vital that it succeeds in practice if wildlife conservation through community development is to work.

Already some conservationists in Nepal are saying that community development projects have helped to reduce rhino poaching. Yet it is still too early to tell, as most of the projects were established in the late 1990s, after the rhino poaching had been reduced in the mid-1990s. By early 1998 the major projects in the buffer zones had not been funded. Even if they had all been started in the mid-1990s, it is very difficult to link most of these projects with direct conservation success. Only the Baghmara Community Forest project has actively saved rhinos through arrests of poachers. It is hoped that when the major projects are under way there will be similar successes, but community development has not yet had a measurable impact on reducing rhino poaching.

Many proponents of eco-tourism argue that bringing in tourists is the best use for certain pieces of land, ecologically and financially. The development of a sustainable eco-tourism project requires time, and often, large amounts of money, usually with help from outside the country. Also, such projects often become dependent on continued external funding to cover running costs. Donor fatigue in many countries is becoming more



Asian rhino horn is generally ten times more valuable than African rhino horn. Nails, like the horn, are consumed in many parts of Asia to lower fever, while the skin is used for curing human skin diseases.

common and local sources of funds must be found for such projects to continue. Nepal, however, is not seeking large amounts of foreign funding, having the benefit of significant Park revenue to share with the villagers' projects. Yet the authorities must be aware that these projects must become self-financing as soon as possible or they will be an endless drain on Park revenue, which could otherwise be spent on improving Park management activities.

The Baghmara Community Forest project seems to be one of the most successful eco-tourism schemes in Nepal. The Project's figures show that the gross annual tourist income produced for its first two years (1996 and 1997) is an average of nearly \$15,000 a year. However, this excludes administration costs plus salaries for the staff who helped to initiate the project at KMTNC, USAID, WWF Nepal, the Nature Conservancy and the World Resources Institute; KMTNC continues to give technical assistance. If these expenses were subtracted, the scheme would have shown a financial loss for 1996 and 1997. The project may be working, but it is not profitable at this stage, and it must aim to become so.

It is important for conservationists to monitor the various factors responsible for the recent success in rhino conservation in Nepal. Indicators of success need to be developed and regularly tested, along with the cost effectiveness of these factors. Funding must not be cut for those strategies which are known to work in Chitwan and Bardia, such as relatively high Park budgets, the presence of staff in high numbers in the Parks for patrolling, the new anti-poaching units, intelligence networks, conservation education, and motivated staff within co-operating departments. It is alarming to note that the Department of National Parks' budget has been cut by roughly half in US dollars from 1994/5 to 1997/8 in both Chitwan and Bardia National Parks (see Tables 3 and 6). The recent trend of reducing the DNPWC budget of Chitwan and Bardia Parks must be reversed, even if this means decreasing the amount of money going into the buffer zones. It appears that in Nepal funds which go directly into anti-poaching efforts are more effective for rhino conservation than the same amount spent on community development schemes.

Community eco-development schemes are important for the long-term survival of the Parks in order to reduce pressure on the Parks' resources, which would otherwise increase with the rising human population. In the short term, it is essential, first and foremost, to continue to manage the Parks effectively and protect the rhinos. If authorities become complacent, allowing financial cutbacks, species and habitat will decline significantly. The Nepalese also hope that the new community development projects will improve rhino conservation further. The next few years will be an exciting opportunity for the authorities and villagers around Chitwan and Bardia National Parks to determine the correct funding balance for both the needs of people and of rhinos.

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CONSERVATION PROGRAMMES FOR SUMATRAN AND JAVAN RHINOS IN INDONESIA AND MALAYSIA

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ABSTRACT

There is an intensive and international programme in progress to try to conserve the Sumatran and Javan rhinos. The effort is employing a diversified and integrated strategy that is attempting to: (1) protect the species in the wild using anti-poaching teams known as Rhino Protection Units (RPU's); and, (2) breed the species under managed conditions, originally in traditional captive situations, but more recently in breeding centres in native habitat. Moreover, the *in situ* protection and managed breeding are linked because the managed breeding centres in natural habitat will also be used as the centrepieces of a conservation tourism programme that is projected to have the potential to generate very significant income to support the protection in the wild.

RESUME

Il y a un intensif programme international en cour pour la conservation des rhinos du Sumatran et de Javan. L'effort s'appuie sur une stratégie intégrée et diversifiée visant à: (1) protéger les espèces sauvages en utilisant des équipes de lutte anti-braconnage spécialisées comme les Unités de Protection du Rhino (UPR); (2) reproduire les espèces dans des conditions de gestion originale et traditionnelle dans des situations de captivité et plus récemment dans des centres de reproduction au niveau des habitats de natalité. En plus, la protection *in situ* et la gestion de la reproduction sont liés, parce que les centres de reproduction dans l'habitat naturel seront aussi utilisés comme éléments principaux de conservation du programme touristique qui est destiné à développer le potentiel, pour générer un revenu significatif qui pourra supporter la protection de la vie sauvage.

INTRODUCTION

The Sumatran (*Dicerorhinus sumatrensis*) and Javan (*Rhinoceros sondaicus*) rhinos of South East Asia are the most endangered of the five surviving species of rhino (Foose and van Strien, 1997). As recently as the early 20th century, both species were widespread over South Eastern Asia from eastern India through Indochina, the Malay Peninsula and selectively on Sumatra (Sumatran and Javan rhinos), Java (Javan), and Borneo (Sumatran, and Javan rhinos until about 12,000 years ago). Today, the only confirmed, significant populations of Sumatran rhinos survive in three geographically distinct areas of two range states: in Indonesia on Sumatra; in Malaysia, on the Peninsula; and in the Malaysian State of Sabah on the island of Borneo. Recent evidence suggests that some Sumatran rhinos still exist in Thailand along the border with Malaysia, in northern Myanmar, and perhaps in India on the border with Myanmar, but the significance and validity of these reports is yet to be confirmed. About 300 Sumatran rhinos are estimated to survive worldwide.

Although not as rare as the Javan rhino poaching pressure

is more intense on the Sumatran rhino, whose populations have declined at least 50% in the last decade, almost entirely due to poachers. Thus, the Sumatran rhino is considered the most critically endangered species of rhino by the IUCN/SSC Asian Rhino Specialist Group (AsRSG) (Foose and van Strien, 1997). There are two confirmed Javan rhino populations: about 50 in Ujung Kulon National Park on the western tip of Java in Indonesia; and another five to seven in the Cat Loc area which is now part of Cat Tien National Park in southern Vietnam (Sung *et al.*, 1998). Hence, there are fewer than 70 Javan rhinos remaining. However, the Indonesian population is consolidated in a relatively well protected Park and the population has remained unchanged in numbers for the last decade. The major rhino areas and estimated numbers are provided in Table 1 and Figures 1-3.

The predominant cause of decline of both rhino species is poaching for the horn. Considerable habitat loss has occurred throughout their range as forests are destroyed for timber or converted to agriculture, but the AsRSG estimates that sufficient habitat remains for at least several thousands of both species, even within the two range state

Table 1. Rhino Areas and Numbers in Indonesia and Malaysia.

	Area size (km ²)	Status	Estimated number of rhinos	RPU's	
				IRF/AsRSG	EU
Indonesia:					
Sumatran Rhino					
Gunung Leuser	8,000	National Park	40-80	4	7
Way Kambas	1,300	National Park	~30	6	
Bukit Barisan Selatan	3,600	National Park	20-30	3	
Kerinci Seblat	10,000	National Park	~10		
Berbak	?	National Park	?		
Javan Rhino					
Ujung Kulon	760	National Park	50-60	3	
Peninsula Malaysia					
Taman Negara	4,400	National Park	40-60	4	
Endau Rompin	1,000+	State Parks (in 2 states)	4-8	2	
Belum	1,400	State Park	6-10	1	
Ulu Selama	1,000	Proposed Wildlife Reserve	4-6	1	
Gunung Inas	500	Forest Reserve	2-3	1	
Jeli	?	Forest Reserve	2-3	1	
Main Range	5,000+	Mixed - Mostly Forest Res.	10+		
Sabah					
Tabin	1,200	Wildlife Reserve	20-35	3	
Danum Valley	2,000	Protected Forest Reserve	20-35	1	
Total			208 - 320 Sumatran 50-60 Javan		

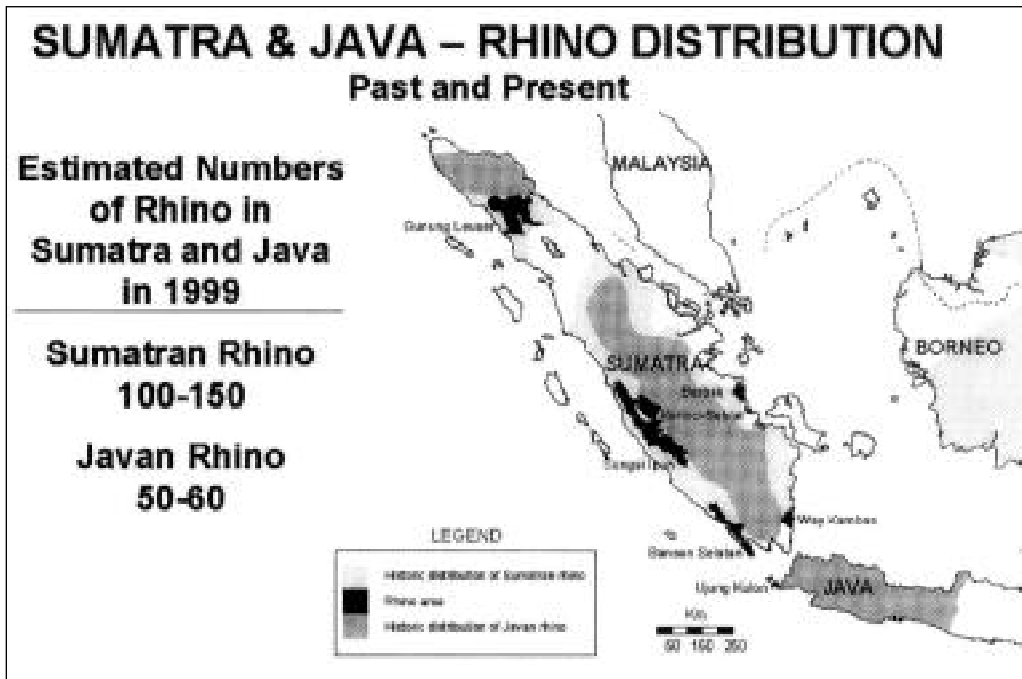


Figure 1. Map of past and present distribution of Sumatran and Javan rhinos in Indonesia.

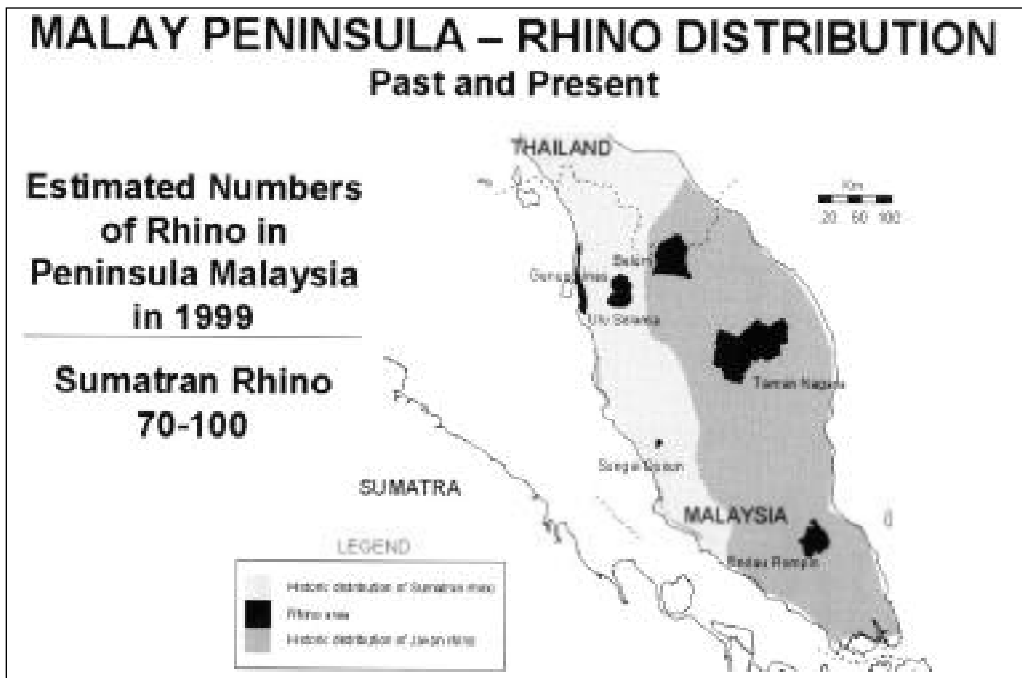


Figure 2. Map of past and present distribution of Sumatran rhinos in Peninsula Malaysia.

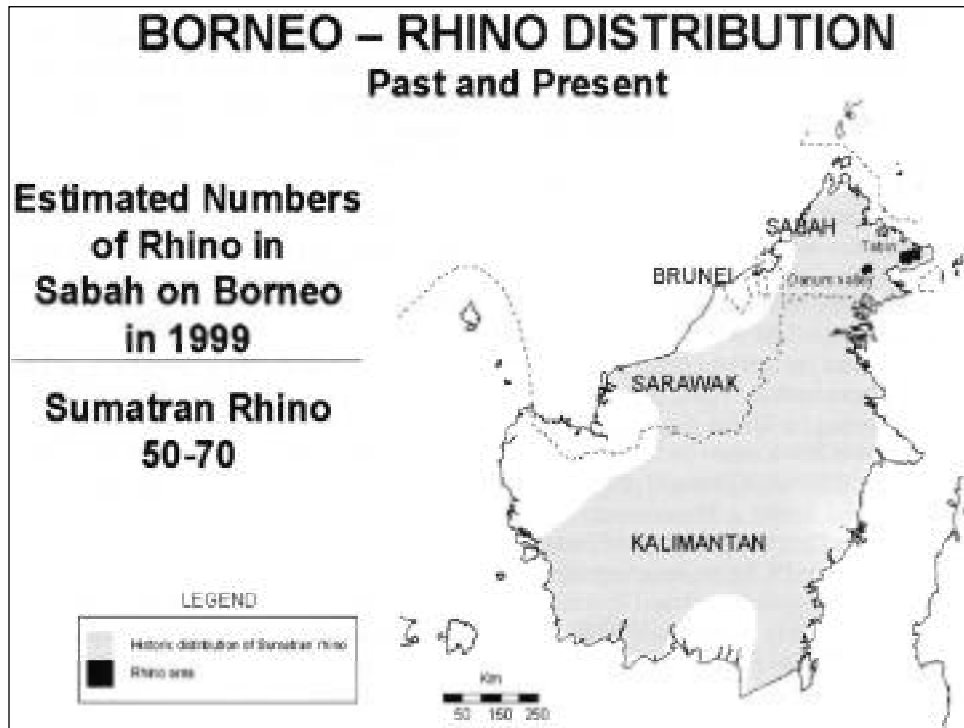


Figure 3. Map of past and present distribution of Sumatran rhinos in Borneo.

of Indonesia and Malaysia. Consequently, while habitat and ecosystem conservation are vital for long-term viability, direct protection of rhinos from poachers is much more critical over the short term. Otherwise, habitat and ecosystems may survive but the rhinos will not, as evidently has been the case in Kerinci Seblat National Park where the rhino population appears to have declined 90% over the last ten to 15 years and by 50 rhinos from 1989 to 1991 alone (Wells & Franklin, in prep).

In response to this crisis, the action plan for conservation of these two species in Indonesia and Malaysia emphasizes two major components:

- (1) Anti-poaching teams known as **Rhino Protection Units (RPUs)** for both Sumatran and Javan rhinos, and
- (2) **Managed Breeding Centres in Native Habitat**, currently for Sumatran rhinos but eventually perhaps for the Javan as well, both to propagate the species as a back-up for wild populations and to serve as centrepieces for a conservation tourism programme that can generate funds to support the RPUs and other *in situ* efforts for the rhino.

However, a number of aspects of the biology of the Sumatran rhino have complicated efforts to conserve the

species. In the wild, the Sumatran rhino inhabits very dense forests, occurs at very low densities, and is by nature very solitary, secretive and elusive. Hence, the rhinos, their poachers, and the anti-poaching teams trying to protect them are all to a certain extent wandering around independently in the forest with only intermittent contact. In captivity, the Sumatran rhino has proven to be one of the most complicated species in terms of both husbandry and reproduction of any mammal species.

RHINO PROTECTION UNITS (RPUS)

Under the conditions that have prevailed in Indonesia and Malaysia over the last five years, Rhino Protection Units (RPUs) appeared to be the best method to protect effectively tropical forest rhinos. The current RPU programme in Indonesia and Malaysia was initiated with and catalyzed by a grant from the Global Environment Facility (GEF) through the United Nations Development Programme (UNDP). The GEF provided \$2,000,000 over three years (1995-1998) to initiate and catalyze a major programme to conserve the Sumatran rhinoceros. Funds were equally divided between Indonesia and Malaysia, the wildlife conservation departments of which administered a large portion of the funds and supplemented them with governmental allocations to rhino conservation. The International Rhino Foundation (IRF) and the IUCN/

SSC Asian Rhino Specialist Group (AsRSG), for which IRF operates as the financial and administrative agent under an MOU with IUCN-The World Conservation Union, co-ordinated and facilitated the GEF Project.

To supplement the GEF funds during the initial three years and particularly to continue the programme after the expiration of the GEF grant in December 1998, the AsRSG and IRF have contributed funds and recruited a number of other donor partners including: the United States Rhinoceros and Tiger Conservation Fund (RTCF) administered by the Office of International Affairs of the US Fish & Wildlife Service (USFWS); WWF-Indonesia (WWF-IP), which in turn has received funds from other WWF National Organisations (UK, Switzerland, Netherlands); the Bowling for Rhinos programme of the American Association of Zoo Keepers (AAZK); and the Anna Merz Trust. The IRF/AsRSG initiated programme operates in Indonesia under a Memorandum of Understanding with the Directorate General of Nature Protection and Conservation (PKA); similar arrangements exist and are evolving in Malaysia through the Department of Wildlife and National Parks in Peninsula Malaysia, and the Wildlife Department in Sabah.

Under the IRF/AsRSG-initiated programme, RPUs have been formed in all areas where Sumatran rhinos exist, with the exception of Gunung Leuser National Park in Sumatra where the European Union has organised and is managing RPUs, albeit with technical assistance from AsRSG/IRF. As of late 1998, RPUs have also been formed for Javan rhinos as a result and at the recommendation of a Javan Rhino Colloquium organised by the AsRSG and IRF with a grant from the USFWS RTCF (Javan Rhino Colloquium Editorial Committee, 1997).

There are a total of 37 RPUs operating in Indonesia and Malaysia under the two auspices described above: (1) the IRF/AsRSG with joint funding in Indonesia from WWF-Indonesia; and, (2) the European Union Project in Gunung Leuser. A summary of these RPUs are provided in Table 1.

Moreover, the RPU programme initiated in Indonesia and Malaysia is extending to other range states in South East Asia. Another recommendation from the 1997 Javan Rhino Colloquium was to provide technical assistance for Javan rhino conservation in Vietnam, which AsRSG



Figure 4. Indonesia RPUs in dress and field uniforms.

has provided with funds from IRF and the USFWS RTCF. An improved rhino census has been conducted and a revised action plan formulated in Vietnam (Sung *et al.*, 1998). One objective is to establish RPUs as soon as possible and they may materialise with funds from WWF-US as well as the Cat Tien Project funded by the Netherlands Government and administered through the WWF-Indochina programme.

In Indonesia and Malaysia, each RPU usually consists of four to five persons (Figure 4) and is engaged in anti-poaching activities, intelligence operations, and community outreach work. The RPUs are attempting to create intensive protection zones (IPZs) for the rhinos in each area. The emphasis for the RPUs is to patrol in the rhino core areas, to destroy traps and snares and to interdict intruders. The RPUs also engage in community outreach efforts as well as intelligence operations to identify poachers in the local area. Each park or reserve (or sometimes a combination of two parks or areas) has an area co-ordinator and there is a programme manager for each of the three major political units where the RPUs operate: Indonesia; Peninsula Malaysia, and Sabah. There are also technical advisers provided by AsRSG/IRF who assist with the training and monitoring of the RPUs.

In Indonesia, the RPUs for Sumatran rhino comprise one PKA *Jagawana* ranger and three members who are recruited from the local community and trained by

the co-ordinators and technical advisers. The area coordinators have also been recruited from outside PKA. The RPUs for the Javan rhino are somewhat different in composition and consists of two PKA rangers and three local recruits. The area co-ordinator for Ujung Kulon is a national park employee. In Malaysia, all the members of the RPUs are government rangers. However, it has recently been decided in Malaysia to recruit area coordinators who are outside of the government structure.

In all cases, the RPUs co-ordinate closely with the existing staff of the national park but are concentrating specifically on anti-poaching in rhino core areas. Prior to the inception of the GEF project, rhino conservation was merely a limited part of the many activities of regular wildlife staff. RPUs were formed because the existing government staff of protected areas simply did not have the time, flexibility and resources to concentrate on the intensive patrols and intelligence work required to protect the rhinos. Hence, a system that combines government rangers and more autonomous staff has proven more effective and is being employed in several variations whose relative performance will be evaluated. Indeed, there have been and will continue to be many adaptive modifications of the system to respond to assessment of performance as well as changes in circumstances.

The most important activity of each RPU is the forest patrols. Each patrol continues for about four to seven



Figure 5. Daytime photographs of Sumatran rhinos collected by RPIJs with hand-held cameras

days, with a day of rest, a day of reporting and a day of preparation for the next patrol. In conjunction with ten days of leave every three months, the optimum number of patrol days per team is 14 per month. To date, many RPU are realising ten to 12 days of patrol per month. The emphasis in the patrols is to detect and destroy snares and traps and to interdict intruders. One indication of the greater activity and effectiveness of the RPU compared to previous efforts is the fact that on several occasions RPU members have been able to photograph for the first time, with hand-held cameras, Sumatran rhinos during daytime encounters (Figure 5).

The difficulty, particularly in Indonesia, of prosecuting poachers (a difficulty that is increasing with the economic and political instability) argues for concentration on preventative rather than corrective measures. This reality also limits the value of intelligence operations versus actual patrols. Intelligence is crucial and the RPU have engaged in such activities and will probably increase these efforts in the future, but the patrols seem still to be the most critical activity.

The RPU have been effective over the last three years.

However, because the number of RPU is limited, they have not been able to provide coverage of the entire area of the parks. Thus, for example, in Way Kambas, where there has been no evidence of rhino poaching, there have been several cases of tigers lost to poachers. In response, the 13 persons involved with the RPU combined forces with the research staff of the Sumatran Tiger Project based in the Park as well as some additional *jagawanas* to form 13 anti-poaching teams, each led by an RPU member. This intensive operation was successful in apprehending the poachers and stopping their activities. This result emphasises the need for more RPU to provide greater and better coverage. IRF/AsRSG are currently attempting to secure the additional funds required to add one RPU in Way Kambas for the first half of 1999.

Over the last year the need for more RPU has intensified due to the economic crisis and political changes in Indonesia and to a somewhat lesser extent in Malaysia. In Indonesia particularly, there have been significant disruptions of civil law and order which are increasing the pressure on the parks and intensifying the challenge, including personal danger, to the RPU. The approximate annual budget for the IRF/AsRSG RPU in Indonesia and Malaysia is in Table 2.

Table 2. The approximate annual budget for the IRF/AsRSG RPU

30 RPU (four to five persons each) at US\$1 2,000/RPU4/year	\$360,000
Technical Assistance & Co-ordination	\$140,000
(May seem high but actually covers 13 persons in Indonesia and/or Malaysia, including:	
• nine area field co-ordinators (for each park or combinations thereof)	
• two national programme managers	
• one field technical assistant	
• one regional SE co-ordinator/technical adviser)	
Total	\$500,000

Poaching has been eliminated or drastically reduced in areas where RPU have been operating. For example, in the first six months of 1998 for which a formal assessment has been compiled (Wells, 1999), the RPU in Way Kambas National Park interdicted 101 intruders, of which 46 were apprehended and 32 delivered to the police for prosecution (of which 75% were successfully prosecuted). Sixty-seven snares/traps were also destroyed or confiscated. Quantitative assessments for other areas (eg., Bukit Barisan Selatan and Kerinci Seblat) are in progress.

A major problem with the RPU programme is that there have not been sufficient funds to deploy an adequate number of RPU to provide satisfactory coverage of the parks. The RPU have the objective of protecting the other large mammals as well as the rhinos in the

The GEF funds concluded at the end of 1998, and under the current GEF system, there was no possibility of renewing or extending the grant, even though the RPU project received excellent reviews. It is difficult to recruit funds for the existing RPU, and a much greater number of RPU are needed. Hence, a major objective currently in progress is to develop financial sustainability of the rhino conservation programmes independent of support from range state governments. Financial self-sufficiency for the rhino conservation programmes is critical as government funds are inadequate and external donor support uncertain.

Over the shorter term, ie. 1999 to 2002, the IRF is attempting both to provide and to recruit bridging funds (until the eco-tourism programmes are in full operation) from other conservation partners such as:

WWF; the USFWS RTCF; AAZK; and the Anna Merz Trust. Over the long term (Year 2002 and beyond), a major mechanism being developed for financial sustainability are the conservation tourism programmes associated with the managed breeding centres described in the next section.

MANAGED BREEDING CENTRES IN NATIVE HABITAT FOR SUMATRAN RHINO

The second major component of the conservation programme for Sumatran and Javan rhinos are managed breeding centres in native habitat. Currently, these centres are being developed for only Sumatran rhinos, but if successful they may be extended to Javan rhinos (van Strien and Sadjudin, 1995).

The managed breeding centres have two major components, biological and conservation tourism.

Biological component:

The breeding centres for Sumatran rhinos are attempting to propagate this species under managed conditions as a back-up to the *in situ* protection efforts. Since *in situ* protection has proven to be difficult, a supporting mechanism through managed breeding could be critical. On this premise, and in response to the dire status of this species, an *ex situ* captive propagation programme was initiated in 1984 as an integral component of the conservation strategy for this species under the auspices of the Species Survival

(black, white, and especially Indian) that have been maintained in captivity in modern times provided encouragement that this *ex situ* programme would also be successful (Foose and Miller, 1997). Indeed, the second rhino known to be born in captivity was a Sumatran at the Calcutta Zoo in 1889 (Rookmaaker, 1998). Moreover, it was decided that only so-called "doomed" rhinos would be rescued for captivity. "Doomed" rhinos are defined as animals located outside protected areas in situations which were not be protectable with available resources, or areas which did not contain enough rhinos to be viable demographically or genetically (IUCN/SSC, 1984).

Three separate captive programmes were initiated in the major and geographically distinct regions where appreciable populations of Sumatran rhino still survive: Indonesia, Peninsula Malaysia, and Sabah (on the island of Borneo). The Indonesian programme was the most international of the programmes with rescued rhinos being placed in captive facilities in Indonesia, the United Kingdom and the United States.

Unfortunately, traditional captive methods have not worked for the Sumatran rhino. The Sumatran rhino is a much more formidable challenge than anticipated. Since 1984, 40 rhino have been collected from the wild. However, mortality has been high: 23 of the 40 have died (60%). Today only 17 (five males and 12 females) survive in ten captive facilities. Moreover, to date no reproduction has occurred although one calf has been born to a female captured pregnant very early in her gestation period (Table 2).

Table 3. Summary of captive (managed breeding) programmes for Sumatran rhinos, 1984-1999.

Country	Captured (males/females)	Born	Imported	Exported	Released	Died Escaped	Alive
Peninsula Malaysia	3/9	0/1	1/0	0/2	0/0	2/2	2/6
Sabah	8/2	0/0	0/0	0/0	0/0	6/0	1/2
Indonesia	7/11	0/0	0/1	4/7	0/0	3/3	0/2
Thailand	0/0	0/0	0/1	0/0	0/0	0/1	0/0
UK 0/0	0/0	1/2	1/0	0/0	0/2	1/0	
USA 0/0	0/0	2/5	0/0	0/0	1/3	1/2	
Total 18/22=40	0/1	4/9	5/9	1/0	12/11=23		5/12=17

Commission (SSC) of IUCN. The recommendation for *ex situ* programmes derived from the extreme difficulties of trying to protect this species in the wild and because an estimated 25% of the rhinos were located in areas where they could never be protected or be part of a viable population.

Successful propagation of the other three species of rhinos

A number of reasons have been proposed for the problems with this captive programme:

- Many of the mortalities seem consistent with nutritional difficulties. The facilities with the lowest rates of mortality (Sungai Dusun and Malacca Zoo) are adjacent to natural habitat forest and use exclusively native browse for the rhino diets. This browse may pro-

vide a better balance of nutrients needed by the rhinos than the diets including browse provided by the captive facilities more distant from native habitat

- Mortalities may also be related to the size and configuration of captive enclosures. Sumatran rhinos have large home ranges (10-15km² for females and 30km² or more for males) in the wild and individual adult rhino probably seldom encounter each other except when females are in oestrus. Most of the captive facilities are relatively small (0.4 hectares). Moreover, males and females are kept in adjacent or even in the same enclosures which do not provide adequate complexity for flight and evasion during the often violent interactions between the sexes. At least one of the mortalities in captivity appears the direct result of such conflict.
- The small size and configuration of enclosures may also inhibit breeding. Indeed, because the rhinos are aggressive if they come into contact with one another, many managers do not place the sexes together. It is also the case that bad luck concerning the sequence of sexes captured (Foose, 1999) and the subsequent distribution of rhinos among facilities due to political agreements rather than biological objectives, has prevented adult males and females from being in the same facility for enough time or in sufficient numbers to try different breeding combinations.
- The reproductive biology of the species causes it to be one of the most difficult that captive managers have ever tried to breed. For one thing, males are very, sometimes fatally, aggressive towards females except when females are in oestrus. Consequently, there is reluctance to place males with females until the female is in oestrus. However, it is difficult to know when the female is receptive without placing her with the male. This presents a real dilemma. Moreover, recently it has been revealed that females are induced ovulators, that is they will not produce eggs that can be fertilised by male sperm until or unless copulation occurs. Furthermore, if the female becomes pregnant, there is speculation that it is important to separate her immediately from the male or she may lose her pregnancy, as occurred three known times at the Cincinnati Zoo and perhaps another half dozen times at other facilities during the captive breeding programme.
- A final cause of captive breeding problems is stress due to exposure, both to human activities and to environmental factors, especially intense sunlight (notably its ultraviolet component), for these normally deep forest animals. Cataracts presumably

caused by exposure to sunlight have been a recurrent problem with captive rhinos.

The conclusion from consideration of the programme performance and suspected problems has been a recommendation that the surviving rhinos in captivity be consolidated in the most spacious enclosures and natural conditions possible consistent with continuation of the intensive protection and management believed necessary because of the precarious situation in totally free-ranging situations in the wild. By providing much larger enclosures and more natural conditions in a managed breeding centre in natural habitat, the hope is that propagation can succeed. These areas have been designated as "sanctuaries", a slightly different use of the term than has occurred in Africa (Leader-Williams *et al.*, 1997) because rhinos in the Sumatran rhino sanctuaries are initially not as free-ranging as their African counterparts. Moreover, food is supplemented and mating controlled. However, as protection improves and the rhino population grows, the objective is to evolve more towards the African model.

Three managed breeding centres in native habitat are already in operation:

The Sumatran Rhino Sanctuary/Suaka Rhino Sumatera (SRS) in Way Kambas National Park, Sumatra, Indonesia

The SRS complex comprises 10,000 hectares (25,000 acres) within Way Kambas National Park (Figure 6). The Government of Indonesia, Ministry of Forestry is providing 'concessions' for management of this area to the conservation partners involved, including the IRF, the AsRSG, and Taman Safari Indonesia (TSI). The SRS complex is divided into two parts: a **Rhino Conservation Zone** of 9,000 hectares and a **Conservation Tourism Zone** of 1,000 hectares.

Within the conservation zone, the first set of enclosures has been completed and encompasses 250 acres (100 hectares) in native forest. This area is currently divided into five 25-acre and one 125-acre enclosures (Figure 7.). The enclosures largely consist of a simple electrified fence and have been constructed with minimal disturbance to the tropical forest habitat. Facilities for the animal staff are adjacent to the rhino enclosures. Completion of construction of this first rhino complex was delayed several months due to the unusually heavy and long rainy season during late 1996 and early 1997.

The first three rhinos (one male and two females) were moved to the SRS in January 1998. This movement

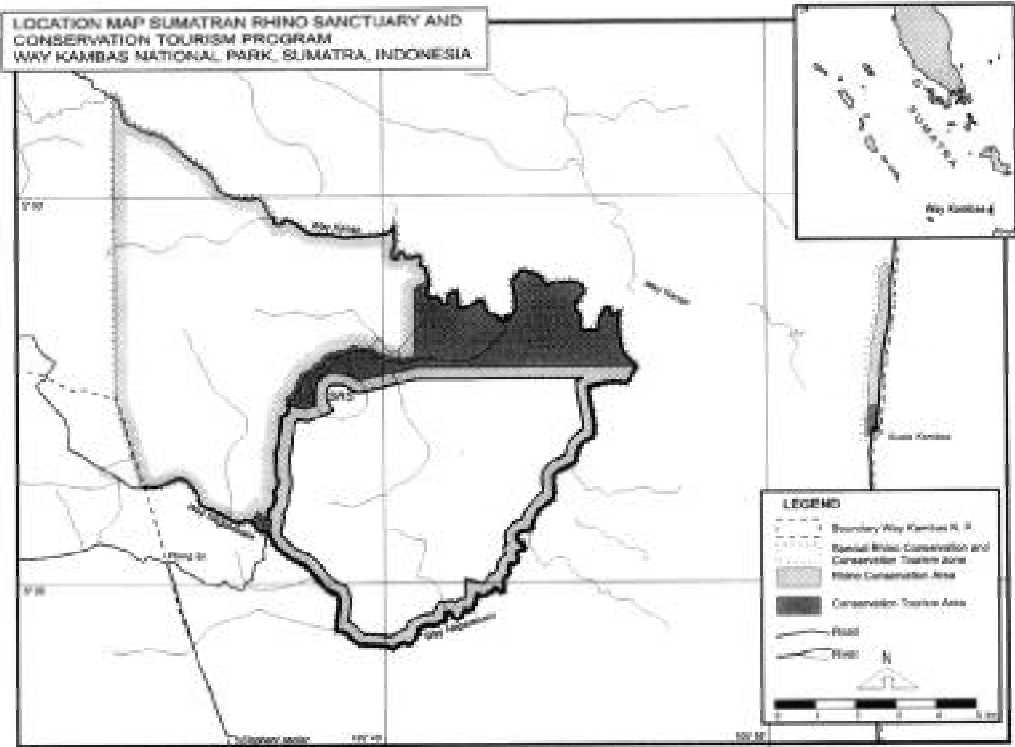


Figure 6. Map of SRS in Way Kambas National Park.

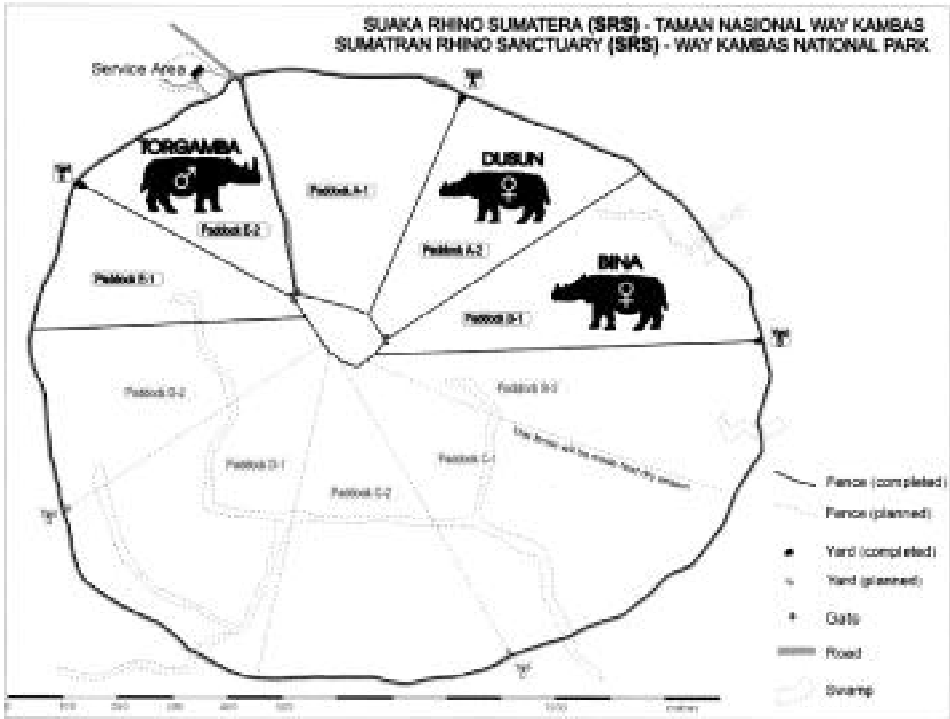


Figure 7. Diagram of rhino enclosures in SRS.

was delayed due to the drought and fires caused by El Niño during late 1997. The rhinos have re-adapted well to their native environment (Figure 8) after many years in captivity as indicated by their increasing weights, which are measured weekly. A monthly Curator's Report is produced by the SRS Curator and his staff. The male rhino (Torgamba; Studbook Number 4) was moved from the Port Lympne Zoo in the United Kingdom; one of the females (Bina, Studbook Number 32) was from Taman Safari Indonesia and the other (Dusun, Studbook Number 12; this animal was captured in Peninsula Malaysia, and exchanged for a male from Indonesia) was from Ragunan Zoo in Jakarta (Foose 1999). These rhinos comprise all but three of the five surviving rhinos of the 18 (seven males and 11 females) originally captured in Indonesia as part of the effort to establish a captive propagation programme for this species. There had been two other rhinos in Indonesia zoos (a male at Taman Safari and a female at Surabaya Zoo) which were designated for the SRS at the inception of the programme. Unfortunately, these rhinos died during 1997 before they could be moved to the SRS.

The other three surviving Sumatran rhinos from Indonesia in captivity are at the Cincinnati Zoo in the United States. During the last year, the programme there has succeeded in producing pregnancy in one of the females (Emi, Studbook Number 29) on actually three occasions (Roth and Brown, 1999).

However, none of the pregnancies has been sustained; two continued for about one to two months; the longest for four months.

One of the females, Bina, at the SRS is definitely manifesting estrus. There is an ongoing programme of placing this female together with the male. To date, there has been increasing courtship activity (particularly intense during November and December 1998) and hopes are high for a pregnancy in the near future. All three rhinos at the Way Kambas SRS were examined by a team of reproductive specialists in February 1999. The conclusions were that the reproductive system of Bina, the female apparently cycling, is in excellent condition. The male Torgamba also appears to be healthy reproductively with evidence of sperm production. Curiously, the other female Dusun seems to be hyper lactating, a condition that reportedly commenced in 1992, when she may have developed but lost a pregnancy. This hyper lactation is suppressing the estrus cycle in this individual. A case of continued lactation due to hyperprolactinemia has been reported in an African elephant (Brown and Lehnardt, 1997).

The IRF provided the initial capital (about US\$500,000) for development of the rhino facilities and is supporting operation of the biological programme (about US\$50,000/year).



Figure 8. Rhino in SRS at Way Kambas

The Sumatran Rhino Conservation Centre -Sungai Dusun (SRCCSD) at Sungai Dusun Wildlife Reserve in Peninsula Malaysia

This centre is currently smaller in size than the SRS in Way Kambas (Figure 9) but has more rhinos: two males and five females. The original facility consisted of a barn with seven enclosures, in total about half a hectare in size. With funds from and through the IRF, a larger enclosure of four hectares contained by an electric fence has been constructed to extend the facilities into the adjacent forest. A project by the Malaysian government will enclose another 40 hectares of forest by the end of 1999. The IRF and AsRSG have now an assumed joint financial and managerial responsibility (with the Department of Wild Life and National Parks of Peninsula Malaysia) for this centre. An objective is to manage the two breeding centres at Way Kambas and Sungai Dusun in an integrated and interactive manner. It is likely that there may be some movement of rhinos between the Way Kambas SRS and the Sungai Dusun Centre to manage the surviving rhinos as a single population to maximise propagation.

The same reproductive team that visited Way Kambas also examined many of the rhinos at Sungai Dusun

in collaboration with the resident staff and other Malaysia scientists. Pathology was observed in some of the female reproductive tracts, but encouragingly three of the females have been observed to copulate in the last six months (one in September 1998, another in December 1998, and the most recent in February 1999). All these matings have occurred in the larger four hectare enclosure in the forest.

The Sepilok Sumatran Rhino Breeding Centre in Sabah

This is the smallest of the three centres and has just a pair of Sumatran rhinos currently. A second female that had been until recently held at Sepilok has been moved to a small enclosure in Tabin Wildlife Reserve. Although there has previously been copulation at this centre (Bosi 1996), the site is deteriorating and another centre may be developed at Tabin or at a new zoo that the State of Sabah is constructing near Kota Kinabalu.

Conservation tourism component:

Ultimately, a more important part of the sanctuary programme is the development of a conservation tourism component to generate funds for operation of the breeding centres as well as other rhino conservation

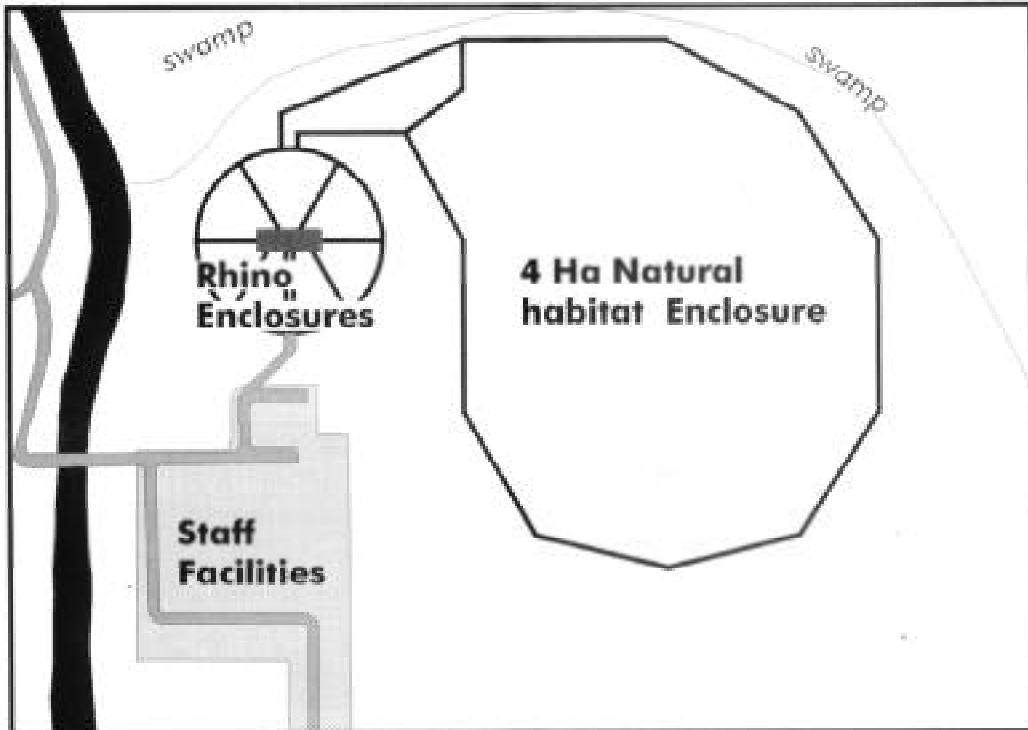


Figure 9. Diagram of Sumatran rhino Conservation Centre - Sungai Dusun.

projects, especially the RPU Programme. A preliminary business plan has been formulated, and projects significant revenue earning for the sanctuaries and rhino protection units in three to five years.

The SRS at Way Kambas is being used as the focal point for the conservation tourism programme. While to date efforts at the SRS have concentrated on ini-

tiation of the biological programme, there has also been steady progress towards the tourism objective.

To achieve these dual objectives, the SRS in Way Kambas is undergoing a joint venture with the Directorate General of Nature Protection and Conservation (PKA) in the Ministry of Forestry and Estate Crops of Indonesia, the Indonesian Centre for

Management Structure for SUMATRAN RHINO SANCTUARY (SRS)

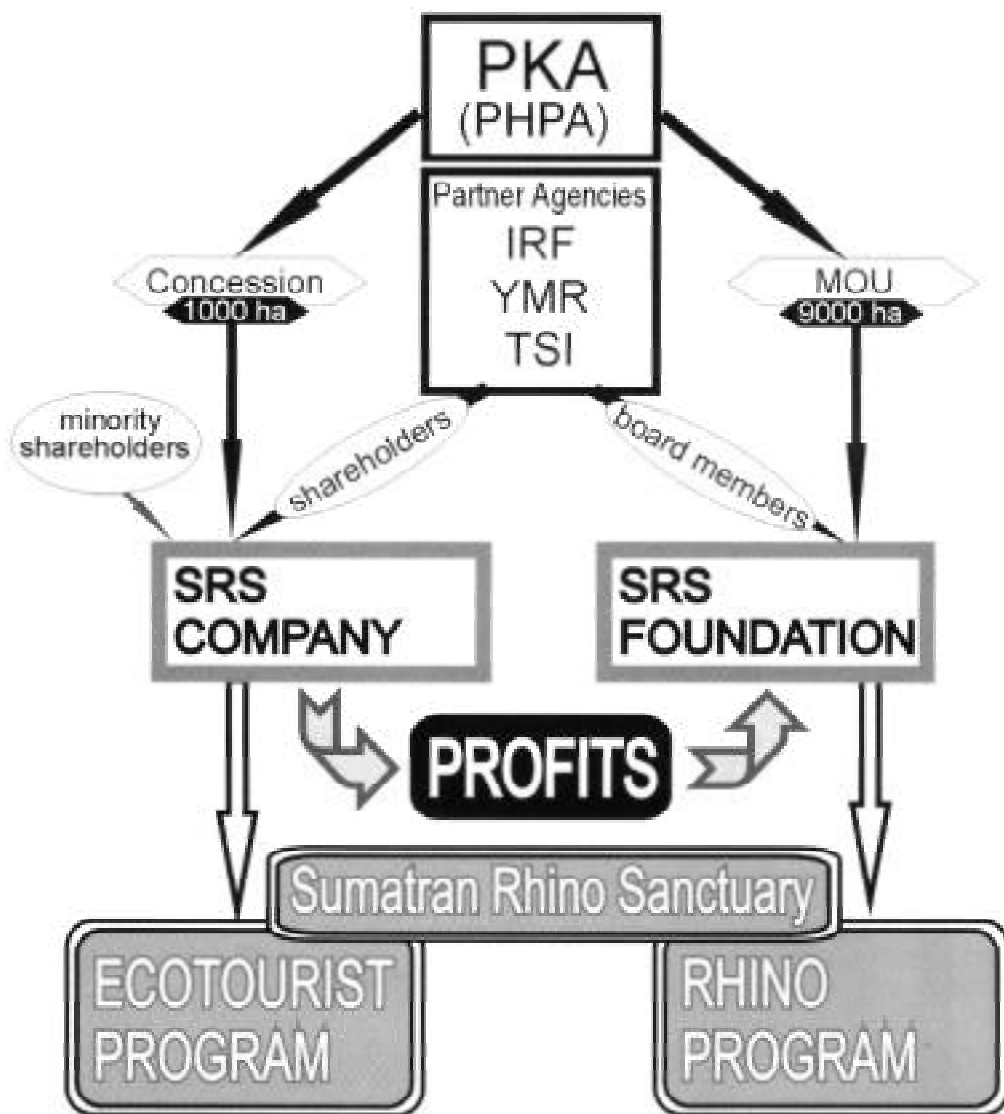


Figure 10. Diagram of structure of and relationship between SRS Foundation & Company.

Reproduction of Endangered Wildlife at Taman Safari Indonesia (TSI), Yayasan Mitra Rhino (YMR - The Rhino Foundation of Indonesia) and the International Rhino Foundation (IRF). Both a SRS Foundation and a SRS Company have been formed. The SRS Foundation, administered by a Board with both Indonesian and non-Indonesian members, manages the biological component of the SRS as well as linking with the Rhino Protection Unit (RPU) Programme through the PHPA/AsRSG/IRF/YMRMOU. The SRS Company is developing and will manage the eco-tourism component through a Board representing the major partners in this programme. All “profits” from the SRS Company will be transferred to the SRS Foundation for rhino conservation, first operating expenses of the sanctuary but then for support of the RPUs. Figure 10 presents a diagram of the structure of and relationship between the SRS Company and Foundation in support of rhino conservation. Similar arrangements are under development for Sungai Dusun.

Conceptual plans for the tourist facilities have been completed. The start-up costs for the eco-tourism programme are estimated at approximately US\$1 million and are not yet secured. However, efforts to recruit funds to initiate construction of the tourism facilities have already commenced. Also in progress are discussions with major international tour operators about possible partnerships in developing the tourism facilities and programmes. Indeed a programme of day visits by tour groups has already provided some income for operating expenses at the SRS. However, it must also be acknowledged that the recent political instability and economic crisis in Indonesia will retard development of the programmes to some degree.

As mentioned above, the prospects provided by the SRS have already induced Peninsula Malaysia to provide joint responsibility for management of Sungai Dusun to the IRF/AsRSG so that there can be integrated and interactive management of this Centre and the SRS in terms of both rhino propagation and conservation tourism. Ultimately, the tourism programme in Way Kambas may also attempt to co-ordinate with similar programmes for the Javan rhino in Ujung Kulon to provide a package that will virtually ensure visitors of observing both species in their natural habitat. This opportunity has indeed been rare. Since World War II, there has been less than 60 minutes of total observation time of Sumatran rhinos in the wild by the substantial number of managers and researchers who have worked on this species. Conservation tourism is much less developed in Asia than in Africa because, in general, it is more difficult to observe wildlife easily. The programmes

associated with the Sumatran rhino breeding centres will be an important and innovative step toward developing more conservation tourism in Asia

RESULTS AND CONCLUSIONS

Despite all the obstacles, the effort to conserve the Sumatran and Javan rhinos continues, and has recently shown signs of progress. In the wild, where RPUs are operating, there has been no (in some areas) or greatly reduced (in other areas) losses of rhinos to poachers. However, the economic and political instabilities in the principal range states present greater challenges. In the breeding centres, matings are occurring and pregnancies have been produced, although not yet sustained, but there are new ideas of how to correct this problem.

The funds available for Sumatran, and Javan, rhino conservation are low in comparison with expenditures, on a unit-area basis, that have proven successful for rhino conservation with the Indian rhino *Rhinoceros unicornis* (Martin, 1996; Martin & Vigne, 1995) as well as for some of the more intensively protected areas for black (*Diceros bicornis*) and white (*Ceratotherium simum*) rhinos in Africa. However, the Sumatran rhino occurs at much lower densities than either the Indian rhino or the African species, and it will not be feasible to expend as much on an area basis as has proven necessary and successful for these other species of rhino. Nevertheless, more rhino areas must be expanded if the Sumatran and Javan rhinos are to survive.

As a final observation, the Sumatran rhino is also known as the “hairy rhino”, because under certain conditions, individuals of the species will develop a rather thick and long coat of hair. This hairy rhino is probably related to the Woolly rhino that lived in Eurasia during the Ice Ages of the Pleistocene. There is compelling, although circumstantial, evidence from the fossil record that humans caused the extinction of the woolly rhino at the end of the Ice Ages. Now, the hairy rhino is also on the brink of extinction. A small but growing and determined group of conservationists is trying to ensure that humans do not commit the same crime twice.

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STANDARDISED BODY CONDITION SCORING SYSTEM FOR BLACK RHINOCEROS (*DICEROS BICORNIS*)

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ABSTRACT

The body condition scoring system for black rhinoceros (*Diceros bicornis*), which has been described by Reuter, H.O. and Horspool, L.J.I. (1996) has been modified. More detailed descriptions of seven body regions to be assessed and pictures which show the specific characteristics of each body condition score have been included in this simple descriptive 5-point scale for assessing black rhino condition. The aim is to minimise assessor bias and thus provide a standardised, reliable and repeatable body condition scoring system for black rhino.

RESUME

Le système d'enregistrement basé sur la condition du corps du rhinocéros noir (*Diceros bicornis*), décrit par Reuter et Horspool (1996) a été modifié. Des descriptions plus détaillées sur sept régions du corps ont été évaluées et les tableaux obtenus présentent des caractéristiques spécifiques de chaque condition du corps enregistré, en incluant cette simple description à l'échelle 5 - point pour évaluer la condition du rhinocéros noir. Le but visé est de minimiser les erreurs de l'évaluateur et fournir un système d'enregistrement de la condition du corps qui soit fiable, standardisé, de dont la répétition est possible.

INTRODUCTION

When an animal is losing condition, the fat reserves are mobilised and then muscle wasting sets in to supply the required energy demand. Body condition scoring assesses the amount of subcutaneous fat and the degree of muscling. This will reflect changes in body weight and provide an estimate of nutritional status and fitness. The average condition among animals indicates the response of a population to prevailing environmental conditions. However, behaviour and sex-based differences between individuals also effect condition. For example, nutritional demands on females increase greatly during late pregnancy and lactation, and such females are often the first to loose condition when food limitations arise.

In animal management, many important decisions, e.g. the provision of supplementary feed, are based on the assessment of body condition. In game species, the assessment of body condition during boma confinement and in the initial post-release period provides an indication of the response of an animal to the translocation and its new environment. In black rhino, loss of body condition is often the only indication of chronic disease. Resistance to disease, drought and frost are also related to an animal's condition. Moreover, there is evidence that mammals may require a minimum level

of body fat for adequate reproductive performance. The provision of a standardised, reliable body condition scoring system for black rhino will enable management to be optimised and increase the speed at which several problems can be detected.

During 1996 a study has been conducted in Namibia by H.-O. Reuter and L.J.I. Horspool, during which a simple descriptive 5-point scale for assessing condition or several body regions of black rhino has been statistically tested for the repeatability and agreement between observers. The results of this study have been published in a paper presented at the Joint 50th, Anniversary Congress of the Namibian Veterinary Association and 2nd Africa Scientific Congress of the World Veterinary Association, 10-12th September 1997, Swakopmund, Namibia. (Assessing body condition using observable criteria in free-ranging black rhinoceros, *Diceros bicornis bicornis*. Reuter, H.O. and Horspool, L.J.I.)

The most repeatable use of the scale was by calculation combined scores given to the various body regions by an observer. During the study it was apparent, that the subjectivity of a descriptive scale scoring system led to assessor bias, i.e. a tendency for some assessors to score consistently high or low.

More detailed description of the body regions to be assessed and better pictures to illustrate the specific characteristics of each body condition score will help to minimise such assessor bias, thus providing a standardised, reliable and repeatable body condition scoring system for black rhino.

DESCRIPTION OF BODY REGIONS TO BE OBSERVED WHEN ASSESSING BODY CONDITION IN BLACK RHINO

The neck

The rhino neck has a complex set of muscles between the back of the head to the rhino's withers, shoulders and chest, allowing the wide range of movements necessary for moving the head during feeding, and lifting and balancing the forequarters while walking or running. The nuchal ligament runs along the top of the neck from head to withers, above the neck vertebrae which are more deeply embedded in the neck. This muscle and ligament structure means the neck can change greatly in appearance, providing a useful measure of condition.

- When black rhino are in good body condition the neck region appears thick across the top, and is well muscled, with a smooth gradation between it and the shoulder blade. It must be noted that adult rhino bulls have a thicker (more muscled) neck than female rhino.
- As body condition deteriorates and muscle wasting sets in the neck region becomes narrower and flattened in appearance. The muscles hollow out in front of the shoulder blade, so that a prescapular groove develops.
- Eventually the -nuchal ligament, back of the skull (occipital bone) and in very emaciated rhino the cervical (neck) vertebra become visible.
- (Neck muscles include the cervical part of the trapezius, splenius, cervical serratus, rhomboideus, complexus and the brachiocephalic muscles.)

The shoulder (scapular) region

- The scapular (shoulder-blade) with its spine is a prominent bony feature in the shoulder region.
- When a rhino is in good condition, this area is well covered by the infra- and supraspinatus, the deltoid and the trapezius muscles, and the subcutaneous fat layer under the thick skin.
- The rounded appearance of the shoulder changes by a flattening of the region, as body condition deteriorates.

- The spinous process of the scapula and eventually the leading (anterior) edge of the scapula become more sharply defined, and the muscled areas appear concave in front of and behind the scapular spine as body condition worsens.

The ribs (costal region)

- When rhino are in excellent condition the ribs are covered with thick skin folds, especially just behind the shoulder and elbow region.
- As the subcutaneous fat reduces in thickness, the ribs become visible and with further loss in condition increasingly more noticeable.

The spine (vertebral region)

The spinous processes of the vertebra are covered along the top (dorsally) by the supraspinal ligament and on either side by the longissimus dorsi muscles.

- The vertebral region appears rounded and the long back muscle and fat deposits fill the gap between the ribs and the spine, if black rhino are in excellent condition.
- As the subcutaneous fat layer is lost the supraspinal ligament, which covers the spinous processes become visible as a defined line.
- Due to wasting of the longissimus dorsi muscles, the back hollows out either side of the spine, which become progressively more obvious. Eventually the costal processes of the vertebrae become visible.

The rump (gluteal region)

The bony protuberances of the pelvis, namely the tuber coxae, the tuber sacrum and tuber ischiadicum, and the major trochanter of the femur along with the surrounding gluteal and biceps femoris muscles are good indicators of a rhino's condition.

- If a rhino is in excellent condition this region appears rounded and the bony points are covered.
- The rump starts to hollow out quite early on during loss of condition, and the bony points become visible as a rhino is losing condition.
- As condition worsens, the bony protuberances become increasingly prominent and the muscled region eventually appears markedly concave, with ropy ligaments and muscle strands showing under the skin.

The abdominal region

- The abdomen appears filled and taut when a rhino is in good condition.
- As a rhino is losing condition, the abdomen becomes

Table 1. Descriptions of the appearance of each of the assessment sites at different body conditions in black rhino (modified from Reuter and Horspool, 1996).

CONDITION Assessment site	Numerical scale Descriptive scale	5 excellent (heavy)	4 good (ideal)	3 fair (average)	2 poor (thin)	1 very poor (emaciated)
A Neck	General appearance	thick, well muscled, rounded	well muscled, rounded	rounded	flat, narrow neck; nuchal ligament visible	narrow, angular (bony) neck; nuchal ligament prominent
	Prescapular groove		-	slightly visible	obvious	deep groove very obvious
B Shoulder	General appearance	well-muscled, rounded	rounded	flat	flat, slightly angular (bony)	angular, bony
C Ribs	Scapula	covered	covered	spine visible	obvious	very obvious
		well covered (skin folds)	covered (skin folds)	visible	obvious	very obvious
D Spine	General appearance	rounded	slightly angular	back groove back visible	groove deep obvious	back groove very obvious
	Spinous processes	covered	slightly visible	visible	prominent	very prominent
E Rump	General appearance	well rounded	flattened	slightly concave	concaveobvious depression	
	Bony protuberances	covered	slightly visible	visible	prominent	very prominent
F Abdomen	General appearance	distended, taught	filled	slightly tucked in	tucked in	tucked in
	Flank-fold	none	sometimes slightly visible	slightly visible	visible	obvious
G Tail base		rounded (bulging)	rounded	narrow	slightly bony	very thin and bony

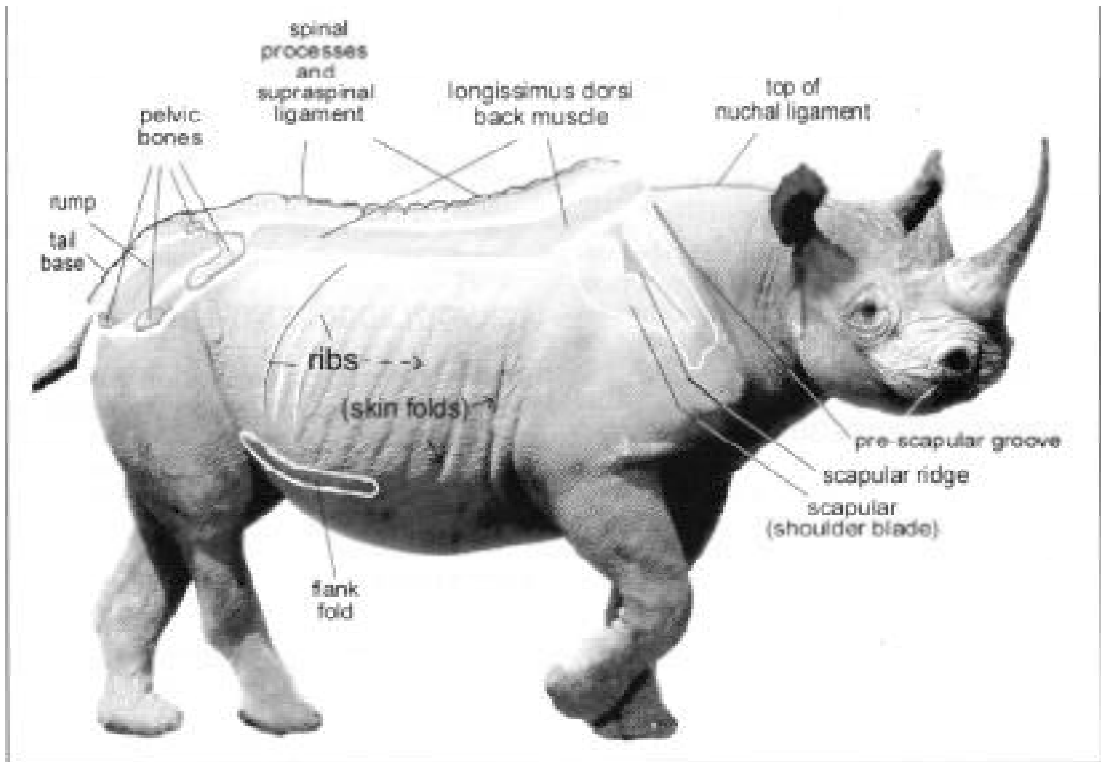
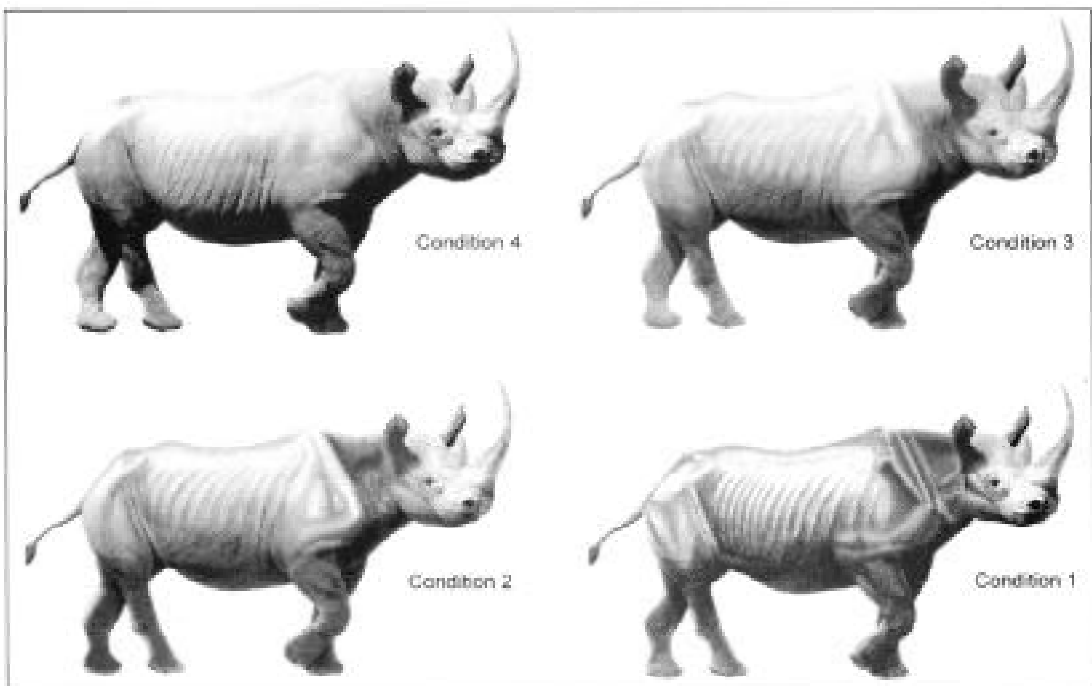


Figure 1. The body regions and specific anatomical features to be observed when assessing a rhino's condition.



Figures 2. The appearance of black rhino for all body condition scores.

tucked in and a skin fold in the flank becomes visible. During a period of anorexia this flank-fold also becomes prominent, even 'though the rhino has not otherwise lost condition noticeably. This suggests that the fullness of the intestinal tract and the state of hydration influence the prominence of the flank-fold.

The tail-base (caudal region)

The amount of subcutaneous fat around the tail-base can help to indicate how good a rhino's condition is. From forming a broad swelling up to the spine, this area narrows and appears more and more bony and raised above the rump, as condition deteriorates.

ASSESSMENT PROCEDURE

- Satisfactory condition scoring can only be achieved if an undisturbed rhino is viewed from its side at close range (not more than 100 metres away) in the open using binoculars. The quality of light is important for reliable assessment and preferably the rhino must be viewed slightly back-lit (early morning or late afternoon), so that any bony prominence become noticeable through the contrast revealed by their shadows.
- The most reliable and repeatable body condition scoring will be achieved by assessing all the regions separately, giving a score (1-5) using unit increments to each region and then combining these scores or calculating their average.
- It may be useful to observe other body regions as well. For standardised, repeatable assessment, however, the side view of the above mentioned regions was found to be most reliable.
- Frequently rhino may, however, present facing the observer or run away before assessment of all sites is completed. Sometimes not all assessment regions are visible, e.g. when rhino are found in thick bush. Also, rhino in a boma are frequently viewed from an elevated position and rhino seen from an aircraft are viewed at an angle from above. Even if only some of the above body regions and their characteristics can be assessed during a rhino observation, some indication of the rhino's body condition will be gained.
- Observers trained to assess condition by applying the described method, will usually find it easier

than untrained people to get some indication of a rhino's body condition, even if conditions for observation are not optimal. The reliability and repeatability of such observations can be assumed to be less consistent, however, than assessment of all the regions under optimal condition. Therefore, whenever possible efforts should be made to view rhino under optimal conditions when assessing their body condition.

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The authors would like to thank R. Brett, R. du Toit, R. Emsley, B. Loutit and P. Morkel for their constructive input towards this paper and for sharing their valuable field experience in assessing condition of rhino with the authors. The original rhino picture adapted for this work is from Penny (1987)6.

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Notes from the Field

Photo Credit: Keryn Adcock



AN APPARENT DECLINE IN THE MASAI MARA BLACK RHINO POPULATION

Recent surveys suggest an apparent decline in the black rhino (*Diceros bicornis michaeli* L.) population within Masai Mara National Reserve (MMNR) in Kenya. Since the mid-1980s the black rhino population within MMNR has been recovering from a serious decline due to poaching. A population of at least 108 rhinos in the early 1970s (Mukinya, 1973) was reduced to less than 13 individuals by the mid-1980s. An increase in surveillance and a virtual elimination of poaching saw the population increase to a high of 38 to 40 individuals within a decade (Morgan-Davies, 1996). However, over the past few years daily ground-based surveillance patrols conducted by Narok County Council (NCC) Rangers with assistance from Friends of Conservation (FoC) have been sighting progressively fewer numbers of known individuals.

During the year April 1997 to March 1998, a total of 30 known rhinos was recorded within MMNR, of which 29 were photographed (S. Milledge, pers comm). However, during the subsequent year (April 1998 - March 1999) only 21 known rhinos were recorded. In February 1999, a three day aerial census conducted jointly by FoC, the Eden Wildlife Trust (EWT), Kenya Wildlife Service (KWS) and NCC identified only 17 different individuals, although an 18th known individual was recorded during ground-based surveillance in the same month.

There are four possible explanations for the apparent decline: (1) the population was previously overestimated; (2) the current population is being underestimated as a result of increasing numbers of individuals becoming less readily observable; (3) the population has declined through mortality, or; (4) the

Sources: Matt Walpole, Durrell Institute of Conservation and Ecology (DICE), c/o P.O. Box 57046, Nairobi, Kenya and Philip Bett, Masai Mara National Reserve, P.O. Box 60, Narok Kenya

population within MMNR has declined as a result of individuals moving out of the Reserve into surrounding areas, including northern Tanzania and the hills to the north and east of MMNR. Photographic evidence suggests that there have been more rhinos within MMNR in the recent past than are now being observed. However, the fate of many of the animals that are no longer being seen is unknown.

Regular foot patrols would help to determine whether these animals are still present in thicker bush or in areas inaccessible to vehicle patrols. Similarly, expanding both ground-based and aerial surveys beyond the boundaries of MMNR may reveal whether rhinos have dispersed from the Reserve. A collaborative project between the Durrell Institute of Conservation and Ecology (DICE), NCC, Trans Mara County Council (TMCC), KWS, WWF, Moi University and the Kenya Department of Resource Surveys and Remote Sensing (DRSRS) is currently investigating factors affecting the recovery of the black rhino population in MMNR, and hopes to shed light on current carrying capacity and the role of habitat change and human disturbance in rhino distribution.

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US FISH AND WILDLIFE SERVICE RHINOCEROS AND TIGER CONSERVATION FUND, AFRICA REGION UPDATE

The Rhinoceros and Tiger Conservation Act of 1994, passed by the US Congress, provides financial resources through the Rhinoceros and Tiger Conservation Fund (RTCF) for conservation programmes that seek to promote the survival of these

beleaguered species. The fund is administered through the Secretary of the Interior in consultation with the Administrator of the U.S. Agency for International Development. Funding in fiscal year (FY) 1996 was \$200,000 followed by \$400,000 per annum in FY The

1997 and 1998. Funding has been increased to \$500,000 for FY 1999. For the period ending in FY 1998, 56 grants for a total of \$970,000 were awarded.

In Africa, the RTCF has sponsored a variety of projects dealing with both black and white rhino conservation. These projects cover a wide range of activities including protection of rhino and critical rhino habitat, capacity building, ecological monitoring, conservation education, and protected area management. The RTCF addresses the challenges of rhino conservation in Africa by considering both short term and long term needs. Practical, high priority activities such as capacity building in rhino monitoring via mark and recapture methods and anti-poaching training have been funded alongside programmes which yield a less immediate return such as conservation education and development of strategic materials for rhino conservation. Thus far, a total of 16 projects in five African countries have been supported or tentatively approved for support by the RTCF. An additional 14 proposals are under consideration. A complete list of projects funded, arranged by target species follows.

BLACK RHINO

- 1) Naikarra/Laleta Community Rhino Scout Programme for Survival of the Black Rhino Population (Friends of Conservation, \$5,690), Kenya
- 2) Training Programme for Game Scouts Involved in Rhino Population Monitoring - revision and production of a new version (IUCN SSC African Rhino Specialists Group, \$5,105), South Africa.
- 3) Rhino Security Appeal (Lewa Wildlife Conservancy, \$20,960), Kenya.
- 4) Staff Training and the Survey of Four Black Rhino Populations in the Selous Game Reserve, Tanzania (World Wide Fund for Nature, \$30,480).
- 5) The Management of a Black Rhino Population and Proposals to Enhance the Effectiveness Thereof (Eastern Cape Nature Conservation, \$1,342 -pilot study), South Africa.
- 6) Black Rhinoceros Monitoring Tembe-Ndumo Complex (Wildlands Trust, \$10,400), South Africa.
- 7) Assistance with the Training Project of the Naikarra/Laleta Community Rhino Scout Programme (Friends of Conservation, \$12,660), Kenya.
- 8) Purchase of Equipment and Supplies for the Masai Mara National Reserve Radio Telemetry Rhino Monitoring Project (Friends of Conservation, \$12,405), Kenya.
- 9) Black Rhino Ear Notching for Population Monitoring in Itala Game Reserve (KwaZulu-Natal Nature Conservation Service, \$6,625), South Africa.
- 10) Rhino Management Group Black Rhino Status Report Summary for 1997 and 1998 (Rhino Management Group, \$3,300), South Africa.

WHITE RHINO

- 11) Aerial Monitoring of the Northern White Rhinoceros in Garamba National Park Zaire (World Wide Fund for Nature, \$19,680), Democratic Republic of Congo.
- 12) Environmental Education at the Khama Rhino Sanctuary (The Khama Rhino Sanctuary Trust, \$20,818), Botswana
- 13) White Rhino Ear Notching for Population Monitoring in Itala Game Reserve (KwaZulu-Natal Nature Conservation Service, \$8,125), South Africa.

BLACK AND WHITE RHINO

- 14) Proposed National Research Project Regarding Suspects Involved in the Organised Poaching of Rhinoceros (Endangered Species Protection Unit of the South African Police Service, \$21,096), South Africa.
- 15) Passive Transponder System Equipment for Rhinoceros in KwaZulu-Natal (KwaZulu-Natal Nature Conservation Service, \$10,182), South Africa.
- 16) Fencing of Weenen Nature Reserve (KwaZulu-Natal Nature Conservation Service, \$4,716), South Africa

The RTCF accepts proposals from Federal, State and local government agencies, non-governmental non-profit organisations, and public and private institutions of higher education or any other entity. Proposals should be submitted to Dr Herb Raffaele, Chief, Office of International Affairs, US Fish and Wildlife Service, 4401, North Fairfax Drive, Room 730, Arlington, VA 22203-1622, USA. Questions regarding the RTCF (Africa Region) may be addressed to Dr Karl A K Stromayer, at the above mailing address and fax. E-

mail:Karl_Stmmayer@mail.fws.gov and telephone: 703-358-1764. Questions regarding other issues concerning the RTCF (Asian Programmes and Administration) may be and fax. E-mail:

Fred_Bagley@mail.fws.gov and addressed to Fred Bagley, at the above mailing address telephone: 703-358-1760.

Source: Karl A.K. Stromayer, US Fish and Wildlife Service, Office of International Conservation

TWIN ELEPHANTS BORN IN ADDO

Addo Elephant National Park (AENP), situated approximately 60km NNE of Port Elizabeth in the Eastern Cape Province of South Africa, is home to Africa's southern most elephant population (excluding the three remaining elephants in the Knysna State Forest). Founded in 1931 with just eleven elephants, Addo's elephant population has now increased (with no immigration) to over 285 individuals, and expansion of the Park is underway to enable continued growth of the population.

A record number of births occurred in 1998, with a total of 29 calves born during the year. Amongst these births were Addo's first ever recorded twins, two females named Duet and Duo, born on 7 October. Although both twins were regularly observed together with their mother, suckling simultaneously (one on each side), following her, or just standing close to her, it was not uncommon to find the twins separated. Duet was usually with her mother, while Duo was often some distance away with other family members. Their mother, a young

cow (18 years old) with just one previous calf, was possibly unable to cope with the demands of two calves at once. Duo was never seen successfully suckling whilst away from her mother — lactating adult cows were observed to push her away, and although sub-adult cows were tolerant of her suckling attempts, they were unable to provide milk. Always the weaker of the twins, Duo unfortunately died shortly before Christmas, when she was just over two months old. Duet, however, appears to be thriving.

Every elephant within Addo (n = 286, February 1999) is currently known as a result of an ongoing research project on the population, initiated in 1996. Additionally, the history of the population has been reconstructed by tracing individual elephants' life histories through photographic and other records. Maternal family trees throughout the Park's life-span have been compiled. These data indicate that Duet, the surviving twin, is the great-great granddaughter of the Park's oldest elephant, 60 year old Buttercup!

Source: Anna Woodd, Addo Elephant National Park P0 Box 52, Addo 6105, South Africa

Book Reviews

RHINOS AS GAME ANIMALS: PROCEEDINGS OF A SYMPOSIUM ON RHINOS AS GAME RANCH ANIMALS

Edited by J van Heerden and BL Penzhorn

Rhinos as Game Animals is an interesting and useful compilation of the papers presented at a symposium held at Onderstepoort, Republic of South Africa in 1994. The version reviewed here was reprinted in 1997, but there is no information on whether or not there has been any earlier versions or that there has been any attempt to update the contents since the symposium. If it is the case that this latest version is the first and only compilation of the symposium in print, some of the information may be dated, as it is three years after the actual symposium.

However, this compilation of 34 papers and a bibliographic list, available in soft cover, has a wealth of information both for the rhino specialist and the non-specialist who may just want to learn more about rhino ecology and 'husbandry'. The papers in the compilation cover a wide range of white and black rhino ecology, conservation and management as well as diseases and veterinary care. The wide coverage of topics means there is something for everyone.

The quality of the papers is variable. There are a few useful and carefully written papers, while many others could have benefited from closer editorial attention. The bibliography on African rhinos by du Toit et al., at the back of the compilation, does not only present a very

comprehensive reference list on rhinos but also offers an analysis of the literature in a tabular form. This is a gem. Anybody already in the 'rhino business' or planning to embark on any aspect of rhino research should be grateful to these authors for providing such a comprehensive list. This welcome analysis makes the targeting of areas needing more attention much easier.

Upon examination of this compilation of 'papers' which vary in style and quality, it is not easy to see the role of the editors. First, the format of this 242-page proceeding is very unusual. The page immediately after the title page has a table of contents that starts by listing the author (s) of the respective papers that is neither alphabetical nor logical. Secondly, there is no introduction or preface by the editors to explain the collection of papers neither to the reader nor to indicate how the compilation may be best used. Thirdly, in view of the diversity of topics covered, it would have been most useful to organise the papers into chapters which had groupings of similar papers by topic, eg. ecology, conservation and management, diseases and veterinary care etc., and with brief introductions to each chapter/section. Such an approach would have certainly have added value to the whole product. These editorial shortcomings notwithstanding, the compilation constitutes an important contribution to the growing literature on African rhinos.

Reviewed by Teye Teferi Programme Officer for Species, Africa & Madagascar Programme, WWF

RHINO RANCHING

by JG Du Toit

As Clive Walker correctly states in his introduction, much of the future of the rhinoceros in Africa will depend upon private landowners. As the human populations of Africa increase, more revenue is being channeled in the direction of education, housing and medical assistance and less in the direction of natural resource conservation, thus making it increasingly difficult for the official conservation bodies to look after

wildlife. Most prospective rhino owners are wealthy businessmen who know very little or nothing about rhino behaviour or requirements. I have seen many mistakes made, often with disastrous consequences, out of sheer ignorance and because the correct procedures and channels were not followed. It is thus high time that a manual like this has made its appearance. There are many experts in the various fields of rhino

conservation, but this is the first attempt to bring together the most important aspects of each field in a practical manner, which is understandable to the layperson.

The introduction, containing the ‘Ten Commandments of Rhino Ranching’, lets the prospective rhino owner know what he is getting himself in for. It also advises him of potential pitfalls and how best to avoid them. On the subject of minimum herd size, while I agree fully with the author regarding breeding bulls, if one does have only one breeding bull and for whatever reason it is not performing, another option would be to take dung from a bull from another ranch and spread it on the property. This usually has a most rapid effect as evidenced by very visible and increased signs of territory marking behaviour and may just lead to the desired results. As far as conflict with other animals is concerned, it cannot be emphasized enough that introducing young animals, mates and even females, into areas where there are already established adult populations, can have disastrous consequences.

The second chapter asks the question ‘Why rhino ranching?’. From a tourism point of view, there is no doubt that the preservation of this particular species on a game reserve is a huge attraction, because they become very tame and usually guarantee close up viewing opportunities, and therefore allowing exciting and memorable sightings. Trophy hunting is very controversial, but whether one likes it or not, it has contributed to puffing a substantial financial value to the rhino - the more valuable something becomes, the more one will do to conserve it.

Chapter 3 (Habitat requirements), Chapter 4 (Social behaviour) and Chapter 5 (Reproduction) provides essential background information together with the important practical implications for the rhino rancher. The information contained herein allows the prospective buyer to plan his introduction properly from the start.

Chapter 6, dealing with ‘Management’, mentions ‘Ear tags under ‘Identification Techniques’. This is definitely only a temporary measure, not only for the reasons mentioned in the text but also because they can become the ears can become infected when kept for an extended period of time. Earnotching is certainly by far the best means of field identification and is a procedure which should be carried out on every rhino. When doing this it is also essential to insert microchips. One must be careful, however, not to drill too deep or too close to the base of the horn where one might penetrate the sinuses, bearing in mind that the horn rests on a bony prominence. The practical implications mentioned in

this chapter are important from a genetic and reproductive point of view, which is replacing breeding bulls every four to six years, purchasing bulls and cows from different sources and acquiring at least two breeding bulls if possible.

Chapter 7 deals with the capture of the white rhino. Here the introduction is all-important as it emphasises the need for specialised expertise and equipment before the operation can even be considered. As far as the drug dosages are concerned, I have a problem with the recommended azaperone levels. They are not too high from a safety point of view, but should an animal go down in an inaccessible position, thus necessitating it to be walked out to the capture crate, it will be very difficult to get it onto its feet using the recommended doses of nalorphine (especially at the end of winter when the animal’s condition is down). One would also have to use higher doses of nalorphine, thus running the risk of reviving the animal too much and causing it to become uncontrollable once it is on its feet. I would recommend 40 to 60mg azaperone for an adult bull, 40mg for an adult cow, 15 to 20mg for a subadult and 5 to 8mg for a juvenile. Nalorphine can also be administered if the animal goes down very quickly or if the venous pressure behind the ears is low, in order to elevate the level of an aesthesia if the respiration is slow and/or shallow, Dopram should also be administered. The recommended walking dose of 30mg nalorphine applies to an adult animal — and even this can vary substantially from 20mg up to 70mg in some cases. As a precautionary method, start with a low dose. Anti-inflammatory compounds such as Finadyne are not recommended routinely, because if a problem does develop it is usually because the journey is too long or that the animal is not tranquilised adequately. One must remember that the white rhino is usually very groggy for at least six to eight hours after being revived and loaded. The precautions in this chapter are extremely important. Paralysis of the hind limb, which the author refers to, is usually unilateral and often permanent, so it is best not to let the rhino lie on the same hind limb for longer than 25 minutes. If the capture process is going to take longer than this, for whatever reason, it is best to roll the animal from one hind limb to the other. This is especially important in heavy, adult animals. As far as the use of hyoscine is concerned, I would discourage its use completely. I would also never recommend releasing animals straight into the bush post capture - even a boma trained rhino may go straight through the boundary fence of its new home. It is better to release the animal into a holding boma, even if it is only for a couple of days, in order to allow the animal to settle down. The smaller the ranch, the more important

this becomes. The last precaution mentions capturing a rhino in poor condition. It is not always easy to judge a rhino's condition, and I have been misled on several occasions. It is better to recommend that under normal South African conditions, it is inadvisable to embark on a capture operation after the end of July. Under the heading 'Transport' there appears to be an error in Table 4 with regards to the Clopixol-Acuphase doses and should probably be read as such: sub-adult 200mg, adult cow 300mg and adult bull 300 to 350mg (even 400mg). It must be mentioned here that this drug does not consistently deliver the desired results. As far as the precautions regarding transport are concerned, the mass carrier pictured on page 37 is designed in such a way that it can and has transported six adult bulls comfortably on numerous occasions. In my opinion, it is inadvisable to spray animals with water during transport. The rhino may slip on the wet floor and not be able to get up, leading to disastrous consequences. Instead, by limiting the number and lengths of the stops, one ensures that there is a regular flow of air over the animals, which should be enough to prevent the rhino(s) from overheating. Pouring water over an animal in aerate whilst the vehicle is stationary, also raises significantly the humidity. As far as 'Boma Management' is concerned, the first point under 'Problems' applies to the 'Release' subsection. Under 'Feeding', mention is made of lucerne- be sure to mix it in gradually with the teff up to a maximum of 10%, as too much can lead to diarrhoea. Constipation may also be due to the fact that the animal does not eat at all for the first few days. Soft stools and even diarrhoea is one of the more common complications - usually due to too much lucerne, too many cubes or both. The problem is usually resolved by feeding exclusively teff for a few days. Under 'Release' I would like to reiterate that it is always better to release a rhino into a temporary holding boma, if at all possible. If not, the advice offered here becomes all the more important.

Chapter 8 deals with mortality and includes some information on the background and intricacies involved in poaching. In Chapter 9, the author briefly goes into the politics of rhino conservation wherein he states that the CITES ban on the trade of rhino products has not been effective in controlling poaching and that the private landowner, in contrast to what 'Green' organisations maintain, should be allowed to do what he likes with his rhino, as they actually belong to him.

Reviewed by PS Rogers-Hoedspruit Research and Breeding Centre for Endangered Species,
PO Box 1278, Hoedspruit, 1380, South Africa

Chapter 10 demonstrates just how expensive it is to properly look after and conserve rhinos, but if one looks at the trend in the selling prices over the last couple of years (the average selling price during 1998 will probably be South African Rand 90 000 [US\$ 15,000] and more), it is obvious that buying and fanning rhinos can be a good investment. There can be no doubt that hunting has contributed significantly to the increased value of the rhino. In this chapter, the author also puts forward arguments for and against legalisation of trade in rhino horn. In my opinion, dehorning rhino will not stop them being poached - the base can surely be cut into blocks and sold as such. Then there is also the revenge aspect - a poacher tracks a particular rhino for days, only to find that it has no horn. More than 95% of the 71 rhino mentioned in the Zimbabwean dehorning operation were shot — and one can only speculate as to the reasons why. I agree with the author when he states that demand exceeds supply and that the poaching efforts will therefore continue until the last rhino is shot. The author also goes through a dehorning costing exercise which is followed by a table showing the sharp increase in the value of rhino horn over the last 10 years or so. It would appear that there is a substantial amount of money to be made out of rhino horn harvesting, if one can accept that a rhino without a horn is still a rhino!

Appendix I lists all the organisations that have been and still are deeply involved in rhino conservation today. Appendix II lists the names of specialists in the various fields of rhino conservation who can be contacted for help and/or advice. Appendix III lists all the Provincial Nature Conservation authorities with whom one needs to work in order to obtain advice and the necessary permits.

To sum up, I believe that every prospective rhino rancher should read this manual and they will not only become aware of all the options open to them regarding the utilisation of the animals, but also the numerous pitfalls that await should they not be adequately prepared. Should the reader wish to get any more information on a particular aspect, the author has included a bibliography at the back stating the sources consulted and suggested further reading. This manual should also be consulted by anyone involved in or interested in rhino conservation as it addresses all of the issues, some of them very controversial, pertaining to rhino ranching and utilisation.

Pachyderm

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Pachyderm welcomes original manuscripts (not published elsewhere) dealing with the conservation and management of elephants and rhinos. All submissions are reviewed by at least two referees. Manuscripts should preferably not exceed 4,000 words; shorter ones have a greater chance of being published. Contributions may be written in English or French and should be typed on one side of A4 paper, double-spaced with ample margins. All manuscripts must have an abstract or summary. Final versions of manuscripts should be submitted on IBM-compatible 3.5" diskettes in WordPerfect or Microsoft Word (preferred) format if possible. The full postal address of the first author should be included as well as the address of any other author.

Tables and figures should be submitted on separate sheets along with the captions to illustrations typed out on another sheet. Figures should be black-and-white high quality graphics, suitable for reduction. Photographs should be unmounted, glossy prints of good quality. Abbreviations and references should be made using the same format provided by the *African Journal of Ecology*.

We also welcome short updates for the "Notes from the Field" section of *Pachyderm*. "Notes from the Field" should describe activities and/or the current conservation situation in your area or country. They should be 500 words or less, and give an account of the current conservation status for elephants or rhinos, new developments (positive or negative), or an important event which affects or will significantly affect elephant and/or rhino conservation. Furthermore, "Notes from the Field" should be informative pieces, which provide an update on important elephant or rhino issues, where there is insufficient information to write an entire manuscript or the author feels it is important to inform the *Pachyderm* readership about recent developments. "Notes from the Field" may also be letters responding to a manuscript published in a previous edition of *Pachyderm*.

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