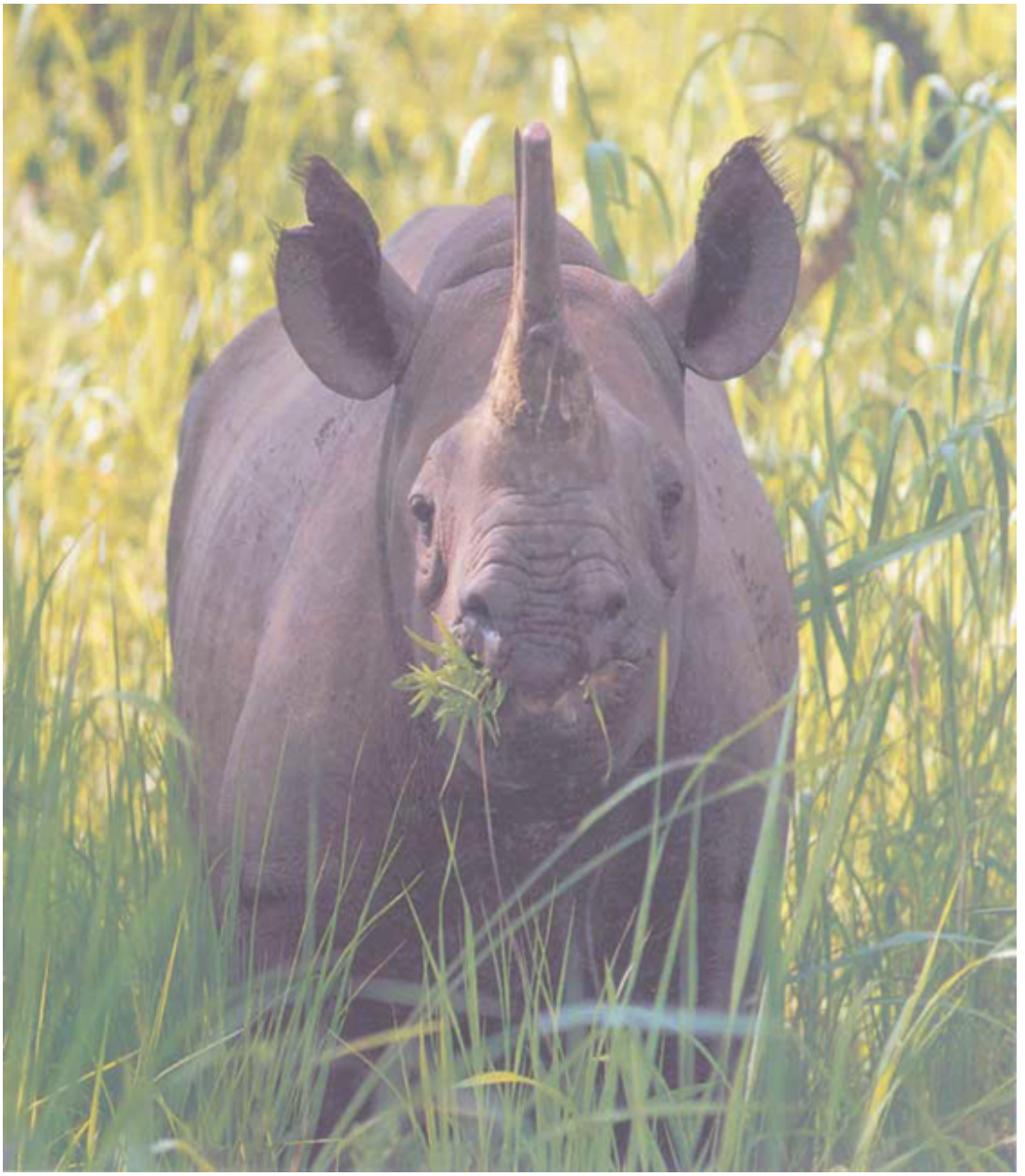
Pachyderm

JAN-DEC 1999 Number 27



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Pachyderm

Journal of the African Elephant, the African Rhino and the Asian Rhino Specialist Group

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Editorial

This issue *of Pachyderm* is a year's issue, covering January to December 1999. We have been lagging behind our publication schedule for some time and need to adjust to the calendar. You will discover a new section: **Review and Opinion,** which is distinctly different from the **Research and Methodology** section, in that the presentation of original research results is not the main focus.

We are trying to streamline the typography and lay-out of incoming contributions and would like to appeal to future contributors to follow more closely the guidelines to ease the editing of manuscripts meant for publication in *Pachyderm.* More detailed "Guidelines to contributors" are published in this issue.

Personally I enjoy design and lay-out, such that the lay-out of this issue was done entirely at the Secretariat. We hope that in future and thanks to a new computer, Monica Buyu, the Secretary of the AfESG, will have the opportunity to continue our desk top publishing efforts.

In no. 26, a short version of a methods paper of John Watkin and Kes Hillman Smith was published. Due to the interest that the note raised and the subsequent enquiries to us to obtain the full version, we decided to publish the paper in full in this edition.

Like the last issue, this one contains comparatively few articles on elephants, but many on rhinos. We have two contributions covering the history of two probably equally threatened subspecies of rhinos, the Westem African black rhino, *Diceros bicornis longipes,* and the Javan rhino, *Rhinoceros sondaicus annamiticus.* The decision as to which of the two should go on the front cover of this issue was not an easy one. These two articles also exemplify something that has always been critisized: both draw heavily on unpublished reports, the contents of which are not easy to verify by the reviewers. However, there is an urgent need to bring the contents of those hidden reports to the attention of a wider readership and decision makers for conservation action.

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ERRATA TO *PACHYDERM* NO.26

I. The caption to the photograph on the front page should have read: Black rhino in Swaziland.

II. The photographs on pages 41, 44, 45, 50 and 122 were wrongly credited to Keryn Adcock and not to Hans Hansen, who is in fact the photographer and owner of the photographs. On behalf of Greg Overton (editor of issue no. 26), the current editor apologizes for this unfortunate error.

III. On page 123, paragraph 2, line 1 should have read: During the year April 1997 to March 1998, a total of 28 known rhinos were recorded within MMNR.

Cover photo credit: Hubert Planton

Caption: Western African black rhino, *Diceros bicornis longipes.* "Sopen", shot in August 1996, was one of the last representatives of the Western African black rhinos in the world.

CHAIRS' REPORTS
RAPPORTS DES PRESIDENTS

African Elephant Specialist Group (AfESG)

Groupe des Spécialistes des E1éphants Africains (GSEAf)

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You will notice that this issue covers a 12-month period from January through December 1999. The transitioning of editors and other factors led me to take the somewhat conservative decision to merge two six-monthly issues and "catch up" the time lost over this past year. *Pachyderm* has grown into a professional publication that now reaches over 1,000 subscribers with each edition. Its timely production is not a trivial task given the limited staff time we have available in the African Elephant Specialist Group (AfESG) and the solely volunteer support provided by our editorial board. We hope you will find this issue deserving of your continued interest and support.

The coming of the new millennium signals the beginning of my ninth year as the Chair of the AfESG. Some days I wonder where the eight years have gone. Other days, I wonder how I will ever have enough time to do justice to all the challenges facing the African elephant that arrive in an ever-lasting flow on my desk each day. I often have to remind myself that I can not hope to take on all issues all the time. Positive outcomes for elephant conservation

Vous remarquerez que cc numéro couvre la période de 12 mois allant de janvier à décembre 1999. La transition entre les éditeurs et d'autres facteurs m'ont conduite à adopter l'approche un tant soit peu conservatrice de réunir deux numéros semestriels en un afin de "rattraper" le temps perdu au cours de cette dernière année. Pachyderm est devenu une publication professionnelle dont chaque numéro atteint plus de 1000 abonnés. Sa production dans les délais n'est pas une tâche facile, le Groupe de Spécialistes de l'Eléphant d'Afrique (GSEAf) ne disposant que d'un temps de personnel limité et le comité de rédaction travaillant sur une base uniquement bénévole. Nous espérons que ce numéro vous confortera dans votre intérêt et votre soutien continus.

L'approche du nouveau millénaire marque le début de ma neuvième année en tant que Présidente du GSEAf. Certains jours je me demande où ces années se sont enfuies. D'autres jours, je me demande si j'aurai jamais suffisamment de temps pour rendre justice à tous les défis auxquels l'éléphant d'Afrique doit faire face, qui arrivent quotidiennement sur mon bureau en un flux ininterrompu. Je dois souvent me forcer à me rappeler qu'il est illusoire de vouloir traiter toutes les questions en même temps. Les succès remportés pour Ia conservation de éléphant

will be determined by how well we, as a community concerned with the conservation of the species, effectively and efficiently marry the priorities for action and the opportunities to address them. This continues to be the motivation that provides me with forward momentum. I am sure it also holds for many of you.

Since the last issue, we have completed the final draft of the "Strategy for the Conservation of West African Elephants". We are now actively addressing needs that were identified in the strategy and a number of funding proposals have been prepared to target interested donors. The challenges are immense but are on a par with the enthusiasm for addressing them. I recently had the opportunity to visit West Africa again and honestly feel that we are on the verge of a renaissance of elephant activity in the sub-region. Realising these actions is made much more certain by the active efforts of our Programme Officer in Burkina Faso, Lamine Sebogo, and the dedicated support of Ibrahim Thiaw, IUCN's Regional Representative for West Africa.

We have also completed the first step in Mozambique's elephant conservation planning process with the finalisation of a "Strategy for the Management of Elephants in Mozambique". It is, of course, important to mention the financial assistance provided by WWF (for the West African and Mozambique initiatives) and the US Fish and Wildlife Service (for the drafting exercise in Mozambique). This donor support provides both political and technical motivation and rigour and is much appreciated by the governments concerned.

As I write, the AfESG recently has been approached to assist the governments of Ghana and Botswana to launch similar initiatives towards improved planning for the management and conservation of their elephants over the next five to ten years. For me, such requests are very gratifying. They provide clear recognition that the AfESG effectively carries out one of its primary terms-of-reference by providing timely and professional technical support to those responsible for managing Africa's elephants.

dépendront de notre capacité, en tant que communauté concernée par la protection de l'espèce, à marier effectivement et efficacement les priorités d'action et les opportunités pour les traiter. Ceci demeure la motivation qui me fournit mon élan. Je suis sûre qu'il en est aussi de même pour nombre d'entre vous.

Depuis le dernier numéro, nous avons terminé la version finale de la "Stratégie pour la conservation des éléphants d'Afrique de l'Ouest". Nous nous attachons maintenant activement à la satisfaction des besoins identifiés dans la stratégie. Un certain nombre de dossiers de financement ont été préparé à l'intention de financeurs potentiels. Les défis sont immenses mais vont de pair avec l'enthousiasme exprimé pour les relever. J'ai récemment eu l'occasion de visiter à nouveau l'Afrique de l'Ouest et j'ai honnêtement le sentiment que nous sommes sur le point de vivre une renaissance de l'activité au béné-fice de l'éléphant dans la sous-région. L'assurance de réalisation de ces actions est renforcée par les efforts actifs de notre coordinateur de programme au Burkina Faso, Lamine Sebogo, et le soutien dévoué d'Ibrahim Thiaw, représentant régional de l'UICN pour l'Afrique de l'Ouest.

Nous avons aussi achevé la première étape du processus de planification de la conservation de l'éléphant au Mozambique, en mettant la touche finale à la "Stratégie pour la gestion des éléphants au Mozambique". Il est bien entendu important de mentionner l'assistance financière apportée par le WWF (pour les initiatives d'Afrique de l'Ouest et du Mozambique) et de l'USFWS (pour l'exercice de rédaction au Mozambique). Le soutien de ces financeurs fournit une motivation à la fois politique et technique ainsi que la rigueur nécessaire, et est fortement apprécié par les gouvernements concernés.

Alors que j'écris, le GSEAf a été récemment contacté en vue d'assister les gouvernements du Ghana et du Botswana dans le lancement d'initiatives similaires pour l'amélioration de la planification de la gestion et de la protection de leurs éléphants au cours des cinq à dix années à venir. De telles demandes sont pour moi trés gratifantes. Elles fournissent une claire reconnaissance de la réalisation par le GSEAf de l'un de ses principaux objectifs fondateurs: fournir un soutien technique rapide et professionnel aux responsables de la gestion des éléphants d'Afrique.

As I reported in a letter to the membership in July of this year, the system for monitoring illegal killing of elephants (MIKE) and the Elephant Trade Information System (ETIS) are now realities. At their February 1999 meeting, the CITES Standing Committee established a Sub-Group to deal specifically with overseeing the implementation of MIKE. This MIKE Sub-Group is comprised of government representatives and includes representation from Africa and Asia, in addition to other regions recognised within the Convention.

Following their formal approval of MIKE and ETIS, the Standing Committee went further to allocate funds for the implementation of the pilot phase of MIKE for Africa and Asia. The implementation of the two pilot phases began in earnest in mid-1999 following the signing of a Memorandum of Understanding between the CITES and IUCN Secretariats. The African pilot phase is being conducted in Central Africa and the Asian pilot phase in South-East Asia. The primary responsibility for the development of the Central African work and the initial training of MIKE officers has been sub-contracted from IUCN to the Wildlife Conservation Society/NYZ and is being coordinated by Dr John Hart in collaboration with a steering group comprised of technical government members from the sub-region. IUCN has continued work on developing and planning for the start up of the South- East Asian pilot phase and further development of the savanna, forest and general data collection protocols, training materials and the centralised data handling functions to be carried out by the MIKE Central Co-ordination Unit, once it is formally established.

From here on, the role of the African and Asian Elephant Specialist Groups will be to provide technical advice, through their Secretariats and the broader membership, to the Central Co-ordination Unit. The lead on the implementation of and fund-raising for MIKE now firmly sits with the CITES Secretariat. TRAFFIC remains the implementing agency for ETIS.

The Human-Elephant Conflict Task Force

Comme je l'ai mentionné dans une lettre aux adhérents en juillet de cette année, le Système de Suivi de l'Abattage Illégal des Eléphants (MIKE) et le Système d'Information sur le Commerce de l'Eléphant (ETIS) sont maintenant des réalités. Lors de sa réunion de février 1999, le Comité Permanent de la CITES a mis en place un sous-groupe chargé spécifquement de suivre la mise en œuvre de MIKE. Ce sous groupe de MIKE est composé de membres des gouvernements; l'Afrique et l'Asie y sont représentées aux côtés d'autres régions reconnues par la Convention.

Suite à son approbation officielle de MIKE et ETIS, le Comité Permanent a fait un pas en avant supplémentaire en allouant des fonds pour la mise en place de la phase pilote de MIKE en Afrique et en Asie. La mise en œuvre des deux phases pilotes a commencé sérieusement à la mi-99, suite à la signature d'un memorandum entre les secrétariats de la CITES et de l'UICN. La phase pilote africaine est conduite en Afrique centrale et Ia phase asiatique en Asic du Sud-Est. L'UICN a délégué par contrat la responsabilité directe du développement du projet en Afrique centrale et de la formation initiale des coordinateurs MIKE à la Société pour la Conservation de la Faune/NYZ. Le projet est coordonné par le Dr John Hart en collaboration avec un Comité Directeur composé de membres techniques des gouvernements de la sous-région. L'UICN a poursuivi le développement et la planification du lancement de la phase pilote d'Asie du Sud-Est, ainsi que le développement de protocoles de collecte de données sur la savanne, la forêt et des aspects généraux, de documents de formation et des fonctions centralisées de traitement des données devant incomber à l'Unité Centrale de Coordination de MIKE dès sa mise en place officielle.

Désormais, le rôle des Groupes de Spécialistes de l'Eléphant d'Afrique et d'Asie sera de fournir à travers leurs secrétariats et l'enscmble de leurs membres une assistance technique à l'Unité Centrale de Coordination. La direction de la misc en œuuvre de MIKE et de la recherche de fonds est maintenant clairement confiée au Secrétariat de la CITES. TRAFFIC reste l'agence d'exécution pour ETIS.

La force d'intervention dédiée aux conflits Homme-Eléphant a été trés occupée ces deux dernières années par la réalisation des sous-composantes de leur projet,

have been very busy working towards completing the sub-components of their project, "Assessing the problems and investigating the prospects for mitigating human-elephant conflict in Africa", for the past two years. The project comprises a variety of sub-components, including: dealing with habitual problem animals, ranking of elephants among other agricultural pests, the relationship between seasonal movements and crop damage, elephant damage to crops in a forest ecosystem, an overview of elephant policies and management actions in southern Africa, the development of a data collection protocol and training manual, and the further development of a GIS model for predicting areas of conflict. This fieldwork is scheduled to be finalised and the results pulled together in a wrap-up meeting in early 2000.

I am happy to report, by the time this issue reaches you, that the African Elephant Database (AED) 1998 will also be complete. You will note from my Chair's report in *Pachyderm* 26 that we had hoped to have the AED 1998 finished and available by the middle of 1999. As our intended publication date grew near, the Data Review Task Force (DRTF) decided that the AED 1998 was not ready to sign off. Substantial revisions were done to both the text and the maps and I would like to give special credit to the entire DRTF for the long hours they each sacrificed to 'whip" the AED 1998 into shape. With last minute committed technical advisory assistance, the AED 1998 was finally sent to the printers in October 1999.

At the DRTF meeting, held in Nairobi in August 1999, the group revisited, in detail, our experience of the past three years. The meeting confirmed the inherent difficulties of providing the technical direction for an undertaking such as the AED, by individuals acting in a totally voluntary capacity. While the AfESG has year after year affirmed its desire to produce this product, the realities of the undertaking have perhaps not been as fully appreciated. I have my own doubts as to whether such extensive volunteer work is sustainable over the long term. Yet, when one sees the product of a single volunteer's work, such as "Evaluation des problèmes et étude des perspectives pour la réduction du conflit homme-éléphant en Afrique". Le projet comprend un large éventail de sous-composantes parmi lesquelles: marche à suivrc envers les habituels animaux à problème, classement des éléphants parmi les autres nuisances pour l'agriculture, relation entre les mouvements saisonniers et les dommages aux récoltes, dommage causé par les éléphants aux récoltes dans un écosystème forestier, vue d'ensemble des politiques envers l'éléphant et des actions de gestion en Afrique du sud, développement d'un protocole de collecte des données et d'un manuel de formation, et amélioration d'un modèle SIG pour la prédiction des zones de conflit. Début 2000 le travail de terrain devrait être terminé et les résultats rassemblés au cours d'une réunion de synthèse.

J'ai le plaisir de vous informer ègalement que lorsque vous recevrcz cc numéro la 'Banque de Données sur l'Eléphant Africain ' (African Elephant Database 1998) sera achevée. Vous aurez noté dans mon rapport dans *Pachyderm* 26 que nous espérions pouvoir terminer et mettre à votre disposition le AED 1998 pour le milieu de l'année 1999. A l'approche de la date prévue pour la publication, la force d'intervention pour Ia revue des données (DRTF) a estimé que le AED 1998 n'était pas encore mûre pour la diffusion. Le texte comme les cartes ont été substantiellement révisés et je voudrais remercier tout spécialement l'enscmble de Ia DRTF ainsi que Ruth Chunge et Charles Amuyunzu pour les longues heures sacrifiées à la remise en forme de AED. L'AED 1998 a finalement pu être envoyée à l'impression en octobre 1999.

Lors de la réunion de la DRTF à Nairobi en août 1999, le groupe a examiné en détail notre cxpéricncc des trois dernières années. La réunion a confirmé les difficultés inhérentes à la supervision d'une telle entreprise maj cure par des individus agissant à titre uniquement bénévole. Alors que le GSEAf a réaffirmé année aprés année son désir de réaliser cc produit, les réalités de l'entreprise n'ont peut-êtrc pas été aussi complètement appréciées. Je doute personnellement qu'un travail bénévole aussi vaste puisse être viable à long terme. Nous sommes actuellement en train de recruter un nouveau coordinateur pour l'AED et il est certain que cette personne devra satisfaire certaines conditions pour assurer la continuation de l'AED.

the new African Antelope Database 1998, compiled by Dr Rod East (Co-Chair of the Antelope Specialist Group), one is driven to even greater heights of volunteerism. What is clear is that the AfESG could not have produced either the AED 1995 nor the AED 1998 without voluntary assistance. On the open market such expertise would cost tens of thousands of dollars to secure, if it could even be found.

The DRTF agreed to a number of changes regarding the process, structure, methods, procedures and outputs if the AED is to remain "alive". These decisions, of course, assume that we will be successful in securing funds to continue the AED updating process over the next three years. At present we have submitted proposals to several donors to solicit such support and we will continue to explore the options available to the AED in future.

All the accomplishments of the past six months would not have been possible without the continuing assistance of our longstanding secretary, Ms Monica Buyu and of Dr Martina Höft who stepped into the shoes of the AfESG's previous Programme Officer in May 1999 and has ably carried out the required duties ever since.

Cependant, le produit du travail d'un seul bénévole, comme la nouvelle 'Banque de données 1998 sur l'antilope d'Afrique' compiléc par le Dr. Rod East (Co-Président du Groupe de Spécialistes sur l'Antilope), témoigne de façon encore plus impressionnantes des sommets atteints par le bénévolat. Il reste clair que le GSEAf n'aurait pu produire ni l'AED 1995 ni l'AED 1998 sans cette assistance bénévole. Sur le marché une telle expertise coûterait des dizaines de milliers de dollars, si taint est qu'elle puisse être obtenue.

La DRTF s'est misc d'accord sur un certain nombre de changements dans le processus, la structure, les méthodes, les procédures et les résultats nécessaires à la survie de l'AED. Ces décisions supposent bien entendu que nous parvenions à assurer les fonds nécessaires à la continuation du processus de mise à jour de l'AED au cours des trois prochaines années. Nous avons déjà soumis des propositions à plusieurs financeurs afin de solliciter un tel soutien et nous continuerons dans le futur à explorer les possibilités disponibles pour la BEA.

Tous les résultats des derniers six mois n'auraient pas été possibles sans le soutien continuel de notre fdèle secrétaire, Mme Monica Buyu, et du Dr Martina Höft qui a repris Ia houlette du précédent Chargé de Programme du GSEAf en mai 1999 et a depuis conduit les tâches nécessaires avec une grande compétence.

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SADC RHINO PROGRAMME

One major development in the period under review is the recent signing of a memorandum of understanding, whereby a consortium has been formed to implement a regional programme of rhino conservation within the Southem African Development Community (SADC) member states in the framework of a 1992 Maputo Consultative Meeting. The project is to be funded for three years by the Italian government. SADC member states currently conserve 83.1% and 98.3% of the continent's black and white rhinos respectively.

The SADC Wildlife Sector Technical Coordinating Unit (SADC-WTCU) will chair the consortium, and provide the linkages with SADC structures for decision-making on regional rhino conservation policies and programme implementation arrangements. The four other collaborating partners in the consortium are the World Conservation Union Regional Office for Southern Africa (IUCN-ROSA) which will provide support and assistance to the SADC-WTCU in motivating and co-ordinating the programme at political and technical levels; IUCN SSC's African Rhino Specialist Group (AfRSG**)** which will provide rhino conservation direction and prioritarisation; WWF's Southern African Regional Programme Office which will implement, in conjunction with relevant rhino man

PROGRAMME POUR LE RHINOCÉROS DU SADC

L'un des développements majeurs pendant l'exercice écoulé est la signature récente d'un protocole d'accord pour la formation d'un consortium. Celui-ci est chargé de la mise en œuvre d'un programme régional de conservation du rhinocéros sur le territoire des Etats membres de la Communauté de Développement d'Afrique du Sud (Southern African Development Community - SADC), dans le cadre d'une réunion consultative en 1992 à Maputo. Le projet sera financé pour trois ans par le gouvernement italien. Les Etats membres du SADC renferment actuellement respectivement 83,1% et 98,3% de la population de rhinocéros noirs et blancs du continent.

L'Unité Technique de Coordination du Secteur Faune Sauvage du SADC (Wildlife Sector Technical Coordinating Unit - SADC-WTCU) assurera la présidence du consortium, et fera la liaison avec les structures du SADC pour la prise de décisions sur les politiques régionales de conservation du rhinocéros et les dispositions concernant la mise en œuvre du programme. Les quatre autres partenaires collaborant au sein du consortium sont le Bureau Régional d'Afrique du Sud de l'Union Mondiale pour la Nature (IUCN-ROSA) qui soutiendra le SADCWTCU à travers la motivation et la coordination du programme aux niveaux politique et technique; le Groupe de Spécialistes sur le Rhinocéros Africain de la Commission pour la Survie des Espèces (SSC) de l'UICN (GSRAf), qui définira les lignes directrices et les priorités pour la conservation du rhinocéros ; le Bureau du Programme Régional

agement authorities, specific rhino projects as identified within the programme; and finally an Italian NGO, CESVI Co-operazione e Sviluppo, which will undertake the management of programme finances and administration, as well as acting as the interface between the implementing consortium of the programme and the Italian Ministry of Foreign Affairs Directorate-General for Development Co-operation which is funding the programme.

The programme has been established to provide expertise, specialised logistic support, training, information and catalytic funding in support of SADC regional conservation projects and policies for rhinos as flagship species. Such projects and policies are to be aimed at maximising population growth rates, enhancing overall biodiversity, ensuring economic sustainability, and stimulating local community conservation awareness and involvement in the protection and wise use of these species. By establishing regional coordination in the management of charismatic rhino species, it is intended that a precedent will be created within SADC so that this coordination can be extended to other wildlife species that should be managed at a regional rather than at a local level.

The SADC rhino programme will be limited to three rhino subspecies whose historical range included more than one SADC state, and whose future metapopulation management is also likely to involve more than one SADC state (i.e. southern African subspecies *Ceratotherium simum simum, Diceros bicornis minor* and *Diceros bicornis bicornis).* The programme will concentrate on rhino projects that are of a regional nature (e.g. those which involve sharing of expertise between SADC member states, involve sharing or exchange of their rhinos, are conservation models for potential replication elsewhere in the region, and/or have regional economic or political implications).

The SADC rhino programme will primarily be concerned with fundamental rhino management issues and with clearly relevant aspects of land-use economics, community interactions,

d'Afrique du Sud du WWF qui mettra en pratique les projets rhinocéros spécifiques identifiés dans le cadre du programme, en collaboration avec les autorités compétentes pour la gestion du rhinocéros ; et enfin une ONG italienne, CSVI Cooperazione e Sviluppo, qui se chargera de la gestion fnancière et administrative du programme et fera l'interface entre le consortium de mise en œuvre du programme et la Direction Générale pour la Coopération au Développement du Ministère italien des Affaires Etrangères, qui finance le programme.

Le programme a été établi afin de procurer une expertise, un soutien logistique spécialisé, des formations, des informations et des financements catalysateurs pour renforcer les projets et stratégies de conservation régionaux du SADC pour le rhinocéros en tant qu'espèce-phare. L'objectif de tels projets et stratégies doit être de maximiser les taux de croissance de la population, améliorer la biodiversité en général, assurer la stabilité économique, et stimuler la sensibilisation des communautés locales à la conservation, leur implication dans Ia protection et l'usage raisonné de ces espèces. L' établissement d'une coordination régionale pour la gestion du rhinocéros, espèce charismatique, devrait créer un précédent au sein du SADC qui permettra d'étendre cette coordination à d'autres espèces faunistiques qui devraient être gérées au niveau régional plutôt que local.

Le programme pour le rhinocéros du SADC sera limité à trois sous-espèces de rhinocéros dont le territoire historique s'étend sur plus d'un Etat du SADC, et pour lesquelles la gestion future de la métapopulation est susceptible d'impliquer plus d'un Etat du SADC (c.à.d. les sous-espèces sud-Africaines *Ceratotherium simum simum, Diceros bicornis minor* et *Diceros bicornis bicornis).* Le programme se concentrera sur les projets pour le rhinocéros de nature régionale (c.à.d. ceux qui impliquent l'échange d'expertise entre des Etats membres du SADC, le partage ou l'échange de leurs rhinocéros, qui sont des modèles de conservation potentiellement reproductibles en d'autres endroits de la région, et/ou ont des conséquences économiques ou politiques de dimension régionale).

Le programme pour le rhinocéros du SADC sera en premier lieu concerné par les questions fondamentales de la gestion du rhinocéros et les aspects clairement

and applied research. It will endeavour to assist SADC rhino range states to the extent they request with the establishment of pro-active measures to protect the rhinos from poaching, but will not become involved in law enforcement or in the investigation of illegal activities. It thus will not duplicate the work of the Southern African Rhino and Elephant Security Group (RESG) or any other regional security/ intelligence networks (e.g. Lusaka Agreement). The programme will include public and private sector rhino conservation projects, and priorities for action within the programme will accord with the regional rhino conservation priorities which are going to be periodically determined by the consortium using criteria outlined by the AfRSG. The programme seeks to complement and not duplicate existing national and regional rhino management committees (notably the southern African Rhino Management Group), and at a continental level, the work of the AfRSG.

RHINO HORN FINGERPRINTING FOR SECURITY

In the last edition of *Pachyderm*, I introduced readers to the major WWF-funded project, which the AfRSG is co-ordinating, to develop a forensic test to enable law enforcement staff to source confiscated rhino horn. I outlined progress made with obtaining samples throughout the continent, and discussed the analytical techniques to be used to determine the chemical composition of horn. The need for the development of horn fingerprinting was again highlighted by a member of the Endangered Species Protection Unit of the South African Police Service (ESPU) who indicated the Unit did not know the source of many of the horns it had recovered in illegal busts.

I am pleased to report that initial pilot statistical analyses of the raw chemistry data by the AfRSG's Scientific Officer have been very promising.

en rapport de l'économie d'utilisation du territoire, des interactions entre les communautés et de la recherche appliquée. Il cherchera à assister les Etats SADC faisant partie du territoire du rhinocéros dans Ia mesure de leur demande pour l'établissement de mesures pro-actives pour protéger les rhinocéros contre le braconnage, mais ne participera pas à la mise en vigueur de la loi ni aux enquètes sur les activités illégales. Ainsi il ne fera pas double emploi avec les travaux du Groupe de Sécurité pour le Rhinocéros et l'Eléphant d'Afrique du Sud (RESG) ou d'autres réseaux de sécurité/ de renseignements régionaux (par ex. Accord de Lusaka). Le programme incluera des projets de conservation du rhinocéros des secteurs public et privé ; les priorités d'action à l'intérieur du programme seront en accord avec les priorités régionales de conservation qui seront périodiquement déterminées par le consortium selon les critères définis par le GSRAf. Le programme vise à compléter et non répéter les travaux des comités nationaux et régionaux de gestion du rhinocéros existants (en particulier le groupe de gestion du rhinocéros d'Afrique du Sud) et, au niveau du continent, ceux du GSRAf.

PRISE D'EMPREINTES DIGITALES DE LA CORNE DE RHINOCÉROS COMME CONTRIBUTION A LA SECURITE

Dans la dernière édition de *Pachyderm,* j'ai présenté aux lecteurs un projet d' importance majeure: celui financé par le WWF et coordonné par le GSRAf, visant à développer un test légal qui permettrait au personnel chargé de la mise en vigucur de la loi de remonter à la source des comes de rhinocéros confisquées. J'ai souligné les progrès réalisés dans l'obtention d'échantillons issus de tout le continent, et discuté les techniques analytiques à utiliser pour déterminer la composition chimique de la corne. La nécessité du développement de la prise d'empreintes digitales des comes fut de nouveau soulignée par un membre de l'Unité de protection des espèces en danger du service de police d'Afrique du Sud (ESPU), qui signala que l'Unité ignorait la provenance de nombreuses corn es saisies lors de perquisitions illégales.

J'ai le plaisir de rapporter les résultats très prometteurs des premières analyses statistiques pilotes

The AfRSG's decision to use Laser-Ablation-Inductively-Coupled-Plasma-Mass-Spectrometry (LA-ICP-MS) to quantify the chemical composition of horn (in this case the abundance of heavier isotopes) has been vindicated. Pilot analyses show this technique is producing data which better discriminate between areas than any other analytical technique which has been used before. On a pilot sample of 67 black rhino horns, 92.5% of these samples were correctly sourced using only LA-ICP-MS data. The data produced excellent separation between most areas.

The use of Inductively-Coupled-Plasma-Optical-Emission-Spectrometry (ICP-OES) to quantify trace elements was also supported by the pilot analyses. Although not as good as LA-ICP-MS, ICP-OES data still had significant discriminatory power, with the source of 76.1% of the pilot sample being correctly predicted using only ICP-OES data.

The analysis of horn samples for lighter carbon and nitrogen at the University of Cape Town also produced four variables with significant discriminatory power. The results of the pioneering work by Dr Julia Lee-Thorp and her colleagues were corroborated by the data which confirmed that a stable carbon isotope ratio provides a cast iron diagnostic technique to discriminate between white and black rhino horn. The pilot discriminant function analyses also showed the carbon and nitrogen data had some discriminatory ability, correctly classifying the source of *50%* of the pilot samples.

Although the results show LA-ICP-MS is the best single technique, pilot analyses indicated the best results will be obtained by building a statistical model using data from all three methods. By combining LA-ICP-MS and ICP-OES data, 98.5% of the pilot sample was correctly sourced with the only misclassification occurring when a sample was allocated to an adjacent area within the same Park. By combining all three techniques together, the resultant model correctly classified all pilot black rhino horn samples used to build the models. While the

des données initiales chimiques brutes effectuées par l'Offcier Scientifiquc du GSRAf.

La décision du GSRAf d' utiliser le couplage inductif spcctrométrie de masse des plasmas - ablation laser (LA-ICP-MS) afin de quantifier la composition chimique de la come (dans ce cas l'abondance des isotopes les plus lourds) s'est montrée justifiée. Des analyses pilotes montrent que les données produites par cette technique permettent une meilleure discrimination entre les zones que toutes les autres techniques analytiques utilisées précédemment. Sur un échantillon de 67 comes de rhinocéros noirs, l'origine de 92,5% a été établie correctement à partir des seules données LA-ICP-MS. Les données produisent une séparation excellente entre la majorité des régions.

Les analyses pilotes ont ègalement confirmé l'intérêt de l'utilisation du couplage inductif de la spectrométrie d'émission optique des plasmas (ICP-OES) pour la quantification d'éléments traces. Bien que d'une qualité inférieure à celles de LA-ICP-MS, les données d'ICP-OES conservent un pouvoir discriminant significatif, avec Ia prédiction correcte de l' orig-ine de 76,1% de l'échantillon test sur la seule base des données ICP-OES.

L'analyse de carbone léger et d'azote dans les échantillons de corne à l'Université du Cap a également produit quatre variables de pouvoir discriminant significatif. Les résultats du travail de pionnier réalisé par le Dr. Julia Lee-Thorp et ses collègues ont pu être confirmés par les données: un rapport isotopique stable pour le earbone procure une technique de diagnostic irréfutablc pour distinguer les comes de rhinocéros blanc et noir. Les analyses pilotes de fonction discriminante ont ègalement montré une certaine capacité discriminante des données carbone et azote, qui permettent de classifier correctement l' origine de 50% de l'échantillon test.

Bien que les résultats montrent Ia supériorité de la LA-ICP-MS comme technique unique, les analyses pilotes indiquent que les meilleurs résultats seront obtenus en construisant un modèle statistique utilisant les données des trois méthodes. Par combinaison des données LA-ICP-MS et ICP-OES, l'origine de 98,5% de l' échantillon pilote a pu être déterminée correctement, avec une seule classification erronée dans laquelle un échantillon a été attribué à une zone adjacente du même parc. Le modèle résultant de la combinaison des trois techniques a permis la classifi-

real challenge will be the ability of the technique to correctly classify independent samples not used to build the statistical models, these preliminary results are still very encouraging and much better than were originally expected was possible.

SITUATION REGARDING REMAINING RHINO IN THE DEMOCRATIC REPUBLIC OF CONGO AND CAMEROON

Garamba National Park in the Democratic Republic of Congo is home to the last remaining confirmed population of northern white rhino *(Ceratotherium simum cottoni).* The AfRSG's Dr Kes Hillman Smith has recently reported that field patrols are continuing and that levels of poaching in the Park have and conserved just over 20% of the continent's southern declined to approximately a third of levels in the last quarter of 1998 and first quarter of 1999. The guards are also reporting seeing rhino frequently which is encouraging, because foot patrols are the least efficient way to find white rhino in the Park. While this news is encouraging, with only 25 or fewer animals remaining, the situation is still critical.

The last few remaining western black rhino *(Diceros bicornis Ion gipes)* in Cameroon are so isolated and scattered that they in all probability are doomed to extinction if left where they are. Time is running out for this subspecies, and the AfRSG has been promoting initiatives to examine and cost the various options for the consolidation and protection of the last remaining animals. Diplomatic efforts to seek high level commitment from the Cameroon authorities are being encouraged, and once this has been obtained, the AfRSG has recommended to IUCN France that as a matter of urgency a meeting of all stakeholders be held to decide on and draw up a plan of conservation action with an implementation schedule, and that significant international funding will need to be secured for such a programme.

cation correcte de tous les échantillons de corne de rhinocéros noir utilisés pour contruire les modèles. Le défi majeur consistera à prouver la capacité de la technique à classifier correctement des échantillons indépendants non utilisés pour la construction des modèles statistiques; cependant ces résultats prèliminaires sont déjà trés encourageants et largement supérieurs à toutes les attentes.

SITUATION DES RHINOCÉROS SUBSISTANT EN RÉPUBLIQUE DÉMOCRATIQUE DU CONGO ET AU CAMEROUN

Le Parc National de Garamba en République Démocratique du Congo héberge Ia derniére population confirmée de rhinocéros blanc septentrional *(Ceratotherium simum cottoni).* Le Dr. Kes Smith du GSRAf a récemment rapporté que les patrouilles de terrain continuent et les niveaux de braconnage dans le Parc ont diminué approximativement des deuxtiers dans le dernier trimestre 1998 et le premier trimestre 1999. Les gardes rapportent également des observations fréquentes de rhinocéros, ce qui est encourageant, sachant que les patrouilles à pied constituent le moyen le moins efficace pour observer le rhinocéros blanc dans le Parc. Bien que cette nouvelle soit encourageante, avec seulement 25 animaux restants au maximum la situation reste critique.

Les quelques derniers rhinocéros noirs occidentaux *(Diceros bicornis longipes)* subsistant au Cameroun sont tellement isolés et dispersés qu'ils sont en toute probabilité voués à l'extinction s'ils sont laissés sur place. L'échéance approche pour cette sous-espèce, et le GSRAf continue à encourager des initiatives visant à examiner et évaluer le coût des diverses options pour la consolidation et la protection des derniers animaux restants. Les efforts diplomatiques pour obtenir l'engagement des autorités camerounaises à haut niveau sont encouragés, et une fois que ceci sera acquis, le GSRAf a recommandé à l'UICN France l'organisation en urgence d'une réunion de toutes les parties concemées et l'élaboration d'un plan d'action pour Ia conservation avec un agenda de mise en œuvre; un financement international significatif devra être assurè pour un tel programme.

AROA PRIVATE SECTOR WHITE RHINO CONSERVATION WORKSHOP

In the last *Pachyderm* I mentioned that a draft South African white rhino conservation and sustainable use strategy had been produced. In 1997, the private sector in South Africa owned white rhino. From 1987-97 South African white rhino (in all populations) increased by an average of 6.7% per year, and if this metapopulation growth rate can be maintained, then the country could have over 15,000 white rhino by 2007. However, for this to be achieved, it is likely that the private sector and communities will need to conserve an increasing proportion of these rhinos. For this to occur, it is clear that incentives to conserve white rhinos will need to be maintained.

Despite the success of private sector white rhino conservation, a number of concerns have been expressed internationally. Monitoring of rhino movements between private properties and the registration and control of private sector horn stocks are two areas with room for significant improvement. Given these concerns, and the realisation that the private sector is likely to play an increasingly important role in conserving southern white rhino, a WWF supported African Rhino Owners Association (AROA) workshop was held at Onderstepoort in early October 1999. Provisional results of the latest WWF-funded survey of the status of white rhino on private land were released at the workshop by Daan Buijs. He showed that numbers of privately owned southern white rhino in South Africa had continued to increase up to an estimated 1,922 (up from 1,742 in 1997). This figure is likely to be conservative, as uncorrected minimum aerial counts were used for some of the larger populations. After excluding the additional animals bought from the private sector, the survey showed numbers on private land increased by 7**0**0 per annum over the last two years.

Three AfRSG members and a member of the Endangered Species Protection Unit of the

ATELIER AROA POUR LA CONSERVATION DU RHINOCÉROS BLANC PAR LE SECTEUR PRIVÉ

Dans le dernier numéro de *Pachyderm* j'ai mentionné qu'une première version d'une stratégie pour la conservation et l'utilisation durable du rhinocéros blanc sud-africain avait été élaborée. En 1997, le secteur privé était propriétaire et responsable de la protection d'un peu plus de 20% des rhinocéros blancs du sud du continent. De 1987 à 1997 le rhinocéros blanc sud-africain (toutes les populations) a augmenté en moyenne de 6,7% par an, et si cette croissance de la métapopulation peut être maintenue, le pays pourrait renfermer 15 000 rhinocéros blancs d'ici à 2007. Cependant pour atteindre ce résultat il est probable que le secteur privé et les communautés seront amenés à conserver une proportion croissante de ces rhinocéros. Dans cet objectif il est clair qu'il sera nécessaire de maintenir les incitations à conserver les rhinocéros.

Malgré le succès de la conservation du rhinocéros blanc par le secteur privé, un certain nombre de préoccupations ont été soulevées au niveau international. Le suivi des mouvements des rhinocéros entre les propriétés privées et l'enregistrement et le contrôle des stocks de comes du secteur privé sont deux domaines avec un fort potentiel d'amélioration. Sur la base de ces préoccupations, et réalisant que le rôle joué par le secteur privé dans Ia conservation du rhinocéros blanc du sud est susceptible d'augmenter, un atelier de l'association des propriétaires de rhinocéros africains (AROA) a été organisé avec le soutien du WWF à Onderstepoort début octobre 1999. Daan Buijs dévoila lors de l'atelier des résultats préliminaires du dernier recensement financé par le WWF sur Ia situation des rhinocéros blancs en territoire privé. Il montra que le nombre de rhinocéros blancs du sud en propriété privée ont continué à augmenter en Afrique du Sud jusqu'à une valeur estimée de 1922 (à partir de 1742 en 1997). Ce chiffre est vraisemblablement une valeur basse, étant donné que des comptages aériens minimums non corrigés ont été utilisés pour plusieurs des fortes populations. Aprés exclusion des animaux supplémentaires achetés auprès du secteur privé, le recensement montre une croissance de la population de 7% par an sur le territoire privé au cours des deux dernières années.

Trois membres du GSRAf et un membre de I' Unité

South African Police Service also gave background presentations. Speakers emphasised the importance of putting conservation first and the need for the highest ethical standards to be adopted by the private sector. The draft conservation plan, its vision, key components and objectives were outlined. A number of strategic issues relevant to private sector white rhino conservation and to meeting the goals of the plan were then discussed. Some inadequacies were highlighted by the speakers, and in particular the urgent need for improved registering of private horn stockpiles was emphasised.

At the workshop, issues discussed included legislation and policy (including registration and "identichipping" of horn stocks), the future structure of AROA (including the need for greater representation of owners and the employment of a full-time co-ordinator), and initiatives to boost security (development of reaction plans and setting up of an emergency fund) and improved monitoring (desirability of ID-based monitoring methods, and the introduction of a standardised status reporting system at least for the bigger populations).

ACTION PLAN

Two further iterations of reviewing and editing the new continental Action Plan for African rhinos have taken place since publication of the last *Pachyderm.* The plan is currently in its final stages of editing and is still on course to be published by the end of 1999.

NEXT AFRSG MEETING

Plans are underway to hold the next AfRSG meeting in Tanzania in May 2000.

NEW EDITOR

I would also like to take the opportunity to welcome *Pachyderm* 's new editor, Martina Hö ft, and to wish her a long and successful term in office.

de protection des espèces en danger du service de police d'Afrique du Sud présentèrent également un conférence. Les orateurs soulignèrent l'importance de donner la priorité à Ia conservation et la nécessité pour le secteur privé d'adopter les normes éthiques les plus élevées. Le projet de plan de conservation, son optique, ses composantes-clé et ses objectifs furent soulignés. Un certain nombre de questions stratégiques appliquables à la conservation du rhinocéros blanc par le secteur privé et à la satisfaction des objectifs du plan furent ensuite discutées. Les orateurs mirent en évidence quelques inadéquations et en particulier l'urgente nécessité d'améliorer l'enregistrement des stocks privés de cornes.

Les questions discutées à l'atelier comprennent la législation et les règles générales (y compris l'enregistement et l'identification électronique des réserves de comes), la structure future de l'AROA (y compris le besoin d'une représentation plus forte des propriétaires et l'emploi d'un coordinateur à p1ein temps) et les initiatives pour renforcer la sécurité (développement de plans de réaction et mise en place d'une caisse d'urgence) et un meilleur suivi (besoin de méthodes de suivi basées sur l'identification et de l'introduction d'un système standardisé pour les rapports, au moins pour les populations les plus grandes).

PLAN D'ACTION

Deux nouvelles itérations de révision et édition du nouveau Plan d'Action continental pour les rhinocéros africains ont eu lieu depuis la publication du dernier *Pachyderm.* Le plan se trouve actuellement dans les dernières étapes de l'èdition et sa publication est toujours prévue avant Ia fin de l'année.

PROCHAINE REUNION DU GSRAF

Des plans sont en cours pour la tenue de Ia prochaine réunion du GSRAf en Tanzanie en mai 2000.

NOUVELLE RÉDACTRICE

J'aimerais saisir cette opportunité pour souhaiter la bienvenue à la nouvelle rédactrice de *Pachyderm,* Martina Höft, et lui souhaiter beaucoup de succès et de longévité dans cc poste.

Asian Rhino Specialist Group (AsRSG)
Groupe des Spécialistes des Rhinos Asiatiques (GSRAs)

Mohd Khan bin Momin Khani, Tom Foose[1] and Nico van Strien[2]

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In the last issue of *Pachyderm* (Number 26), there was an article entitled "Conservation Programmes for Sumatran and Javan Rhino in Indonesia and Malaysia". Table 3 ("Summary of captive (managed breeding) programmes for Sumatran rhinos 1984-1999") contained a serious misalignment of columns and failed to reflect the repatriation of a male rhino from the UK to Indonesia. A corrected version of the table appears below.

Dans le dernier numéro de *Pachyderm* (no˚ 26 Juil-Déc. 1998) a été publié un article intitulé "Programmes de Conservation pour les Rhinocéros de Sumatra et de Java en Indonésie et en Malaisie". Du fait d'une erreur importante dans l'alignement des colonnes, le tableau 3 ("Résumé des programmes d'élevage en captivité (élevage géré) pour le rhinocéros de Sumatra 1984-1999") ne reflétait pas la rapatriation d'un rhinocéros mâle du Royaume-Uni vers l'Indonésie. Ci-dessous se trouve une version corrigée du tableau.

Table 3 (rev.). Summary of captive (managed breeding) programmes for Sumatran rhino 1984-1999. *Résumé des programmes d'élevage en capivité (élevage géré)* pour le rhinoceros de Sumatra 1984-1999.de

Country *Pays*	**Captured** *Capturé*	**Born** *Né*	**Imported** *Importé*	**Exported** *Exporté*	**Released** *Relâché*	**Died** *Mort*	**Alive** *Vivant*
Malaysia	3\9	0\I	I\0	0\2	0\0	2\2	2\6
Sabah	8\2	0\0	0\0	0\0	I\0	6\0	1\2
Indonesia	7\11	0\0	I\1	4\7	0\0	3\3	1\2
Thailand	0\0	0\0	0\I	0\0	0\0	0\I	0\0
UK	0\0	0\0	1\2	I\0	0\0	0\2	0\0
USA	0\0	0\0	*2\5*	0\0	0\0	1\3	1\2
Total	18\22 = 40	0\I*	5\9	5\9	I\0	12\11= 23	5\12 = 17

***** Born but not bred in captivity. *Né mais non élevé en captivité.*

As reported in the last AsRSG Chair Report, a global set of management master-plan assessments and recommendations was formulated in February 1999 at Sungai Dusun Sumatran Rhino Conservation Centre for the 5/12 rhino in managed breeding facilities. These assessments and recommendations appear in the next table below.

Comme signalé dans le dernier rapport du Président du GSRAs, une séric d'évaluations et recommandations globales pour les plans directeurs de gestion a été formulée en février 1999 au Sungai Dusun Sumatran Rhino Conservation Centre pour les 5/12 rhinocéros des infra-structures d'élevage géré. Ces évaluations et recommandations sont présentées dans la table suivante.

There are some additions to the AsRSG Membership since the list was last published in *Pachyderm* (Number *25):*

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Finally, AsRSG laments the loss of one of the leading figures in rhino conservation in India, Mr Sanjoy Deb Roy, who died on 16 August 1999. His work first in the field in Assam and later in New Delhi was a crucial contribution to the great success of rhino conservation in India.

Depuis la publication de la liste des membres du GSRAs dans *Pachyderm* 25 (Janv.-Juil. 1998) se sont ajoutées quelques entrées supplémentaires.

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Enfin, le GSRAs déplore la perte d'une des figures directrices de la protection du rhinocéros en Inde, M. Sanjoy Deb Roy, décédé le 16 août 1999. Ses travaux, d'abord sur le terrain en Assam et plus tard à New Delhi représentèrent une contribution cruciale au grand succès de la protection du rhinocéros en Inde.

Table 1. Reproductive status of Sumatran rhinos in breeding centres.

		Captured/[born] *Capturé/[né]*	**Estimated age** *Age estimé*	**Cycling** *Activité cyclique*	**Pathology** *Pathologie*	**Copulation** *Copulation*	**Pregnancy NOW** *Grossesse en cours*	**Pregancy PAST** *Grossesse passée*
Sungei Dusun and Melaka, Malaysia								
Dicerorhinus sumatrensis sumatrensis (Malaysia)								
female	Minah (born in facility) *(né dans le centre)*	[1987]	12	Y	N	$Y_{(12/98)}$	?	N
female	Panjang (Melaka)	1997	17	Y	?	N	N	?
female	Seputih	1988	20	Y	Y	$Y_{(2/99)}$	**?**	**?**
female	Mas Merah	1987	20	Y	Y	N	N	?
female	Rima	1986	20+	Y	?	$Y^{(9/98)}$	?	Y
female	Jeram (Melaka)	1984	25+	N	Y	N	N	?
male	Ara	1984	10+			Y		?
male	Shah	1988		14+		N		N
SRS-Way Kambas, Indonesia								
Dicerorhinus sumatrensis sumatrensis (Indonesia)								
female	Bina	1991	15+	Y	N	?	?	?
female	Dusun (from Malaysia)	1986	17+	?	Y	N	N	?
male	Torgamba	1985	20			?		?

Recommendations

For all females start faecal hormone analysis, and vaginal smear analysis if trial successful.
Commencer une analyse des hormones fécales pour toutes les femelles, et une analyse des frottis vaginaux si les essais sont positifs.

All animals x-ray dentition for age assessment. Cincinnati to develop.
Dentition rayons X de tous les animaux pour estimation de l'âge. Cincinnati à développer.

Confirm pregancy. Blood plasma-April. Isolate from male when confirmed.
Confirmer la grossesse. Plasma sanguin en avril. Isoler du mâle aprés confirmation.

Introduce to male soonest. *Introduire au mâle /e plus tôt possible.*

With male, continue till copulation. *Avec le mâle, continuer jusqu'à copulation.*

Evaluate estrous state for three months before pairing with Shah. Ultrasound.
Evaluer l'état oestrus pendant trois mois avant l'accouplement avec Shah. Ultra-sons.

Confirm pregancy. Blood plasma-February. *Confirmer la* grossess. *Plasma sanguin en féevrier.*

Keep for exhibit. *Conserver pour exposition.*

Evaluate sperm if pregnacies do not occur. *Analyser le sperme si absence de grossesses.*

Evaluate sperm. *Analyser le sperme.*

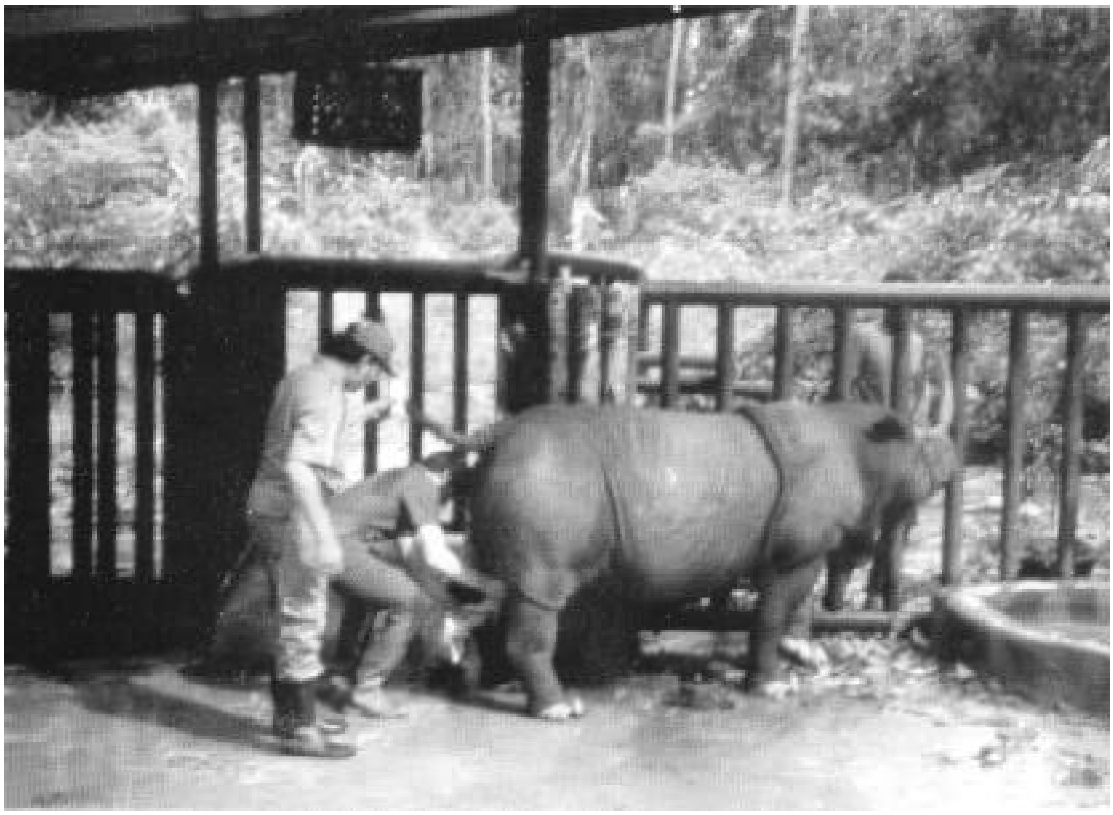
Continue current protocol till pregnant. Ultrasound February.
Continuer le protocole actuel jusqu'à une grossesse. Ultra-sons en février.

Ultrasound February; Possibly develop hormonal stimulation strategy.
Ultra-sons en février. Eventuellement développer une stratégie de stimulation hormonale.

Evaluate sperm. Analyser le sperme.

Table 1. continued

Cincinnati Zoo, USA								
Dicerorhinus sumatrensis sumatrensis (Indonesia)								
female	Emi	1991	8	Y	N	Y	N	Y
female	Rapunzel	1989	20+	N	Y	N	N	?
male	Ipuh	1990	20+			Y		Y
Sepilok and Tabin, Sabah								
Dicerorhinus sumatrensis harrissoni (Borneo)								
female	Lunparai (Tabin)	1989	13	Y	Y	Y	N	?
female	Gologob	1994	18	Y	Y	Y	N	?
male	Tanjung	1993	15			Y		?



Continue current protocol. Move male after conception. Progesterone suppl. *Continuer* le protocole actuel. *Déplacer le mâle aprés conception. Apport de* progestérone. Biopsy on uterine 'mass'. Possibly hormonal stimulation. *Biopsie* sur *la "masse"uterine. Eventuellement stimulation hormonale.*
Move to breeding situation soonest. *Placer en condition de reproduction dès que possible.* Start monitoring and breeding programme soonest. Reprendre la reproduction dés que le mâle sera en bonne santé. Evaluate sperm. Analyser le sperme.

RESEARCH AND METHODOLOGY

A Simple Method for the Analysis of Stratified Aerial Sample Counts

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ABSTRACT

Aerial sample count methods are widely used to accurately determine numbers and distribution of animal populations. In this paper we present a relatively simple procedure to depict aerial survey results on a spread sheet whose inner contour lines resemble the sampled area and give estimates of numbers or densities in individual cells. The procedure is based on the standard method of Jolly for the provision of the population estimate and a measure of the error (Jolly, 1969). Our method aims at improving the accuracy of the population estimate and at deriving simplified raster maps from spreadsheet programs such as Quattro Pro, Excel or Lotus.

RESUMEE

Les méthodes aériennes de comptage d'échantillon sont largement utilisées pour déterminer avec exactitude la taille et la répartition de populations animales. Nous présentons dans cet article une procédure relativement simple pour décrire les résultats de recensements aériens dans un tableau dont les lignes de contour intérieures représentent la surface échantillonnée et donnent une estimation des nombres ou densités à l'intérieur de chaque cellule. La procédure est basée sur la méthode standard de Jolly pour l'évaluation de la population et la mesure de l'erreur (Jolly, 1969). L'objectif de cette méthode est d'améliorer l'exactitude de l'estimation des populations et de dériver des cartes de quadrillage simplifiées à partir de tableurs comme Quattro Pro, Excel ou Lotus.

INTRODUCTION

Aerial sample count methods - perfected in the 1960s - have been comprehensively described by Norton-Griffiths (1978) and more recently by Mbugua (1996). These methods are widely applied for the census of wild and domestic mammals throughout Africa. Jolly's II method for unequal sized sampling units (Jolly, 1969) has been consistently used to provide both the population estimate and a measure of the error of the estimate. Norton-Griffiths (1978) also explains how stratification of the census zone serves to reduce the margin of error in the population estimate. However, although both the practical aspects of the methods undertaking the sample count and the mathematics required to calculate the population estimate have been adequately described, there is little information on the methods that can be used to undertake a series of calculations to produce the population estimate and confidence limits, and figures to represent the distribution of wildlife in the count zone.

Several researchers have developed computer programs to calculate the Jolly's II population estimate

and map distributions (Burrill and Douglas Hamilton, unpubl.; Campbell, unpubl.; Western, 1976). However, these programs have often been tailored for individual areas or are not widely available and cannot be easily adjusted to other count zones.

This paper describes how readily available spreadsheet programs can be used to provide:

- a simple method of data entry
- an instant total of each species in each stratification block
- a simple calculation of both the population estimate and the 95% confidence limit
- figures depicting the distribution of species within the count zone - of both the numbers of each species per subunit or the density of each species per subunit.

This method of data analysis is of value to researchers who are undertaking the analysis of sample count data and who would like to improve on the accuracy of the population estimate and produce basic figures representative of the distribution of wildlife surveyed without the need for Geographic Information Systems. Other programs do exist for both of these aspects, but this method makes use of commonly available software (Fox, 1998) and does not require the most up-to-date computer hardware to undertake more elaborate analysis.

The paper is based on the use of QuattroPro 4.1 (Borland, 1992), but the approach can be used in all other similar spreadsheet programs eg Microsoft Excel, Lotus 1-2-3. In other spreadsheet programs most of the commands will be identical or require only limited changes.

Many aspects of this method of analysis can best be illustrated through tables. The majority of the tables attempt to depict spreadsheet windows with letters and numbers giving the co-ordinates for columns and rows respectively.

This method was developed in 1993 as part of the Garamba National Park Monitoring Programme (Smith et al., 1993) and has been thoroughly tested since (Hillman Smith et al., unpubl. 1995a,b).

METHODS

The analysis involves seven basic steps prior to and after flying the count.

Prior to flying the count:

1. Defining the count zone and individual strata on the spreadsheet (here after called MAPfile)
2. Preparing the spreadsheet for calculating the population estimate (referred to as JOLLY'SII file)

After flying the count:

3. Flying the calibration flights and producing the regression equation.
4. Using the altitude above ground level and the regression equation to calculate the strip width and N.
5. Calculating the area sampled per subunit from the altitude above ground level
6. Calculating the area sampled in each stratum
7. Transposing the totals for each stratum into the Jolly's II calculation.

Figure 1 gives an example of how the MAPfile relates to the area censused during the aerial count of Garamba National Park and the surrounding reserves.

So that this method of analysis can be applied to other aerial survey sites, this paper uses an example of a generic "count zone" comprising three strata A, B and C (Figure 2). From the description provided it is hoped that the approach can be used to create a mapfile and JOLLY'SIIfile that pertain to specific areas. These primary files can then be used in any subsequent counts of the same count zone.

Prior to the flying the count

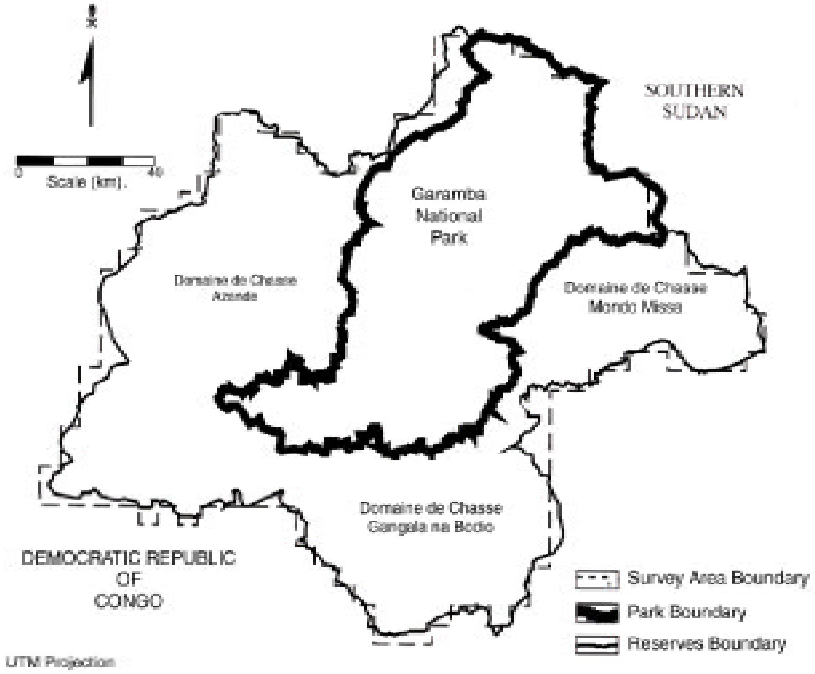
Definition of the survey area in the spreadsheet (mapfile).

The analysis hinges upon a primary MAPfile which needs to be prepared in advance of the count. This file uses the spreadsheet columns as the transects and the rows as subunits or visa versa depending upon the direction that the transects are flown. The transects and subunits are numbered and the survey area defined with lines and shading for clarity. The individual strata should also be sketched in using lines (Figure 1b).

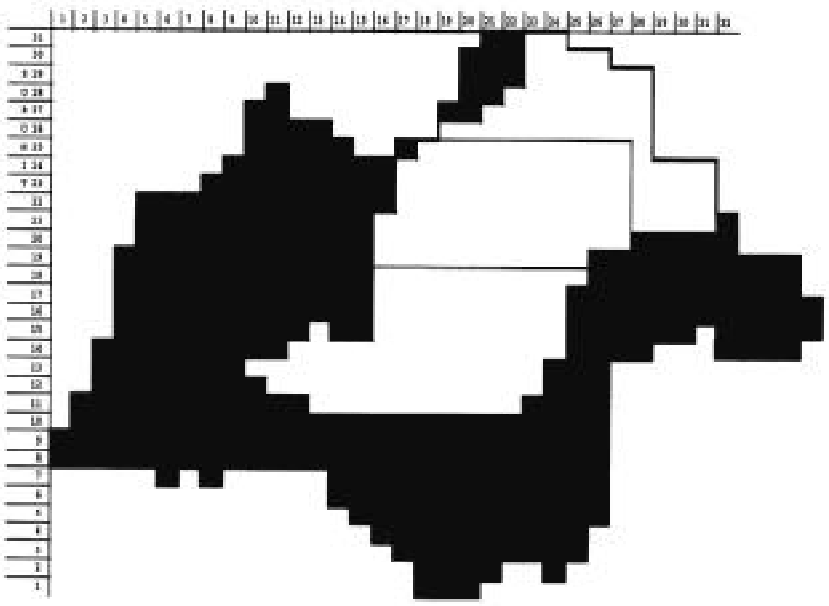
Once the MAPfile has been defined it is useful, when entering data, to lock the titles of both the columns and rows so that these are always displayed (freeze panes). The survey area defined in the MAPfile only occupies part of the grid established by the transect/subunit matrix. Many of the procedures in this analysis will involve writing an equation in the top left hand corner of the survey area (cell B2 in Figure 2) and then copying this formula across the whole sur-

Figure 1. Similarity between a digitised map (a.) and the Mapfile (b.) produced using the cells of the spreadsheet as subunits.

a.



b.



vey area. Using Figure 2 as an example the source block would be cell B2, and the destination, B2..J10. The **E**dit/c**O**py Special/**C**ontents function is very powerful as it does not overwrite the formatting (lines and shading) used to define the survey area.

Stratification bar

Below the MAP defined on the spreadsheet, a series of rows which total the cells in each transect above need to be defined using the @SUM command. Cells falling into individual strata should be totalled in separate rows. Figure 2 illustrates how the stratification line relates to the strata defined in the MAP above.

This MAPfile forms the basis of the data entry, analysis and figures depicting the wildlife distributions. Several back-ups of this original file should be made in case the original file is overwritten.

Jolly'SII Population estimate spreadsheet (JOLLY'SIIfIle)

The JOLLY'SIIfile is composed of two parts (Tables 1a-c): an upper section where data are received from the Mapfiles (Tables 1a and b) and a lower section in which the formulae are predefined to calculate the population estimates and confidence limits (Table 1c). The left hand block receives the area data calculated from the height AGL for each strata. Below these are the formulae used to calculate the areas used in the derivation of the population estimates.

To the right of the area data in the block G2 to Jl0, figures for the number of each species are copied from the species MAPfile. Below these columns are the calculations to produce the population estimate and confidence limits for each species by strata and the stratified total.

Tables 1a-c detail the steps involved in transposing data from the MAPfile but also show the location of the formulae required to calculate the population estimate for each stratum, the 95% confidence limit and, hence, the stratified total. These formulae are detailed in Table 2. When adapting these formulae to another survey area the formula must include all the values in the column above. With the @SUMPRODUCT command, a blank cell in the column above will return an error (ERR) command. Blank values need to be replaced with a zero value to make the above column a continuous list of numbers.

The flight plan for an aerial sample count should provide the values of "N" (the total number of units in the population from which the transects were drawn) and "n" (the number of sample units in the sample). Many of the formulae in Tables 2 and 3 are anchored to specific cells, containg these values rather than having numbers contained in the formulae. QuattroPro uses the "$" sign before the column and row values to fix on to one cell. This enables new values for n, N, and area sampled to be inserted into the MAPfile for subsequent counts. If these values need to be changed all the calculations will adjust automatically.

Once the calculations for the first animal population estimate have been completed it is simply a matter of copying the whole block across horizontally directly underneath the first column of the next stratum. In the case of Table 2 this involves copying the block G12..K25 across to L12. Block copying these formulae across reduces the chance of introducing errors.

Table 2 is a simplified version of the formulae which relate to the Mapfile and the data transposed

Figure 2. The grammar of the formula for each stratum in the stratification bar below the map. Note the use of commas as well as specified ranges of cells to include all cells of an individual stratum in the column above.

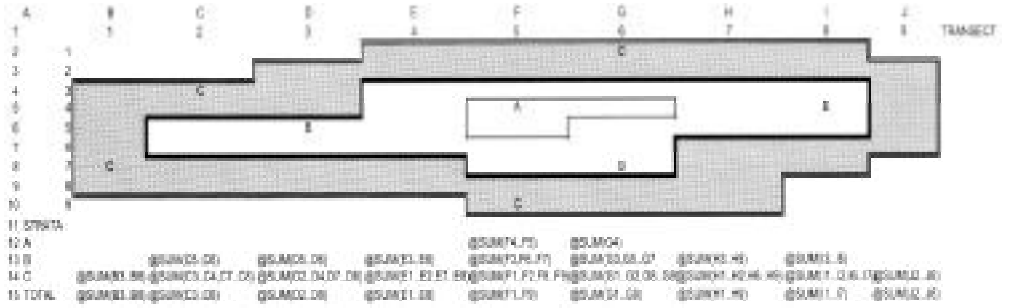


Table 1a. Original AREAfile.

	A	B	C	D	E	F	G	H	I	J
1	Transect	1	2	3	4	5	6	7	8	9
11	Strata									
12	A					3.4	1.7			
13	B		3.7	3.6	7.3	5.1	7.4	5.2	5.5	
14	C	9.7	7.8	9.5	7.2	7.5	7.1	11.7	7.2	9.6
15	Total	9.7	11.5	13.1	14.5	16	16.2	16.9	12.71	9.6

Table lb. Original SPECIESfile.

	A	B	C	D	E	F	G	H	I	J
1	Transect	1	2	3	4	5	6	7	8	9
11	Strata									
12	A					37	9			
13	B		1	41	29	47	37	49	18	
14	C	5	41	49	44	2S	1 9	22	37	36
15	TOTAL	5	42	81	64	109	55	7t	55	36

Table lc. Transposed AREA and SPECIESfile into JOLLY'Sllfile.

	A	B	C	D	E	F	G	H	I	J	K
			STRATA						STRATA		
1	TRANSECT	A	B	C	TOTAL			A	B	C	TOTAL
2		1			9.7	9.7					5	5
3		2		3.7	7.8	11.5				1	41	42
4		3		3.6	9.5	13.1				41	40	81
5		4		7.3	7.2	14.5				20	44	64
6		5	3.4	5.1	7.5	16		37		47	25	109
7		6	1.7	7.4	7.1	16.2		9		37	9	55
8		7		5.2	11.7	16.9				49	22	71
9		8		5.5	7.2	12.7				18	37	55
10		9			9.6	9.6						36
		STRATA							STRATA			
11		A	B	C	TOTAL			A	B	C	TOTAL	
12	Total		SEE TABLE 1				Total		SEETABLE 1			
			FOR DETAILS						FOR DETAILS			
			OF THE FORMULAE						OF THE FORMULAE			
			IN THESE CELLS						IN THESE CELLS			
13	Sum ot						Sum ot					
	Squares						Squares					
14							Sum(Z*y)					
15	n											
16	N						R=Sy/Sz					
17	Area						Vary			STRATIFIED		
18	Var Z									TOTAL		
19							Covar zy					
20												
21							Pop est					
22												
23							SE(Y)					
24							95%CL					
25							95% as %					

from the stratification bar (Figure 2). These calculations come to life in Table 3 which shows a worked example of the analysis for the elephant population in Garamba National Park in 1993.

After flying the count

Calibration graph

Norton-Griffiths (1978) describes the need for around 20 calibration flights to determine the strip width. The altitude above ground level and the observed strip width can be used to calculate the regression equation using the Tools/Advanced Math/ Regression function in QuattroPro.

Height above ground level (AGL) and the total strip width observed (left plus right) are entered in separate columns in a spreadsheet.

The height above ground should be defined as the independent variable. The total strip width should be selected as the dependant variable. Define a blank cell on the spreadsheet for the output and select Go. An example of the regression output from the 1993 aerial sample count of Garamba National Park is shown below.

Regression Output:

Constant (c)	-1.51
Std Err of Y Est	31.72
R Squared	0.89
No. of Observations	80.00
Degrees of Freedom	78.00
X Coefficient (m)	0.96
Std. Err. of Coef.	0.04

Thus the equation for the line y = mx + c is:
strip width = 0.96*height above ground level - 1.51.

Height Above Ground Level

During the count the height above ground level (AGL) should be recorded. For this analysis it is preferred that the AGL is noted in every subunit by the front seat observer.

The original Mapfile should be opened and immediately renamed. The AGL for each subunit should be entered across the survey area. Any blank cells in the survey area should have the mean AGL entered.

Calculating the strip width

The observed strip width in each subunit can be calculated using the regression equation calculated above and the AGLfile. Once again the Mapfile should be opened and renamed. In the top left hand corner (B2 in Figure 3) of the spreadsheet type the regression equation is as follows:

@SUM((m*[AGLfiIe]B2)+c)

Make sure that the equation refers to the top left hand cell of the survey area of the aglfile. Using the **E**dit/c**O**py Special/**C**ontents function this formula should be copied over the whole survey area. It may be easier to type in the whole range (e.g. B2..AN35) than use the mouse to drag over the whole area.

In the cells outside of the survey area, the equation should return the value of the constant. In all other cells it should calculate the strip width in each subunit.

All these formulae can be converted to their real values (**E**dit/**V**alues) remembering to overwrite the block. Normally only the top left hand cell needs to be defined for the destination. The next step is to use **E**dit/**S**earch/**R**eplace to remove

Figure 3. Formulae required to calculate N and n from STRIPWIDTH file. The original @SUM command in the stratification bar has been replaced with @AVG to obtain the main value of the strip width for each stratum.

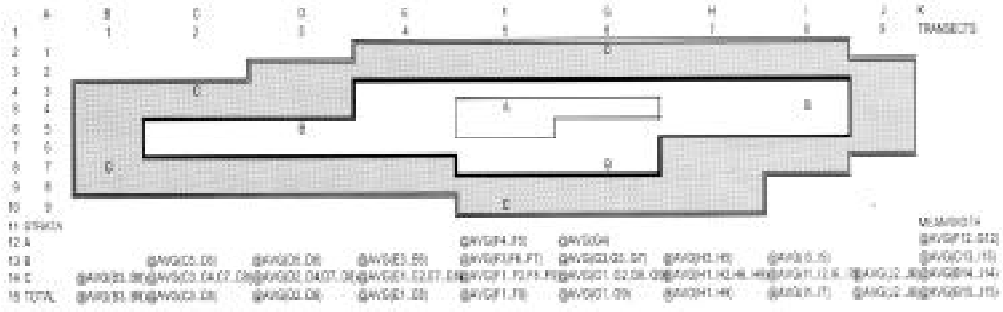


Table 2. The spreadsheet for calculating Jolly's II population estimate. Columns wise calculations shown in Norton-Griffiths (1978) for an individual species the stratified sample estimate for the species.

	A	B	C	D	E	F	G
11		A	B	C	TOTAL		A
12	Total	@SUM(B6..B7)	@SUM(C3. .C9)	@SUM(D2..D10)	@SUM(E2..E10)		@SUM(G6..G7)
13	Sumsqu	@SUMPROD	@SUMPROD	@SUMPROD	@SUMPROD		@SUMPROD
		(B6..B7,B6..B7)	(C3..C9,C3..C9)	(D2..D10,D2..D10	(E2..E10,E2..E10)		(G6..G7,G6..G7)
14						Sum(Z*y)	@SUMPROD
							($B$6..$B$7,G6..G7)
15	n	23	17	15	37		
16	N	343	255	223	500	R=Sy/Sz	@SUM(G12/$B$12)
17	AREA	5500	3550	1950	9675	Vary	@VARS(G6..G7)
18	Varz	@VARS(B6..B7)	@VARS(C3..C9)	@VARS(D2..D10)	@VARS(E2..E10)		
19						Covarzy	@SUM(1/$B$15-1)
							•(G14-($B$12*G12)
							/$B$15))
20							SPECIES
21						Popest(Y)	(G16*$B$17)
22							
23						SE(Y)	@SQRT(@SUM($B$16
							*($B$16-$B$15)/$B$15)
							(G17-2*G16*J19
							+(G16^2)*$B$18))
24						95%C.L.	2.04*G23
25						Percentage	@SUM(G24/G21*100)

the constant values. Define the survey area block and enter the full value for the constant as the search string but do not enter anything as the replace string. This should remove all the values outside the MAP area.

Calculating n and N

Variations from the flight plan and differences in terrain mean that values for both N and n need to be calculated for each stratum from the actual strip width recorded for each sub-unit during each transect (Norton-Griffiths, 1978).

ln the STRIPWIDTH fiIe the stratification bar summarises the strip width in each stratum which determines the value of N for each stratum. To calculate N the @SUM command needs to be replaced with @AVG (Figure 3) This is easily done with the **E**dit/**S**earch/**R**eplace routine as above.

Calculating the area of each stratum

The regression equation giving the strip width will also provide the area surveyed in each subunit. The equation is:

AREA SURVEYED = ((mx) + c) * subunit length/l 000

This calculation again should be entered into the block B2 and then using the **E**dit/c**O**py Special/ **C**ontents function copied to the range e.g. B2..J11. The stratification bar below will total up the area surveyed in each stratum in each transect.

B to E calculate the area surveyed for each stratum. Columns G to J follow the step-in each stratum. Column K combines the estimates from individual stratum to reach

H	I	J	K
B	C	TOTAL	
@SUM(H3..H9)	@SUM(12..I10)	@SUM(J2..J10)	
@SUMPROD	@SUMPROD	@SUMPROD	
(H3..H9,H3..H9)	(12..I10,I2..I10)	(J2..J10,J2..J10)	
@SUMPROD	@SUMPROD	@SUMPROD	
($C$3..$C$9,H3..H9)	($D$2..$D$10,12..I10)	($E$2..$E$10,J2..J10)	
@SUM(H12/$C$12)	@SUM(I12/$D$12)	@SUM(J12/$E$12)	
@VARS(H3..H9)	@VARS(12..I10)	@VARS(J2..J10)	
			START
@SUM((1/$C$15-1)	@SUM((1/$D$15-1)	@SUM((1/$E$15)	TOTAL
(H14-($C$12*H12)	*(I14-($D$12*I12)	*(J14-($E$12*J12)	
/$C$15))	/$D$15))	/$E$15))	
(H16*$C$17)	(I16*$D$17)	(J16*$E$17)	@SUM(G521,H21,I521)
@SQRT(@SUM($C$16	@SQRT(@SUM($D$16	@SQRT(@SUM($E$16)	@SQRT(@SUM
*($C$16-$C$15)/$C$15)	*($D$16-$D$15)/$D$15)	*($E$16-$E$15)/$E$15)	(G23^2,H23^2,123^2))
*(H17-2*H16*J19)	*(I17-2*I16*J19)	*(J17-2*J16*J19)+	
+(H16^2)*$C$18))	+(I16^2)*$D$18))	(J16^2)*$E$18)	
2.04*H23	2.04*I23	2.04*J23	@SUM(K23*1.96)
@SUM(H24/H21*100)	@SUM(I24/I21*100)	@SUM(J24/J21*100)	@SUM(K24/K21*100)

Data entry

Once the MAP file has been finalised, with the stratification bar it is ready for entering species data. A new file is needed for each species.

Open the MAP file and rename this file immediately with a name that refers to the count and the species to be entered. Data from the observers should be entered in the appropriate cell corresponding to the transect and subunit indicated on the count data sheets. It is useful if the left and right observed figures are entered in the same cell but as a part of a formula.

Left Obs.		Right Obs.	
30	+	28	= 58

If only one observer recorded a sighting, enter a zero value for the other observer. This practice makes checking data entries far easier. If tests have been undertaken to correct for observer bias these values can be included in the formula at this point. The totals for the numbers of each species observed in each stratum should automatically be recorded in the stratification bar below.

Transposing data

Transposing rearranges data from rows into columns. This can be done either on the same spreadsheet or data can be transposed from one open file onto another open file. The latter procedure is examplified in Table 1c.

The values for the area surveyed need to be transposed for N/S transects or copied for E/W from the area file into the JOLLY'SIIfile as do the values from the stratification bar for each animal species. It is less complicated if there are only two windows open at the same time. There are two steps involved in transposing data.

- The formula solutions in the stratification bar have to be converted into their true values. Using the **E**dit/**V**alues command convert all the stratified totals for the range into their mathematical values, overlaying these values on to the original, or place them slightly below the stratification bar.
- These values have to be transposed into the JOLLY'SIIfile spreadsheet. Define the range of cells to be transposed i.e. the whole stratification bar. On Figure 2 this corresponds to B12..J15. When prompted for the destination, swap between open files to the JOLLY'SII spreadsheet. You need only define the top left hand comer of the block for where the columns need to be placed, and not the whole area for the columns.

In Table 1c the values for the area surveyed in each-transect were transposed from the range B12..J15 to cell B2. Likewise the count data for the first species was transposed from range B12..J15 into cell G2. One column needs to be left for calculating the stratified total and the next set of species data would be transposed into cell L2.

Table 3. A worked example of a stratified sample (Smith et al. 1993). Values for the area respective files into the relevant columns. dence interval are then calculated

Trans	Park	North	South	Domain	
1				3.3	
2				7.1	
3				11.6	
4				20.8	
5				22	
6				27.8	
7				25.2	
8				28	
9				28.9	
10	1.7		1.7	32.4	
11	3.4		3.4	31.1	
12	4.9		4.9	26.9	
13	8.7		8.7	24	
14	6.7		6.7	26.6	
15	6.6		6.6	27.7	
16	18.7	6.7	12	17	
17	24.2	12.4	11.8	15.2	
18	24.3	13.1	11.3	15.5	
19	24.7	13.5	11.1	18.7	
20	26.5	14.6	11.8	18.4	
21	28.7	16.6	12.1	23.2	
22	31.5	19.4	12.1	18.8	
23	33.1	22.8	10.3	14.3	
24	29.3	22.9	6.4	20.8	
25	21.4	21.4		26.6	
26	19	19		25.1	
27	15.8	15.8		10.5	
28	15.2	15.2		11.6	
29	6.5	6.5		9.8	
30	6.1	6.1		10.2	
31	6.8	6.8		7.2	
32	2	2		7.1	
33					
12.3					
34				7.5	
35				8.1	
36				7.9	
37				3.3	
Total	365.7	234.9	130.8	652.3	
Sumsqu	8,234.60	3,891.30	1,314.80	14,128.20	
n	23	17	15	37	
N	343	255	223	500	
AREA	5500	3550	1950	9675	
Varz	110	40.4	12.4	73	

count from 1993 aerial survey of Garamba National Park, Zaire sampled and elephants sighted were transposed from their The results for Jolly's II population estimate and 95% confiautomatically from the formula in Figure 5.

	Park	North	South	Domain	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
				0	
	0		0	0	
	8		8	0	
	0		0	0	
	0		0	0	
	0		0	5	
	0		0	0	
	12	0	12	0	
	11	0	11	0	
	66	0	66	0	
	92	10	82	0	
	99	17	82	0	
	47	0	47	4	
	57	27	30	0	
	111	24	87	2	
	80	1	79	0	
	0	0		1	
	0	0		0	
	0	0		0	
	0	0		0	
	0	0		0	
	0	0		0	
	0	0		0	
				0	
				0	
				0	
				0	
				0	
	583	79	504	12	
	47,129.00	1,695.00	35,052.00	46	
Sum(Z*y)	16,178.30	1,478.90	5,261.10	280.9	
R=∑y/∑z	1.6	0.3	3.9	0	
Vary	1,470.50	83	1,294.10	1.2	
Covar zy	314	27.2	96.6	1.9	STRAT. TOTAL
Pop. est.(Y)	8,768	1,194	7,511	178	8,883
SE(Y)	1,890.30	496.5	1,504.30	83	1,586.30
95% C.L.	3,856.10	1,012.90	3,068.90	169.2	3,109.20
95% C.L as %	44	84.8	40.9	95.1	35

RESULTS

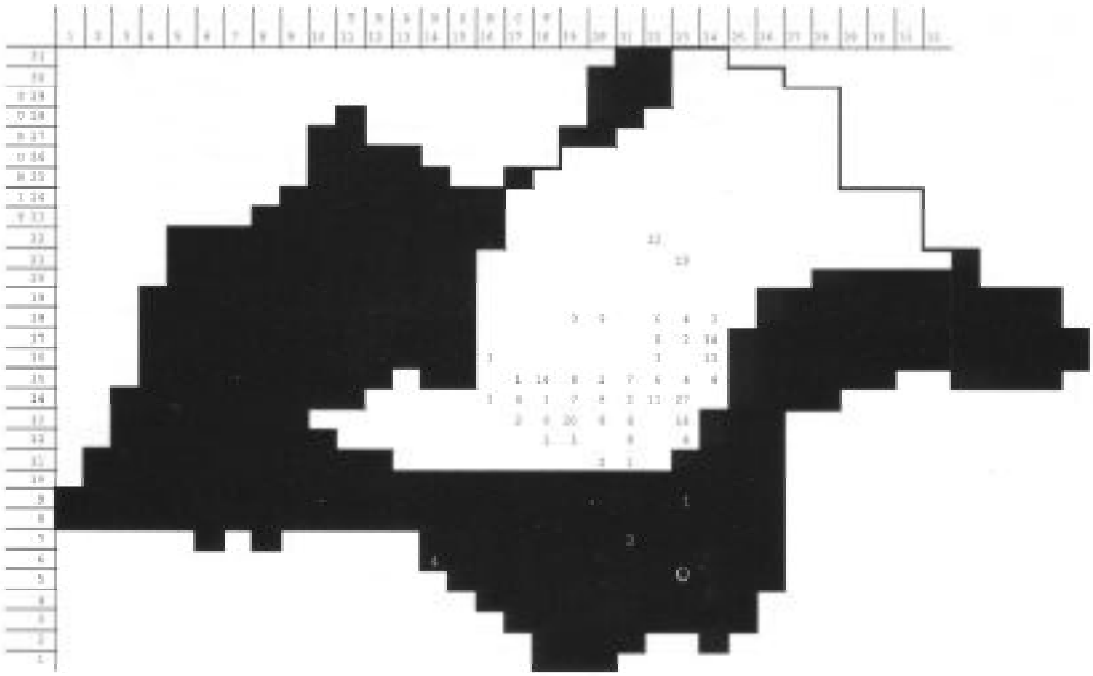
Figures represent-lug the distribution of individual species

A side product of this method is that figures representing the observed distribution of each species are produced during the course of the analysis. In their most basic form this involves printing the original SPECIESfile using the print to fit function.

By combining results from both the SPECIESfile and the AREAfile it is possible to determine the species density for subunits. There are five steps involved in producing these maps.

- Open a new MAPfile and rename this. Also open one SPECIESfile and the AREAfile.
- The calculation simply involves dividing the number of the species counted by the area censused. The easiest means to enter this formula is to swap between windows. The formula should be entered into the top left hand corner of the mapfile regardless of whether this falls in the survey area. The formula should refer to the top left hand corner of the other two files. Using Figure 2 as an example the formula would appear as:

Figure 4. Garamba National Park aerial sample count May 1993. Point densities of elephants per 25km² sub unit.



	A	B
1		
2		@SUM([SPECIES-file]B2/[AREAfile]B2)

- Using the **E**dit/c**O**py Special/**C**ontents command copy this equation over the whole range of the survey area e.g. B2..J11. Cells outside the survey area, which have no values for the area or species, return an ERR message. Cells where the species were not present will return a zero value
- Using the **E**dit/**V**alues function all the equations can be converted to their numeric values. The error (ERR) messages are also converted to text.
- The **E**dit/**S**earch and replace function can be used to remove all the ERR symbols from the block. Define the whole MAP range. Enter ERR as the search text but leave the replace box blank. To remove zero values a supervised search and replace needs to be undertaken, confirming each replacement; otherwise, zero values contained in the density values will also be removed.

This should leave only the density values remaining in each cell for where the species was recorded. Figure 4 is an example of such a distribution map from the 1993 aerial survey of Garamba National Park and surrounding hunting areas.

CONCLUSION

The most difficult aspect of this method is defining the count MAPfile with the stratification bar and ensuring that the formulae in the JOLLY'SIIfile include all the values in the column above and are linked to the relevant cells. This is a short-term problem and can be overcome with some attention to detail. In the long term, once established, the basic files can be used in analysing future counts of the same area. Other aspects of the analysis rely on sure footedness in using spreadsheet packages.

Data entry and analysis is overt and easy to verify. In addition the data from the figures depicting the distribution of species can be transferred to a raster or vector format for further analysis and

mapping using geographic information systems as illustrated in Hillman Smith (1995c).

The benefits of calculating the stratified population estimate can be seen in Table 3 where the 95% confidence limit is reduced from 56.9% to 35.0% of the population estimate.

ACKNOWLEDGEMENTS

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The Javan Rhinos, *Rhinoceros son daicus annamiticus,* of Cat Tien National Park, Vietnam: Current Status and Management Implications

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ABSTRACT

Recent studies into the plight of the Javan rhinoceros in Vietnam *(Rhinoceros sondaicus annamiticus)* are presented in this report. The January 1999 rhino survey in Cat Tien National Park estimates the number of rhinos surviving to be seven or eight. Over recent years their range has severely diminished and is now a mere 6,500 ha. The preliminary findings of an on-going camera-trapping exercise are presented here, including the first-ever pictures made of *Rhinoceros sondaicus annamiticus.* A literature review discusses the past status of the Javan rhino in Vietnam. Management implications include a discussion on improved protection and zoning of the protected area in which the rhinos occur.

RESUMEE

Ce rapport prsénte des études récentes sur la situation critique du rhinocéros de Java au Vietnam *(Rhinoceros sondaicus annamiticus).* Le recensement des rhinocéros dans le Parc National de Cat Tien en janvier 1999 estime le nombre de survivants à sept ou huit. Leur territoire a été sévèrement diminué au cours des dernières années et ne s'étend plus actuellement que sur 6,500 ha. Nous présentons ici les résultats préliminaires d'une expérience en cours de piégeage par caméra, incluant les premières photographies jamais réalisées du *Rhinoceros sondaicus annamiticus.* La position du rhinocéros de Java au Vietnam dans le passé est discutée dans une recherche bibliographique. Les conséquences pour la gestion comportent une discussion sur l'amélioration de la protection et le zonage des espaces protégés dans lesquels le rhinocéros est présent.

INTRODUCTION

Cat Tien National Park is famous for its Javan rhino population, the only one known on mainland Asia. Apart from this population, one other Javan rhino population is known to exist in Ujong Kulon National Park, Java, Indonesia. The two populations are recognised as being two different subspecies of Javan rhino; *Rhinoceros sondaicus annamiticus* (Desmarest, 1822) in Cat Tien National Park and *Rhinoceros sondaicus sondaicus* in Ujong Kulon National Park. Just seven or eight individuals are believed to survive in the Cat Loc area of Cat Tien National Park and between 50 and 60 in Ujong Kulon National Park. The Javan rhino is therefore probably the most endangered large mammal in the world.

This paper aims to provide an overview of the past and current status of Javan rhino in Cat Tien National Park, Vietnam. It does so by providing a literature review and by presenting the results of a rhino survey held in January 1999 and an on-going camera trapping exercise. Finally the paper highlights several management implications which seek to ensure the continued survival of R. *s. annamiticus* in Vietnam.

STUDY AREA

Cat Tien National Park is located about 150 km north of Ho Chi Minh City, situated in the plains of the Dong Nai river and just south of Vietnam's central highlands. The Park consists of two sections, each of about 35,000 ha, in the provinces of Dong Nai, Binh Phuoc and Lam Dong (Figure 1). These sections are separated by a zone which is inhabited by people of different ethnicity, who are rapidly opening up large areas of wild lands for farming.

The Park has a variety of habitats: primary and re-growth evergreen tropical lowland rain-forests dominated by Dipterocarpaceae; primary and re-growth semi-evergreen tropical lowland rainforests dominated by *Lagerstroemia* spp.; tropical freshwater wetlands with open lakes and seasonal floodplains containing *Saccharum spontaneum, S. arundinaceum* and *Neyraudia arundinacea;* flood forests dominated by *Hydnocarpus anthelmintica* mixed with *Ficus benjamina* and areas severely denuded by warfare but dominated by bamboo and open grasslands. Table 1 provides an overview of the most recent vegetation cover information available for the Park.

Apart from Javan rhinos, the Park hosts a variety of rare and endangered animal species. Orange-necked partridge *Arborophila davidi* is endemic to the Park. Other rare avian species include white-winged wood duck *Cairina scutulata* and black ibis *Pseudibis davisoni.* The Park is known to host large mammals such as Asian elephant *Elephas maximus,* tiger *Panthera tigris* and gaur *Bos gaurus,* albeit in rather low numbers (Polet, in press; Polet and Khanh, 1999). A population of Siamese crocodile *Crocodylus siamensis* is probably extinct (Bembrick and Cannon. 1999).

The section of the Park situated in Dong Nai Province received protected status in 1978 and became known as Nam Cat Tien National Park in 1992. The section of the Park situated in Lam Dong Province became a rhino sanctuary in 1992, known as Cat Loc. Tay Cat Tien in Binh Phuoc Province has been part of a logging concession. In December 1998, these three areas have been integrated administratively and are now known as Cat Tien National Park.

The Javan rhino habitat in Cat Tien National Park

The topography of the area in which the rhinos occur is characterised by many small steep hills ranging between 300 and 600 m above sea level. Soils are alluvial and consist of heavy clay. Numerous streams criss-cross the area and drain into the Dong Nai river.

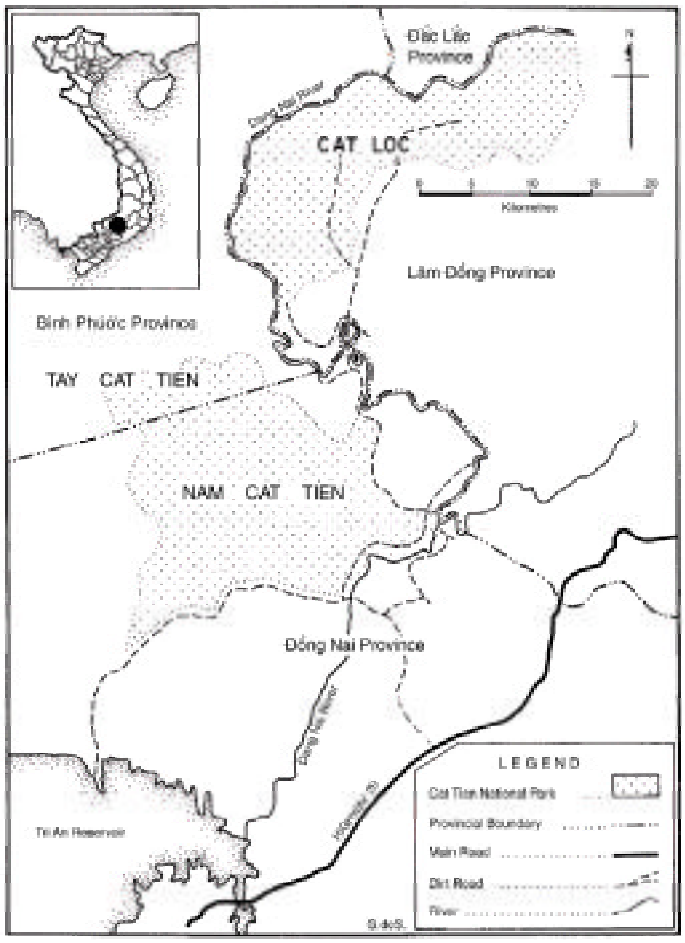
Originally the area in which the rhinos currently occur was tropical lowland semi-deciduous forest, dominated by Dipterocarpaceae and *Lagerstroemia* spp. During the American war, the area was severely sprayed with defoliants (on average of 84 1/ha). Most of the large trees have thus been killed. Although the forest is recovering, the area is mainly covered with bamboo and rattan.

People, park and economy

Cat Tien National Park is situated on the territory of two indigenous ethnic minorities, known as S'Tieng and Chau Ma. In Nam Cat Tien, these shifting cultivators have been sedentarised in a village called Ta Lai on the southern border of the Park. A large number of S'Tieng and Chau Ma still live within the Park in the Cat Loc area. That people live within the National Park is against Vietnam's National Park laws. It is however understandable because in the case of the S'Tieng and Chau Ma, the National Park was declared on their ancestral land. But also a large number of Kinh Vietnamese (the dominant ethnic group in Vietnam) and minority people from the north live in Cat Loc. Most of them came under the New Economic Zone Programme (the Vietnam government's re-settlement programme of the 1980s aiming at reducing population pressure in the Red River delta), before the area was designated a protected area. Polet (in press) estimates a total of about 9,800 people living within the Park, of whom about 5,000 belong to indigenous groups.

It is estimated that 6,100 people live within the Cat Loc sector of the Park, the sector which holds the rhinos (Polet, in press). These are all indigenous ethnic minority people. Two hundred people live within the current rhino range (which consists of about 6,500 ha within the Cat Loc sector).

Figure 1. Location of Cat Tien National Park, Vietnam.



Large areas of forestland have been transformed into cashew nut plantations. Most of the cashew nuts are traded in kind by the ethnic minority people with traders from cities in the vicinity. On several occasions this has led to dependency relations whereby the ethnic minority people remain living under very poor conditions despite the favourable market prices for cashew nuts.

Along Dong Nai, most of the flat land has been converted into rice fields by Kinh Vietnamese and ethnic minority people from the north and middle of Vietnam. These people have also converted the area of one of the most important rhino saltlicks into rice fields.

With the arrival of a cash economy and an increasing pressure on the land due to a large and rapidly growing human population, the traditional slash-and-burn farming system has been modified whereby instead of leaving the forest to re-generate, cashew nut is being planted. Kinh Vietnamese converted a lot of flat land into paddy fields. This process took place especially within the Cat Loc sector as this area received a protected status relatively late, while parts of it had been designated New Economic Zones and thus the area has more people living within its boundaries.

The combination of having a number of very rare animals within the Park and at the same time a large and growing pressure from, human populations provides potential for a classic human -wildlife conflict. The Cat Tien National Park authorities see themselves faced with a very complex and demand-

Table 1. Vegetation cover of the Cat Tien National Park.

Vegetation Types	Total Cat Tien National Park		Sector		
	Area	% of area	Nam Cat Tien	Tay Cat Tien	Cat Loc
Total Natural Area	74,219	100.0	38,202	5,382	30,635
1. Evergreen forest	17,819	24.0	7,844	147	9,828
1.1 Primary evergreen forest	687	0.9	662	25	-
1.2 Logged evergreen forest	17,132	23.1	7,182	122	9,828
2. Semi-evergreen forest	5,097	7.0		5,097	- -
3. Bamboo forest	29.805	40.1	10.519	2,692	16,594
4. Mixed forest	14,361	19.3	11,760	529	2,072
5. Plantation	62	0.1	-	62	-
6. Bush/shrub	487	0.6	487	-	-
7. Grasslands	2,388	3.2	1,109	577	702
8. Cultivation/settlement	2,509	3.4	69	1,001	1,439
9. Wetlands/lakes	1,603	2.2	1,287	343	-
10. Other	61	0.1	30	31	-

Source: MOF/WWF, 1994.

ing task. The Park's ecosystem and its many rare and sometimes critically endangered species is designated to be conserved as an example of a relatively intact ecosystem, typical for lowland southern Vietnam. At the same time human populations within and around the Park are trying to improve their poor standards of living, illegally utilising the Park's natural resources in the process.

In order to improve the protection of the Park and to assist the people living around the Park to develop alternative livelihoods, Cat Tien National Park receives substantial technical and financial assistance from the Netherlands government "WWF-Cat Tien National Park Conservation Project", as well as from other donors such as WWF-US and the US Fish and Wildlife Service.

MATERIALS AND METHODS

For this study, a comprehensive review of literature has been carried-out. The result of a rhino survey, carried out by the WWF - Cat Tien National Park Conservation Project in January 1999, is reported here as well. Lastly, the initial results of an on-going photo-trapping exercise, carried out by the WWF-Cat †ien National Park Conservation Project, are presented here.

Rhino survey

For the rhino survey, standard tracking analysis methods were used consisting of three components:

- establishment of the current range by surveying a wide area for any signs of rhinos,
- track analysis by measuring footprints encountered and making plaster casts in order to identify individual rhinos based on foot measurements and front hoof measurements to estimate the minimum number of rhinos in the area, and
- extrapolation for areas not covered in the track analysis but within the rhino range in order to estimate a maximum number of rhinos in the area.

The survey was carried out over a period of one month by two teams, consisting of six people each. Each team had one person dedicated to take

all measurements in order to avoid errors, which could occur if more than one person was involved in taking the measurements. Geographical co-ordinates were taken for every measurement. Data were recorded on a standard sheet and included length and width of footprint and length and width of front hoof for every good quality footprint encountered and observations on other signs such as droppings, grazing signs, saltlicks, etc. The total length of investigation lines was around 218 km, with some lines repeated several times. The survey team collected data on wallows (12), dung (6), salt licks (2), footprints (241 of which 137 plaster casts were made) and other signs such as traces of body-rubbing on tree trunks and traces of eaten and broken plants and trees.

The total number of plaster casts used for the analysis was 144 of which 137 casts were made during the survey in January 1999 and 7 casts just prior to the survey in December 1998. Of the 144 casts, 33 could not be analysed because of poor quality; the other 111 were carefully analysed in the laboratory. Also the dimensions of 241 measurements taken in the field were included in the analysis. The width and length of all the footprints and front hooves were recorded.

Based on dimensions of the casts, the dimensions of the field measurements and differences in forms, the plaster casts were divided into groups, each group with the same characteristics in form and size. In this manner individual rhinos were recognised (Dang and Khanh, 1999). The plaster casts and other raw data are kept at the headquarters of Cat Tien National Park.

The field and analysis methods used for this survey were similar to the ones used during the April 1998 census carried out under the auspices of the International Rhino Foundation and the IUCN/SSC/Asian Rhino Specialist Group (Sung et al., 1998). Methodologies used during both these surveys follow the procedures developed by van Strien (1986) in Gunung Leuser National Park, Sumatra, Indonesia during his work on the Sumatran rhino. The April 1998 survey was carried out during the dry season while the January 1999 survey was conducted just after the rainy season.

Automatic camera trapping

The two rhino surveys provided a detailed understanding of the locations within their range where the rhinos come frequently. This information combined with suggestions from local people was used to install ten automatic photo camera sets in the area. The sets are made by Trail Master, a company based in the US.

One set consists of an infrared transmitter, an infrared receiver and a modified compact camera. Whenever the infrared beam is interrupted, the receiver gives a signal to the camera, which is then triggered. Sensitivity of the receiver and the interval time between pictures can be adjusted. Sensitivity is measured in pulses of 0.05 seconds each. The receiver records every event in which the infrared beam is interrupted, even if the interruption is of less duration than the set sensitivity. Therefore, the number of pictures taken is usually lower than the number of events recorded. As falling

Table 2. Basic settings of infrared cameras in Cat Tien National Park.

Item	Setting
Height above ground of transmitter / receiver	approximately 75 cm
Sensitivity of receiver	5 - 7 pulse (= 0.25 - 0.35 seconds)
Interval time between pictures	6 seconds
Film	Fuji Color 200 ASA 24 exposures
Time between change of films	12-15 days
Time between change of batteries	1 month

leaves, extremely big raindrops and insects attracted by the infrared transmitter can also trigger the camera, not all pictures taken have the targeted species on them. Table 2 provides some of the basic settings of the cameras used in Cat Tien National Park.

For every camera the following infonnation is kept on record: geographical location, dates in the field for every location, dates of change of film and batteries, dates and times of pictures taken, dates and times of events and contents of pictures.

RESULTS OF THE JANUARY 1999 RHINO SURVEY

Number of rhinos

The results of the analysis of dimensions and forms of plaster casts and field measurements are summarised in Table 3. Here it is noted that in general that the widths of the feet measured from casts and in the field are comparable, but the lengths of the feet measured in the field are generally one cm larger than those measured from casts.

The analysis of differences and dimensions and the form of plaster casts made of full prints and front hooves, suggests that there are six individual rhinos.

However, the analysis and comparison of the dimensions of 241 footprint sizes measured in the field shows that the range of variation is rather large. From 157 mm to 240 mm wide, and 187 mm to 258 mm long. The smallest footprint is 157 mm wide and 197 mm long, and the largest footprint is 240 mm wide and 248 mm long. It is concluded that these are the footprints of many different individuals. 90% (217 measurements) of the footprints' widths are within the range from 176 mm to 215 mm. There are 19 footprints shorter than 176 mm and five wider than 215 mm.

Among the footprints which are wider than 216 mm, there are three particularly large, of which measurements were taken at three different

Table 3. Comparison of rhino footprint characteristics for identification of individuals: average dimensions of footprint plaster casts and measurements in the field

Characteristics	Foot plaster casts N = 111		Footprints N = 241		Front hoof plaster casts	
	Width [mm	Length	Width [mm]	Length	Width [mm]	Length
Rhino 1 (n=21) Front hoof regularly round, wide, high	191.2	217.9	191.1	228.3	106.0	46.9
Rhino 2 (n=19) Front hoof regularly round, wide	202.1	222.9	195.8	234.7	111.9	33.7
Rhino 3 (n=10) Front hoof slanting, wide, high	196.6	219.7	194.6	232.0	107.6	47.4
Rhino 4 (n=29) Front hoof regularly round, low, narrow	185.8	220.8	190.0	228.9	101.1	33.4
Rhino 5 (n=17) Front hoof slanting on the right, high, narrow, hoof rim sharp	187.0	207.4	190.0	218.6	93.4	47.1
Rhino 6 (n=15) Front hoof slanting on the left, high, narrow, hoof rim sharp	191.1	210.1	187.5	218.5	96.4	44.4

locations. There is also a very large plaster cast of 135 mm wide and 246 mm long. All the other casts are less than 120 mm wide. Obviously, this is the footprint of a rhino different from the six rhinos that were recognised above. Based on the above analysis, the minimum number of rhinos in Cat Tien National Park is estimated to be seven.

Besides these seven individuals, there are a number of footprints of which the widths are beyond the above seven rhinos' range of dimensions. In addition, in the process of investigation there were many footprints recognised at different locations, but their plaster casts could not be made because they were not clear. There were also a number of locations in which there might be rhinos' footprints but the survey team could not reach them despite the fact that this survey has been the most intensive one ever. It is possible that several rhinos were not counted in this survey. Therefore, the maximum number of rhinos in Cat Tien National Park is estimated to be at least eight.

Population structure

Of special interest was the discovery of a tree with many cuts on the bark, which might be inflicted either by a rhino's horn or by a rhino's incisors. If it could be established that these marks were caused by the horn of a rhino, then that would be strong evidence that an adult male is present in the population.

Based on survey results, the rhino population of Cat Tien National Park is believed to include young individuals (footprints less than 170 mm), adult individuals (footprints over 170 mm), probably male individuals (very large footprint of 230 mm and the goring traces against tree-trunks), and female individuals (because there are young individuals). It should be stressed that these conclusions are based on deductions from a comprehensive set of plaster casts and field measurements of rhino footprints only and need to be confirmed by more direct observations. Also obtaining important information such as the exact number of male, female and young individuals and whether there are individuals at the reproductive stage of their lifecycle (i.e. age structure and sex structure of the population) can only be achieved by direct or indirect observation of individuals.

Based on the 1999 rhino survey the following conclusions can be drawn:

- The rhino population in Cat Tien National Park is estimated to include minimally seven and maximally eight individuals.
- The rhino population in Cat Tien National Park is confined to an area of 6,500 ha in the Cat Loc sector of the Park.
- The rhino population in Cat Tien National Park is believed to include sub-adult, adult male and adult female individuals.
- Important information on sex and age structure of the population can only be obtained through more direct observations of the rhinos.

Preliminary results of the on-going camera trapping exercise

It is with the last observation in mind that the WWF-Cat Tien National Park Conservation Project decided to execute a camera trapping exercise in the Park. It is hoped that enough pictures of rhinos can be taken so that individuals can be recognised and related to footprint sizes and shapes. Thus critically important information on the population's sex and age structure might be obtained.

Ten cameras were installed at ten different locations within the rhino range of 6,500 ha in the week of 26 April to 2 May 1999. Within two weeks the first pictures of rhinos were taken These are believed to be the first-ever pictures taken from life of R. *s. annamiticus.* Having these pictures assists scientists to make a step ahead in learning more about this secretive animal. The seven pictures taken so far are depicted on pages 42 and 43. They originate from three different locations and the time at which the pictures were taken indicate that the animals are most active during the night.

Photo 1 shows a rhino (rhino 1) where a height-marker is visible behind the animal, just in front of its ears. The height of the marker is one meter (32 mm on the picture, about 40 mm at rhino's shoulder when accounted for perspective). The height at the shoulder of this individual is estimated to be 130 cm (52 mm on the picture/40 mm) which is slightly larger than the estimate presented (110-120 cm) by Sung et al. (1998).

Sung et al. (1998) estimate that the *R. s. annamiticus* is about 75 to 80% of the size of a *R. s. sandaicus.* They base this estimate on the ratio of the width of the hind feet measured in Cat Loc (20-23 cm) versus those recorded in Ujong Kulon (25-28 cm). Using this relation in size and estimating the weight of a *R. s. sondaicus* to be 1,600 kg, it may be estimated that a *R. s. annamiticus* weighs about 650 to 800 kg (1,600 kg x 0.75^3 to 0.8^3).

DISCUSSION

The small size of the footprints from Cat Loc is more in accordance with the size of footprints of Sumatran rhinos *(Dicerorhinus sumatraensis)* or with sub-adult *R.s. sondaicus* (Sung et al., 1998). Since all footprints from Cat Loc are between 20 and 23 cm in width, it would be hard to conclude that the Cat Loc population consists only of sub-adults. From the pictures presented in this article it is beyond doubt that the Cat Loc rhinos are Javan and not Sumatran rhinos. Sung et al. (1998) argue that the poor quality of the habitat in Cat Loc may have contributed to the smallness of R.s. *annamiticus* and that the Ujung Kulon and Cat Loc populations belong to clearly distinct gene pools. To stress this point, they also suggest for *R.s. annamiticus* the vernacular name "Vietnamese rhino" instead of using the term "Javan rhino" in Vietnam.

Looking at the locations, dates and times that the pictures were taken, combined with the fact that adult Javan rhinos are generally regarded as solitary animals, an attempt can be made to deduct whether the pictures are all of the same or of different individuals. The rhinos on photos 1 and 2, 3 and 4, 6 and 7 are almost certainly of the same individual (each pair of pictures has been taken at the same place and very shortly after each other). Hence it is deducted that all pictures are of at most four different individuals (including the possibility that all pictures are of the same individual).

Referring to camera trapping of Javan rhinos in Ujong Kulon, Griffiths (1992) describes eight parameters with which individual rhinos could be recognised: size, horn shape, eye-wrinkles, neck folds, skin pores, scars, neck plate profile and cheek profile.

The size of the animals in the pictures where a height marker is visible, is roughly the same. Although differences in perspective make estimates difficult, the rhino in the wallow also seems to be about the size as the others. It is clear that on the basis of the available pictures one cannot differentiate individuals by their size.

The shape of the horn of rhino 5, 6 and 7 looks rather similar; not sharp but somewhat flattened on the top. The shape of the horn of rhino 1 2, 3 and 4 is more pointed. Although this characteristic could indicate that the available pictures belong to two individual rhinos, evidence seems to be too crude to build upon.

The eye-wrinkles of rhino 5, 6 and 7 look more oval than the others, which seem to be more round. Using this characteristic, one could again argue there are two different individuals on the picture.

The neck folds, neck plate profiles and cheek profile look in general similar. Using this characteristic seems unworkable because differences in position of the head relative to the body, differences in pose and differences in positioning of the camera result in differences in appearance of details in the folds. Patterns in skin pores cannot be recognised clearly in these pictures. From the limited part of the body visible and the mud on the animals, no obvious marks or wounds are visible.

The sex of the animals in the pictures cannot be seen and there are no calves who usually join their mothers.

Griffiths (1992) recognising 31 individual Javan rhinos in Ujong Kulon, 60% of which the sex was known, notes that all individuals confirmed to be male have a horn, while all individuals confirmed to be female have no horn. Amman (1985) concludes that female Javan rhinos in Ujong Kulon have at most a small "hump" and exceptionally a "small horn". Schenkel and Schenkel-Hulliger (in Amman, 1985), however, observed that all the rhinos they saw in Ujong Kulon had a distinctive horn and assumed that at least some of them must have been female. Whether or not female Javan rhinos from Ujong Kulon have a small horn or a hump remains unclear. The horn in the pictures of the rhinos from Cat Tien National Park are not large but seem to be too large to be, subjectively, classified as "hump" or "small horn".

Photo credit: WWF-Canon/Mike Baltzer/CTNPCP

Photo 1. First-ever known picture of Javan rhino in Cat Tien National Park, Vietnam (location A, May 11, 1999, 22:54).

Photo credit: WWF-Canon/Mike Baltzer/CTNPCP

Photo 2. Full size Javan rhino in Cat Tien National Park (location A, May 11, 1999, 22:54).

Photo credit: WWF-Canon/Mike Baltzer/CTNPCP

Photo 3. Javan rhino in wallow in Cat Tien National Park (location B, May 17 1999 04:00).

Photo credit: WWF-Canon/Mike Baltzer/CTNPCP

Photo 4. Javan rhino in wallow in Cat Tien National Park (location B, May 17, 1999, 04:00).

Photo credit: WWF-Canon/Mike Baltzer/CTNPCP

Photo 5. Head of Javan rhino in Cat Tien National Park (location C, May 19, 1999, 3:21).

Photo credit: WWF-Canon/CTNPCP

Photo 6. Javan rhino in Cat Tien National Park (location C, May 25, 1999, 19:37).

Photo credit: WWF-Canon/CTNPCP

Photo 7. Javan rhino in Cat Tien National Park (location C, May 25,1999,19:37).

The rhino on Photo 4 (rhino 4) has its mouth wide open. A large incisor in the lower jaw is clearly visible. Van Strien (pers. comm.) believes that having large incisors is typical for male Javan rhinos.

Based on the above the following tentative conclusions can be drawn:

- the pictures confirm that the Cat Loc rhino population consists of Javan rhinos and not Sumatran,
- the Cat Tien National Park rhinos are most active during the night,
- the pictures are of 1, 2, 3 or 4 different individuals,
- all pictures are of adult rhinos,
- at least rhino 1 and probably rhino 3 and 4 are males,
- it is unlikely that there is a female individual on any of the pictures,
- the pictures confirm that *R.s. annamiticus* is between 75 and 80% of the size of *R.s. sondaicus*, and
- *R.s. annamiticus* is between 110 and 130 cm high at the shoulder and weighs between 650 and 800 kg.

Perhaps, at this stage of the exercise, it is more important to conclude that it requires large numbers of pictures and detailed analysis to be able to recognise individual Javan rhinos using camera traps, if possible at all. Nevertheless, any piece of information is welcome in getting to know this elusive animal better.

Current status of rhinos in Cat Tien National Park

With an estimated population of seven or eight individuals, the future of the *R. s. annamiticus* looks grim. It is probably the most endangered large mammal in the world. Over the years the population has steadily declined and its range has become progressively limited, nowadays to a meagre 6,500 ha of heavily denuded habitat. Apart from these bare facts, hardly anything else is known about this population. The pictures recently taken just confirm its existence, which was known from footprints and other signs and reports of sightings of local people. Sizes of footprints and some of the pictures indicate that the population contains an adult male.

It is, however, too early to conclude that the rhinos of Cat Tien National Park have no future. First of all, not enough is known (e.g. sex and age structure) about this population to justify such a conclusion. Secondly, Santiapillai et al. (1993) discuss the danger of loss of genetic diversity in such a small population through inbreeding depression. They conclude that inbreeding depression may cause a loss in fitness initially but that viability of the population usually returns.

After the Vietnam government declared the Cat Loc area a protected area after the poaching incident in 1988, no further rhino poaching incidents have been reported. The general awareness about the animal's protected status is well spread amongst local communities. However, the possibility of illegal hunting cannot be discounted whereby the main threat could come from organised outside poaching groups. Of a more immediate threat to the future existence of Javan rhinos in Vietnam is the continued conversion of forestland into farmland, also taking place within the protected area of Cat Loc.

Past and present status of Javan rhinos in Vietnam

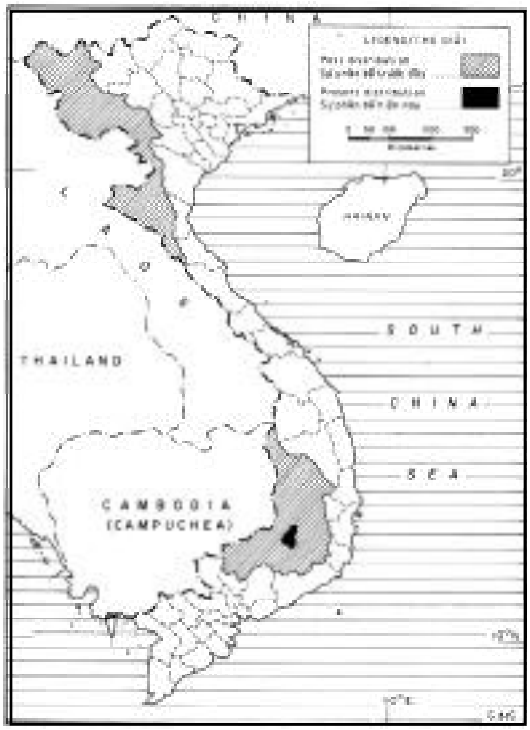
In the past, Javan rhinos were spread over a large area in South East Asia (Figure 2). They were to be found in India, Bhutan, Bangladesh, China, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia and Indonesia (Sumatra and Java). Reports of local people and explorers indicate that the animals were quite numerous during the late 19th and early 20th century. The sub-species *R. s. annamiticus* was found in Vietnam, Laos, Cambodia and the eastern parts of Thailand (Foose and van Strien, 1997).

Old Vietnamese and French reports indicate that the Javan rhino was once common in Vietnam. Early this century the Javan rhino was to be found in the north-western and south-western parts of Vietnam (see Figure 2).

In the 1960s it was feared that the Javan Rhino had become extinct in Vietnam and thus on mainland Asia. In 1969 van Peenen wrote: *"at present there probably are no living members [of Javan rhinos] in South Vietnam, although as recently as the 192Os rhinoceroses were hunted not far from Saigon"* (in Schaller et al., 1990).

In 1988 a hunter shot a female rhino near the Dong Nai River in Cat Tien District. Rhinos were a protected species by Vietnamese law already at

Figure 2. Past and present distribution of the Javan rhino *Rhinoceros sondaicius annamiticus* in Vietnam. (Source: modified after Santiapillai et al., 1993).



that time and thus the hunter was arrested after he tried to sell the horn and skin on the market (Schaller et al., 1990). This incident renewed the attention of the Vietnamese and international scientific and conservation communities for the rhinos of Vietnam. Moreover, the incident proved that rhinos were still surviving in Vietnam.

This incident has also been the last documented poaching incident. Whether more rhinos have been lost due to poaching after 1988 is not certain but unlikely when taking into consideration the effective intelligence network of local police and the Cat Tien National Park. A poaching incident would have been difficult to keep hidden from authorities. However, Haryono et aI. (1993) report that one rhino was killed in Song Be province in 1991 and two rhino horns were offered for sale in Ho Chi Minh City in 1992. The data on which this report was made is, however, unclear. Also, authorities cannot confirm these incidents; it seems there are no official documents describing these incidents.

A number of publications in the early 1990s (Schaller et al., 1990; Haryono et al., 1993; Santiapillai et al., 1993) report on different field investigations on the plight of the Javan rhino in Vietnam. From these investigations it became clear that local people had seen rhinos on different occasions and in different places in southern Vietnam over the past decades. But the last observation of rhino in northern Vietnam was from 1964 and the species is considered extinct in that part of the country.

Schaller et al. (1990) provide an overview of rhino sightings and killings during the late 1970s and 1980s. These are all from the Dong Nai river area, where Doug Nai, Lam Dong, Song Be (now divided in Song Be and Binh Phuoc) and Dac Lac province border one another.

Santiapillai et aI. (1993) report tracks only in Lam Dong province and an animal which crossed the river into Song Be province. By that time the rhinos of Dong Nai province may have permanently retreated into Lam Dong province, ranging throughout the 35,000 ha Cat Loc area.

Recent field investigations (Sung et al., 1998; Dang and Khanh, 1999) confirm that Javan rhinos

Table 4. Recent numbers of Javan rhinos in Cat Tien National Park.

Year	Minimum estimate	Maximum estimate	Source
1989	10	15	Schaller et al., 1990
1991	8	12	Santiapillai et al., 1993
1993	7	9	Haryono et al., unpubi.
1998	5	7	Sung et al., unpubl.
1999	7	8	Dang and Khanh, unpubl.

in Vietnam only remain in the Cat Loc area but that its range has been reduced to a mere 6,500 ha.

The number of rhinos in Vietnam has been falling steadily over recent years. The most recent estimate (Dang and Khanh, 1999) is that there are just seven or eight animals surviving (Table 4).

Based on the literature review, the following conclusions can be drawn:

- The number of Javan rhinos in Vietnam is slowly but steadily diminishing.
- The range of Javan rhinos in Vietnam has progressively been declining.
- The most critical threat to the future survival of Javan rhinos in Vietnam is the continued conversion of forestland into agricultural land.
- Poaching seems to have been gradually brought under control by the Vietnamese authorities.

CONCLUSION

In order to safeguard the future existence of the Javan rhino in Vietnam, many activities have to be deployed and basically at the same time. These activities are as follows and a number of them are being worked upon by the government of Vietnam and various donors (see Introduction).

Improved protection

The first and foremost requirement to safeguard this population is to ensure that potential poachers do not get a chance and that the current range is free from any human intervention. After the integration of Cat Loc into Cat Tien National Park, the Park authorities deployed 25 additional forest guards to Cat Loc to assist the seven existing forest guards in the area. Much increased patrolling of the area resulted in numerous cases in which people cutting trees, hunting and a complete illegal sawmill were involved. The more active presence of the Park authorities understandably causes unrest amongst some people. The people living within the protected area would especially like to see the question as to whether or not they need to be resettled resolved soon.

Two new guard posts have been built and equipped by the CTNPCP, which also has provided means of transportation and allowances. WWFUS funded a training course on patrolling and protection techniques and provided field gear and allowances for forest guards organised in five teams. The USFWS funded an information campaign under which materials will be printed targeting different audiences such as decision-makers and children.

Cat Tien National Park authorities have a good relation with the provinces, districts and communes which border the National Park and collaborate closely with them. Dong Nai province especially has provided substantial support to the National Park. All government levels not only have shown their support to forest protection activities in the Park but also have assisted the Park actively with conservation education and have encouraged its residents to participate in active environmental protection and management.

A large World Bank assisted project is scheduled to start its implementation phase in September 1999 in the buffer zone of Cat Tien National Park and will build upon the experience gained by the various governmental bodies. It seeks to develop infrastructure and alternative livelihood sources for the people in the buffer zone with an aim to reduce the dependence of these people on the natural resources within the protected area.

Protected area zoning

The case of Cat Loc shows that conserving a highly endangered species and economic development of

local communities do not go together very well. Recent history shows how rapidly poorly endowed people seeking economic security by converting forestland into cashew nut plantations have pushed the last surviving rhinos into a fast diminishing area.

In order to find and agree on a suitable balance between economic development and conservation, it has been proposed to execute a zoning exercise. Various levels in the government of Vietnam have welcomed this idea. This exercise will define which areas will have to be strictly protected and in which areas a partnership approach between the Park and local communities could be established. A clear demarcation of the Cat Loc boundaries and possible future sub-boundaries of multiple-use zones is urgently required. If deemed necessary, the exercise could indicate the need to resettle some local communities currently living in the most ecologically sensitive areas. If that is the case, an intensive consultation process with the communities involved will be started during the preparation of the resettlement action plan and its implementation. In this manner the incorporation of these communitiy aspirations and ideas will be best guaranteed.

Officials in the National Park and Lam Dong province are well aware of the fact that the current rhino range (6,500 ha) is too small to maintain a viable rhino population. The inhabited area between Cat Loc and Nam Cat Tien forms an obstacle for the rhinos to re-enter their previous range within Dong Nai province. Therefor the establishment of a corridor between the Nam Cat Tien and the Cat Loc sectors of the park is of utmost importance. Lam Dong province officials support plans to implement activities which seek to re-arrange people living within the protected area and assist them in seeking stable lifestyles in order to ensure that more area is available to the rhinos.

Further Research and Monitoring

A better knowledge of the rhino population's sex and age distribution is urgently required because such information has a bearing on concrete management activities. The camera trapping exercise will therefore be continued. Rhino monitoring surveys using the footprint methodology are foreseen for 2001 and 2003.

In the near future a DNA analysis study will start, funded by the USFWS. Rhino dung will be collected and analysed for traces of intestinal DNA by the Columbia University in the USA. It will be extremely difficult to find fresh rhino dung in the rugged terrain of Cat Loc and therefore data collection will be of rather an opportunistic nature. Nevertheless it is hoped that more insight will be gained on the sex structure of the population. This exercise is led and co-ordinared by WWF-Indonesia, which executes a similar survey amongst the rhinos of Ujong Kulon.

Habitat improvement

Currently the CTNPCP is executing an assessment of the food availability for rhinos. First of all an inventory is being made of the food plants as there is little known on this subject while the plant species in Ujong Kulon (Amman, 1985) differ considerably from the ones in Cat Loc and can thus not be taken as guidance. The next step will be to make some trials with habitat manipulation and improvement and monitor the rhino's response. If these trials look promising, habitat improvement on a larger scale could be implemented.

Translocation

Some specialists have suggested capturing the rhinos from Cat Loc and moving them to the Nam Car Tien section of the Park where the habitat seems better and security is better organised and there is no issue of conversion of forestland into farmland. Also, the Action Plan for the Survival of the Vietnamese rhino (1998/9) foresees translocation of these rhinos. The Plan states this translocation should be a rescue operation in case protection in Cat Loc has not improved by the year 2000. Ideally rhino numbers should increase. Capturing the rhinos right now in this difficult-to-access terrain is likely to be extremely difficult and expensive. In addition, losing just one rhino in the process will be a disaster for the population.

Therefore the short-term strategy should be to ensure the survival of the rhinos in Cat Loc so that the population can start growing. Whenever a relatively large and stable number (e.g. 15) of rhinos

exists in Cat Loc, some of them should be captured and translocated to Nam Cat Tien. This will have to be done because the protected area of Cat Loc (in total 35,000 ha) is too small to keep more than about 35 rhinos. In order to maintain a stable number of rhinos, sooner or later some rhinos will have to be translocated elsewhere. One could only work towards this goal and hope that the plight of the rhinos in Cat Tien National Park will improve in such a way that translocation of rhinos becomes necessary.

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Reducing Drug Induction Time in the Field Immobilization of Elephants

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ABSTRACT

Individual elephants have been routinely immobilized by remote injection (darting) methods for research, translocation or the treatment of injuries. Any operation to immobilize an elephant is both expensive and a considerable logistical exercise in which much can go wrong. Logistical problems, veterinary complications, danger to people and wastage of money can be largely avoided by limiting the animal's post-darting travel. Although operator technique plays a large part, safe recumbency can be greatly facilitated through the rapid knock-down effect of high doses of the immobilizing drug propelled in a type of dart which overcomes two common problems: poor placement and malfunction of the internal detonation mechanism,

RESUMMEE

L'injection à distance (darting) est une méthode cornmunément employée pour immobiliser un éléphant à des fins de recherche, de transfert ou pour le traitement de blessures, Toute opération d'immobilisation est coûteuse et en même temps un exercice logistique considérable sujet à de nombreux problèmes. Les problèmes logistiques, les complications vétérinaires, le danger pour les humains et le gaspillage des fonds peuvent être largement évités en limitant le déplacement de l'animal après l'injection. Bien que l'adresse de l'opérateur joue toujours un rôle primordial, la chute sans danger de l'animal peut être considérablement facilitée grâce à l'effet assomant rapide de fortes doses de la substance immobilisante propulsée dans un type de flèches qui surmonte deux problèmes courants: mauvais positionnement et dysfonctionnement du mécanisme de détonation interne.

INTRODUCTION

Individual elephants have been routinely immobilized for research (Thouless, 1995; Elkan et al., 1998; Whyte and Grobler, 1998), translocation (Putterill, 1993) or the treatment of injuries. Translocation is becoming an increasingly common practice in the management of elephants and is being used for the purposes of restocking (du Toit, 1998), problem elephant removal (Karindawaro, 1998), or movement of semidomesticated 'working' elephants. A recent proposal to offer an alternative form of trophy hunting, called "green hunting" (Douglas-Hamilton ,1997) involves immobilizing elephants and could be linked to research. The immobilization of elephants in very dense vegetation has presented particularly serious problems (Njumbi et al., 1996, Elkan et al., 1998), which have in turn prejudiced important research studies or much-needed management interventions in certain wild populations.

The principal immobilizing drug used in wild herbivores (Etorphine hydrochloride-M99, C. Vet, UK), has a high therapeutic index and therefore appears to be safe at higher doses in African elephants (R. Kock et al., 1993). M99 is a very concentrated synthetic opiod drug which induces narcosis, not anaesthesia or tranquillization. Combinations of various classes of immobilizing and tranquillizing agents which are sometimes applied to other species are nor required in elephants immobilized for short-duration procedures (M. Kock et al., 1993; ZVA, unpubl.). Any operation, however, to immobilize an elephant is both expensive and a considerable logistical exercise, The

cost of hiring professional people, using aircraft and vehicles and providing for ground teams and equipment means that failed immobilization efforts can waste enormous sums of money. The efficiency of the immobilizing drug in a very large, very mobile and potentially dangerous animal is therefore crucial.

No two immobilizations proceed in exactly the same manner and post-darting problems can present themselves in many different and often surprising ways. Partially sedated but still mobile elephants are distressed and can be dangerous or induce their group mates to become aggressive. Delayed effect from the drug may result in the animal disappearing from sight in difficult terrain and remaining unrecovered, The elephant could die if it does become immobilized, falls in the wrong position (e.g. occludes its trunk) or remains unattended for a long time. Particular dangers to unattended animals are (1) prolonged sternal recumbency which may cause severe respiratory distress and (2) hyperthermia.

It is the remote delivery of the drug via a dart which presents the most problems in immobilizing elephants in the field. I report on the immobilization of 65 elephants, mostly for research, over a period of five years in Zimbabwe (Hoare unpubl., 1997, 1998). The techniques used are recommended to reduce the induction time by the drug, thereby rendering the animal safely recumbent and humanely manageable in the shortest possible time.

MATERIALS AND METHODS

Of the 65 elephants immobilized, 58 were carried out by personnel on foot, supported by a fixed-wing aircraft with observer and pilot in radio contact with the ground team. The remaining seven were darted from a helicopter. With the aircraft method animals were located from the air and the ground team directed to them by radio. The movement of the elephant after darting was monitored and the ground team was directed to the animal when it was recumbent, The aircraft crew also observed the elephant's behaviour in the recovery period after reversal of the immobilizing drug.

If a helicopter can be afforded it is the method of choice because target animals can be split from the herd, driven to a convenient location or repeatedly darted if there is insufficient restraint, all with minimal risk to the operator. Operations to immobilize elephants in dense forest (Elkan et al., 1998), however, cannot use any form of aerial support and as such are particularly vulnerable to failure,

Operator technique, which comes only with experience, is very important in immobilizing elephants. Due to the legal restrictions in handling the M99 drug which is exceptionally dangerous to humans, a veterinarian is usually involved in elephant immobilizations. Darting elephants in savannas is done from a maximum range of about 40 m with most cases being carried out at about 20-25 m. It is important not to use a high power setting on the gun or a powerful charge to propel the dart otherwise it will be damaged by the impact and fail to deliver the drug properly. A sharp needle will penetrate the thick skin of an elephant (2-3 cm) even in a relatively slow travelling dart. Accurate dart placement and deep intramuscular injection are required with the low fluid volumes used in wildlife immobilizing drugs (<2 ml for an elephant). The greatest contributor to poor dart placement is the operator being too hasty to fire a shot.

I used both a South African-made 'Kruger dart' (Fauncap, South African National Parks Board, P Bag X402 Skukuza, RSA) which on contact with the animal has a spring detonation mechanism and the Pneudart (Pneudart, Pneu-Dart Inc., Williarusport, USA), which has an internal explosive mechanism.

RESULTS

I found two main problems with drug delivery in elephants, both involving the dart. One was malfunction of detonation in darts that inject their contents via an internal explosive charge. The other was poor penetration or incorrect placement of the dart needle, often due to the difficulties of stalking and approaching wary elephants at close range. But with experience I found the problems of remote drug delivery could be largely overcome using a 'triple strategy' involving

1) a spring loaded type of dart,
2) high doses of M99 (15-18mg), and
3) the routine addition of hyaluronidase to M99.

Hyaluronidase (Hyalase 2000 I.U./ampoule, Fisons Pharmaceuticals, RSA), an enzyme which facilitates drug absorbtion from any application site, and high doses of M99 have been both previously recommended (M. Kock *et al.,* 1993; R. Kock *et al.,* 1993; ZVA, unpubl.) for use in free-ranging elephants. Hyaluronidase has a limited life in solution at ambient temperatures (Morton and Kock, 1991) and has to be replaced if the dart is not used for 2-3 days, a situation which does arise quite frequently.

The Kruger dart proved absolutely reliable, delivering drug in 100% of cases (n=57). When using a Pneudart with an internal explosive charge I experienced a *25%* failure rate with good dart placements (n=11). The Kruger elephant dart has a 70 mm needle which is longer than that on any other commercially available dart. This length of needle usually achieves the required depth of penetration into muscle layers even if the dart placement is poor. In combination with high doses of M99 and hyaluronidase this means that even if the dart was poorly placed, enough of the drug was usually absorbed to at least slow the animal down considerably and greatly reduce awareness of its surroundings. The Kruger dart has an advantage if there is a need to alter the dart contents. Adding new hyaluronidase or altering the dose of M99 can be relatively easily achieved because the needle point of a Kruger dart has a removal rubber cap. With reasonable initial narcosis, a 'top-up' M99 dose sufficient to induce recumbency in such an elephant, was relatively easily administered. In other types of darts (e.g. Palmer, Pneudart) the needle tip is sealed with vaseline which makes the alteration of the dart contents messy and possibly dangerous.

The drug induction time (time from darting to recumbency) was recorded in 48 of the 65 elephants (Figure 1). The negative correlation between dose and induction time was significant (r= - 0.46, p=0.01). Figure 1 shows that variation is high at lower doses. Once higher doses are employed, the data suggest that (1) higher doses are more efficient in all sizes of elephant and (2) that a 'threshold dose' of about 14 mg may exist above which the problems associated with remote injection can be minimized.

I did not experience evidence of respiratory depression in any immobilized elephants, even with

Figure 1. Induction time (time to recumbency) in a sample of 48 African elephants immobilized with different doses. of etorphine hydrochloride (M99).

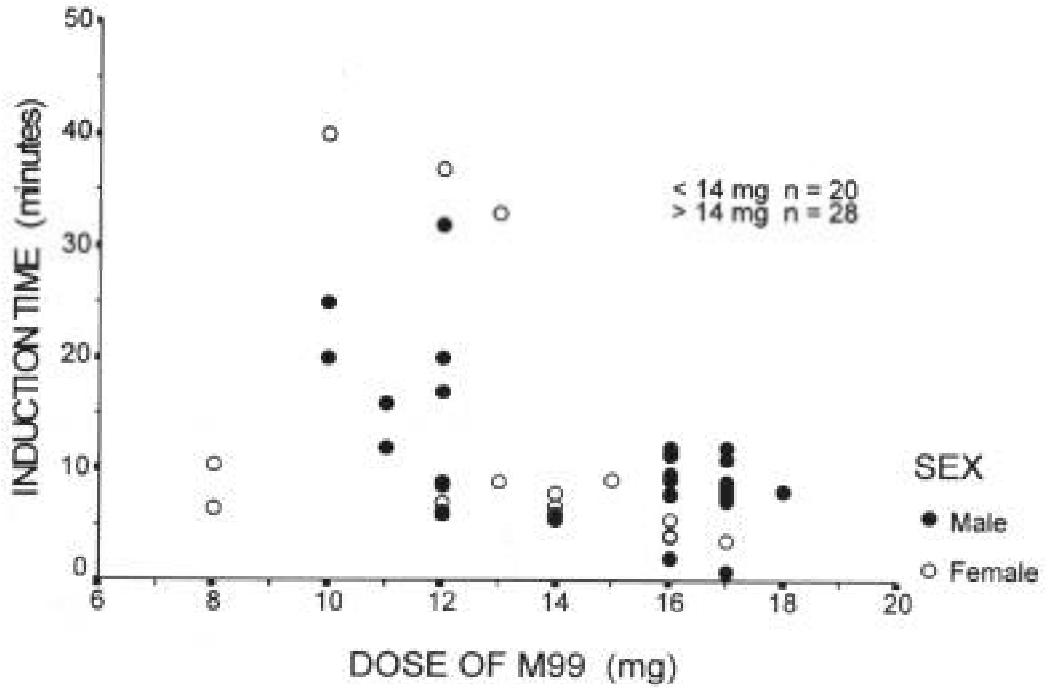

Photo credit: The Zambezi Society

Photo 1. Immobilised elephant being fitted with a radio tracking collar. (The author is standing to the right.)

small females having received high doses of M99 or animals having fallen in an awkward recumbent posture. As these animals were immobilized for fitting or removal of radiocollars or removal of snares, revival was relatively prompt, usually within 20 minutes of induction. One elephant in very rugged terrain was not located for 2.5 hours but when found in lateral recumbency was radiocollared and revived without incident. Partial revival was tried on one occasion to try to get another subject to alter its head position slightly for collar fitting. A minute dose of the M5050 antagonist drug (far less than the recommended revival dose) rapidly restored full mobility with consequent embarrassing failure of the operation.

DISCUSSION

Although the above sample of elephants in Zimbabwe was immobilized in savannas, field conditions were often characterized by thick vegetation and low visibility. Over the five year period both sexes of elephant of a great variety of sizes were immobilized, latterly all with the higher doses of M99. Cows and young bulls, easily as small as most forest elephants, were included.

Swapping darts and adjusting dart contents in the pressured conditions of field operations places particularly stressful demands on the operator who is faced with difficulties of weight estimation and therefore, in theory, dose adjustment.

The results show that a 'one dose for all' regime (16-17 mg M99+2000 I.U. Hyaluronidase) should maximize the chances of inducing recumbency of any elephant within about 10 minutes. This is in agreement with R. Kock et al. (1993) who found a significant decrease in induction time in a paired sample of fifteen elephant cows immobilized with 12mg M99 and re-immobilized with 15mg M99.

A standardized initial darting technique for all elephants makes field operations much easier. I believe that both post-darting location problems and respiratory complications were avoided in my sample because of a combination of:

1) lateral recumbency usually induced by the rapid knock-down effect of the higher doses of M99 (ZVA, unpubl.),
2) timely opportunities for the ground team to adjust recumbent posture, and
3) quicker revival of any animal in difficulty. As a strategy, this amounts to preferably managing

the known side-effects of opiod drugs rather than risking the unpredictable complications of under-dosing. Expressed more simply, in a veterinary training manual on wildlife immobilization (ZVA unpubl.): "many more animals are killed by too little M99 than by too much".

An example of extreme difficulty in immobilizing elephants is given by Elkan et al. (1998) in the Cameroon forests. They experienced 50% failures in twelve elephant immobilization attempts and of the six elephants immobilized, two were found dead after 32 minutes due to cardio-respiratory complications. Their greatest difficulty was limiting post-darting travel despite employing various technological aids e.g. crossbows to fire darts silently or darts equipped with miniature radio-transmitters or 'gametracker string'. They relied on ground tracking to guide them to the immobilized elephant but suspected that sometimes the trackers were not sufficiently competent.

Elkan et al. (1998) mostly used darts with explosive internal charges (Cap-chur darts, Palmer Chemical Co., Atlanta, USA) containing low doses of M99 (range 4.9-6.1 mg). They may have believed their low M99 doses were appropriate for relatively small forest elephants and although well aware of the potential benefits of hyaluronidase, did not use it because of the need to keep darts loaded for long periods.

Poorly executed immobilization attempts on elephants can cause danger to people, distress to the animals, waste money and attract adverse publicity. Vital research on important wild populations (e.g. forest elephants) or much-needed management interventions like translocation therefore may have been foregone due to lack of confidence in the cost-effectiveness of elephant immobilization. Similarly, the proposal on "green hunting" (Douglas-Hamilton, 1997) will never gain acceptance if in practice there are elephant deaths or welfare concerns. In elephant translocation operations described by Njumbi et al. (1996) in Kenya, the need for experience and close logistical co-ordination amongst members of the capture team was highlighted as essential for avoiding undue stress to immobilized animals. A most important veterinary experience gained in this Kenyan operation was evidence of the elephant's intolerance to immobilization whilst acidotic at a time of vegetation flush.

By advocating a slightly modified immobilization technique. I am not suggesting operator preference for different equipment combinations be ruled out. Large numbers of elephants (a total of nearly 1,000) have been successfully translocated in recent years in southern Africa (Putterill, 1993; Coetsee, 1996; du Toit, 1998). Coetsee (A.M. Coetsee, pers. comm. 1996.) used Pneudarts with internal charges and only 37 mm needles to immobilize and translocate 670 elephants in southern Zimbabwe but at all times he had the benefits of the use of a helicopter.

While acknowledging the considerable difficulties of immobilizing elephants in forests, I believe some of the problems experienced by Elkan et al. (1998), who were forced to experiment continually with their approach, might have been overcome through the use of a more standardized technique. In my case refinements to detail and technique prior to ground-based operations seemed to minimize dart failures so that subsequent cascades of potential problems were avoided. This meant whole operations became largely free of logistical and veterinary complications making the 'research processing' of studying elephants more routine and cost-effective.

The future application of some elephant translocation and research may be more limited by financial (e.g. prohibitive cost of helicopters) and political constraints than by difficulties in immobilizing the subjects. Nevertheless, with an increasing need to immobilize elephants and an increasing media interest in elephant management in general, it is imperative that wildlife professionals have at their disposal a fairly routine technique which can virtually guarantee a safe and humane method of elephant immobilization.

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NOTES FROM THE FIELD

Airlifting Immobilized Rhinos

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BACKGROUND

The KwaZulu Natal Nature Conservation Services (KNNCS) (formally Natal Parks Board and KwaZulu Directorate of Nature Conservation) manages approximately 1,811 white rhinoceros *(Ceratotherium simum)* and 628 black rhinoceros *(Diceros bicornis)* in eight parks in the province of KwaZulu Natal, South Africa. In the past 40 years approximately 4,560 white rhinos and 400 black rhinos have been caught and relocated from these parks (McKenzie, 1993) and conventional capture methods for both black and white rhinoceros have been described (McKenzie, 1993). Because of strict adherence to wilderness principles in designated areas with no vehicle access or with inaccessible terrain, an alternative method of removing rhino from these areas was sought.

In 1992, ten black rhino and one white rhino were successfully airlifted out of the wilderness area of Hluhluwe Umfolozi Park. These animals were all crated in a fully awake state prior to being airlifted. This method although successful had limitations. The crate was severely affected by the down wash of the rotors causing it to spiral making flying unsafe. The crate, being built of robust materials, was heavy, thus limiting the size of animal to be caught, as the combined weight of the rhino and crate plus the effect of the down wash caused the load to be too heavy to lift when adult white rhino were attempted.

In 1996 a total of seven black and 119 white rhino were to be removed from the wilderness area of Hluhluwe Umfolozi Park. Because of the limitations described above it was decided to make use of a cargo net and transport the animals while under anaesthetic. This method had been previously used on one white rhino without the lifting frame, when a single animal was relocated from an island in an inland dam in Mpumalanga province, South Africa (du Toit pers. comm., 1998). The method described below has now been successfully used in air lifting 35 black rhinos and 119 white rhinos from the KZNNCS Hluhluwe Umfolozi Park and Itala Game Reserve.

PERSONNEL

Personnel are divided into three teams: airlift helicopter team, landing zone team and light helocopter team.

Airlift helicopter team

This team should comprise of at least 12 individuals. This team has to cope with rolling the rhino onto the cargo net. This can be a difficult situation at times.

Landing Zone Team

This team should comprise of at least eight individuals in order to crate the rhino using conventional methods.

Light Helicopter Team

This team comprises the helicopter pilot and darter. If conditions are suitable a third person may be used as an observer to assist in locating rhino. Each team should include at least one individual who is trained and competent in all aspects of rhino capture.

CAPTURE TECHNIQUE

The lifting helicopter is prepared for cargo swing operations and will have the lifting cables and lifting frame in place in preparation for the first rhino. The rhinos are located by means of observation posts and/or a light helicopter. In the case of the KNNCS a McDonnell Douglas 500 turbine helicopter is used.

Once a suitable animal has been located and verified by the light helicopter crew the lifting helicopter crew are instructed to start up and are given a GPS reading or a compass heading in order to locate the animal. Two types of lifting helicopters have been used namely the Oryx SA military helicopter and the MI 8 M.T.V Russian helicopter, both capable of lifting in excess of 3,000 kg. This lifting capability is necessary in order to accommodate an adult white rhino, the lifting frame, 12 capture personnel, three flight crew and sufficient fuel to lift at least one rhino.

The animal is then darted from the light helicopter. Once the animal is recumbent the darter is dropped off to monitor the immobilized animal. Eye ointment is administered, a blindfold is fitted and the animal's ears are plugged with cotton wool. Additional tranquillizer is given if the animal is not completely relaxed. The light helicopter remains airborne to guide the lifting helicopter to the animal. Once the crew of the lifting helicopter has the recumbent rhino visual, the light helicopter can land or search for the next animal.

The lifting helicopter will drop a cargo net as close to the recumbent rhino as possible. It will then land a safe distance from the rhino to allow the airlift team to disembark.

An area adjacent to the rhino is cleared of all rocks, bush etc. The cargo net is then opened and placed alongside the rhino. The rhino is then rolled onto the centre of the vertical line of the net, but with the front portion of the rhino off centre on the horizontal line. This ensures that the rhino's head will remain elevated during the flight. The rhino is placed on the net in lateral recumbency.

Once the rhino is in position on the net the lifting helicopter is summoned. It will then proceed to hover above the rhino bringing the lifting frame to within one metre above the rhino. A designated member of the airlift team will then earth the frame to reduce static. The rest of the crew will take a hold of the frame to steady it in order that four designated staff will hook up the strops of the cargo net to the Crosby7 master links of the lifting frame. This is done by means of Crosby7 latching hooks.

On completion, the team leader will then signal to the flight engineer that lifting may commence. This is done with the utmost care. Whilst lifting commences, capture staff who are positioned around the net ensure that the net is free from obstructions and that the rhino's legs are folded in a natural position and that its nostrils are not restricted by the net. When the rhino is off the ground and the team leader is satisfied that all the above is in order, he will signal a "thumbs up" to the flight engineer to indicate that they may proceed with the rhino to the drop zone. If there are any concerns the team leader will signal "thumbs down" which will indicate that the rhino needs to be repositioned. The helicopter will then lower the rhino gently back on to the ground for the necessary adjustments to be made. The flying speed should not exceed 80 km/h (39 knts) and the helicopter should fly as low as possible whilst slinging the rhino.

The animal is then slung to the pre-selected drop zone where it is lowered gently to the ground. The frame is then moved slowly to the side of the rhino and lowered to the ground where the drop zone team will unhook the cargo net. Any spare cargo nets will be loaded into the lifting helicopter which will return to the crew where the operation may continue. The rhino is then crated in the usual manner.

EQUIPMENT

Lifting frame

The lifting frame bears no weight and it serves merely to spread the cargo net. Without the frame the net bunches, resulting in the rhino taking up unnatural postures which could result in spinal or other injuries.

Two master links are joined by a length of heavy chain (approximately 200 mm in length) by means of a Herc-alloy7 hammerlock coupling link at each end. These pass through a welded triangle on the corner of the lifting frame. The master links are large enough so as not to pull through the triangle and thus remain in place.

The lifting frame is constructed of robust steel

tubing (50 mm x 100 mm) and weighs 134 kg. It is essential that this frame is of sufficient weight so as not to be easily affected by rotor down wash. For ease of storage the frame used by the KNNCS can be split into two halves.

Ropes
The usual capture ropes ie. the head and leg ropes are secured to the rhino in the usual manner. This is done when the airlift team arrive at the rhino. A leg rope is carried in the light helicopter in case of emergencies.

Cargo Net
A cargo net made from flat webbing with a length and width of approximately 5.65 m with Crosby7 latching hooks fitted to the strop ends is required. It is essential to have the centre of the net marked in order to position the rhino correctly. At least three nets are required for a continuous operation.

Blind Fold
This should be made so as to fit securely to the rhino's head covering both eyes completely. It should be fitted in such a manner so as to withstand the severe down wash created by the lifting helicopter (this can be done by the use of velcro straps).

Sling and swing cables
A four-leg sling with Crosby7 latching hooks and swivel is required. The legs of the sling should be approximately 4 m long. A cargo swing cable of approximately 10 m is usually adequate depending on terrain. Cargo swing cable to make up a length of at least 30 m should be available to cater for extreme situations in steep terrain or amongst tall trees.

Radios
It is imperative that all teams are in radio contact with one another. Provision should be made for enough portable radios to achieve this. Provision should also be made to have ground to air communications with both helicopters. The darter should also carry a portable radio when dropped off with the immobilized rhino.

Antistatic Bar
This can be made from a metal reinforcing rod (insulated) with a length of light chain of approximately 2.5 m long welded to one end. The lifting frame is struck with the rod whilst the chain is touching the ground before capture staff take hold of the frame. If this is not done the static shock can be quite severe.

Water
Two 25 litre containers of water are carried in the lifting helicopter to cool the rhino when necessary.

Cane knives
Each of the airlift crew should carry a sharpened cane knife to assist in clearing bush etc. A cane knife is also carried on the light helicopter in case of emergencies.

Saws
A chainsaw is carried in the lifting helicopter for clearing large trees or shrubs. A bow saw is carried for back up.

Safety Equipment
Ear muffs and goggles are necessary because of the serious noise and wind caused by the lifting helicopter. It is essential that all staff wear these items when working in the vicinity of the lifting helicopter.

DRUG DOSAGES

White rhino
It is not unusual for adult animals not to be completely relaxed when recumbent. This can be easily rectified by injecting additional Azaperone (I.V.) 40 mg. Recommended dosages are listed in Table 1.

Black rhino
Relaxation problems seldom occur in black rhino. Hyalase is added to the cocktail to achieve quick knock down times (usually between three and four minutes, Table 2). Additional Azaperone is given to animals five to ten minutes before crating.

Table 1. Dosages for white rhino [mg].

	Adult	Sub-Adult
Etorphine	3-4	2-2.5
Reversal (Diprenorphine)	6 - 8	2-5
Azaperone	100-150	50-100

N.B. These drug dosages are merely a guide. Condition, size of animal etc. should all be considered before dosages are decided.

Table 2. Dosages for black rhino [mg].

	Adult	Sub-Adult
Etorphine	4	3
Reversal (Diprenorphine)	8	6
Azaperone	200	100
Hyalase	5,500 IU	5,500 IU

PRECAUTIONS

Legal Requirements

It should be noted that lifting machines and lifting tackle should comply with the Occupational Health and Safety Act. Act 85 of 1993 (Regulation 18 Sub. Reg.1-9 Lifting Machines and Regulation 18 Sub. Reg. 19 Lifting Tackle).

Immobilized rhino

It is essential that the rhino's vital signs are closely monitored as animals may be under anaesthetic for up to an hour. Before lifting, it is also imperative to check the depth of anaesthesia and if the animal is showing signs of recovery, it should be "topped up" before being lifted. If breathing is not satisfactory (laboured) 10 mg of Nalorphine can be administered shortly before lifting commences. To prevent neuromuscular damage to its hind legs it is important that the rhino's position be changed if it is immobilized for longer than 20 min.

It is essential to acquire complete relaxation before the rhino is lifted. In male rhinos the penis is often relaxed and protruding. Care should be taken that it is not constricted and damaged by the net.

Personnel

All personnel should be fully briefed in helicopter safety precautions and procedures before lifting commences.

Drop Zone

The drop zone should be a large flat area free of trees and shrubs. It should preferably be well grassed to reduce dust. Because of the high costs involved in running the lifting helicopter, it is advised that all dehorning, marking etc. take place at the landing zone and not at the place of capture.

The lifting helicopter

When slinging, flying speeds should be kept below 80 km/h. This is to avoid hypothermia through the wind chill factor. It also prevents too much tension/pressure in the net. If the flying speed is excessive and the head of the animal is facing the direction of travel, difficulty in breathing may be experienced. When dropping the cargo net from the lifting helicopter avoid the net getting entangled in the lifting frame. Do not approach the recumbent rhino and ground team with the lifting frame swinging out of control. Steady the frame by lowering it to the ground or steadying it against a tree away from the team and rhino. Plan approaches so that the minimum amount of dust is blown up. During the drop off, attempt to fly a long straight final approach so as not to cause a swing. The rhino should be lowered slowly to the ground.

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Rhino Tracking with the CyberTracker Field Computer

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INTRODUCTION

To interpret animal tracks the tracker must have a sophisticated understanding of animal behaviour. There is in principle no limit to the level of sophistication to which a tracker can develop his or her expertise (Liebenberg, 1990a,b).

Apart from knowledge based on direct observations of animals, trackers gain a detailed understanding of animal behaviour through the interpretation of tracks and signs. In this way much information can be obtained that would otherwise remain unknown, especially on the behaviour of rare or nocturnal animals that are not often seen.

Expert trackers can give valuable assistance to researchers studying animal behaviour. Combining traditional tracking with modern technology, such as radio tracking, may enable the researcher to accomplish much more than by applying either method on its own.

Trackers can also extend the capacity of researchers to gather data by orders of magnitude. As long as the scientist is satisfied that the data collected by trackers are reliable, a team of trackers who go out on daily patrols can gather large quantities of very detailed data on an ongoing basis.

In the past, trackers have been used in research on animal behaviour, but received little or no recognition for their contributions. Recently some researchers have recognised the contributions of trackers by including them as co-authors of papers.

While trackers have worked in collaboration with researchers, it has still not been possible for trackers to document data and conduct their own research independently. The main obstacle is the fact that the best traditional trackers often cannot read or write. To overcome this we developed a user interface for a pen-based hand-held computer for trackers who cannot read or write.

THE CYBERTRACKER FIELD COMPUTER

The field computer is designed to be quick and easy to use in the field, enabling trackers to record all significant observations they make in the field. The field computer therefore makes it possible to generate a large quantity of very detailed data. Computer visualisation makes it possible for scientists to have instant access to all the information gathered over a period of time.

Icons allow the tracker to select options by simply touching the screen of a pen-based computer. The menu includes icons that enable the tracker to record sightings of animals, animal track observations, species, individual animals (such as individual rhinos) and numbers of males, females and juveniles. Species covered may include a full range of mammals, birds, reptiles and other animals. Activities such as drinking, feeding, territorial marking, running, fighting, mating, sleeping, etc. can be recorded. A plant list enables the tracker to record plant species eaten by the animal. The tracker goes through a sequence of screens until all the necessary information is recorded. When the tracker saves the information an integrated Global Positioning System (GPS) automatically records the location of observations.

With each recording the tracker (if s/he can write) also has the option to make a field note if s/he observes something unusual that is not covered by the standard menu. (An illiterate tracker can ask a literate apprentice tracker to write the field notes).

When the tracker gets back to the base camp he follows a very simple procedure to transfer the data onto the base station PC.

The CyberTracker field computer system has been tested by two of the authors, Benadie and Minye, for almost three years in the Karoo National Park in South Africa. Although they cannot read or write, they have been using the field computer to record their observations in the field and download the data onto the PC by themselves. They have therefore demonstrated that they can use the computer independently.

RHINO TRACKING

Individual rhinos can be identified by the distinctive random pattern of cracks that show up in their spoor. This allows trackers to track individual rhinos and collect data on their behaviour and feeding habits.

The movements of individual rhinos are shown on a map. This shows areas frequented exclusively by each individual rhino, as well as areas where their territories overlap.

From an anti-poaching point of view, knowing where the rhinos drink and sleep may help to protect them in the areas where they are most vulnerable, since these would be the locations where a poacher will most likely find them during the day. To optimise available manpower (there are at present not many women trackers in anti-poaching units), anti-poaching patrols can therefore cover those areas where poaching will most likely occur.

The data collected on feeding is very detailed. For example, shifts in rhino feeding behaviour can be seen every two months, shifting from the rainy season through to the dry season. Figure 1 shows the relative frequency of plant species fed on. Towards the end of the first year, the trackers were collecting a lot more data than at the beginning of the project. The period July/August 1997 is probably more respresentative than the corresponding period September/October 1996, which shows some gaps due to the fact that the trakcers gathered less data. A shift towards plants that the rhino do not usually feed on may indicate over grazing, which may happen in drought years or due to too many antelope (such as kudu) feeding on the same plants, or a combination of the two.

This may make it possible to anticipate poor feeding conditions before the rhino starts to lose condition. Once the rhino has lost condition it is already under stress, increasing the risk of death if it is translocated in an effort to save it from starvation.

In addition they record animal tracks of rare or nocturnal species that are not normally monitored.

They record virtually everything that they find interesting in the field. This may make it possible to monitor long-term trends that would not otherwise be noticed at all.

For example, a porcupine may destroy a whole *Acacia karroo* plant by eating the root in one meal. At present it is not known what impact porcupines have on plants utilised by the rhino. But to manage highly endangered species like rhino it may become increasingly important to monitor the whole system in order to get a better understanding of how they interact and compete with other species.

Initial field tests indicate that a tracker can generate more than 100 observations in one day. One field computer could therefore generate more than 20,000 observations in a year. If, for example, a large park like the Kruger National Park could have about 100 field computers, it may be possible to generate more than two million observations per year.

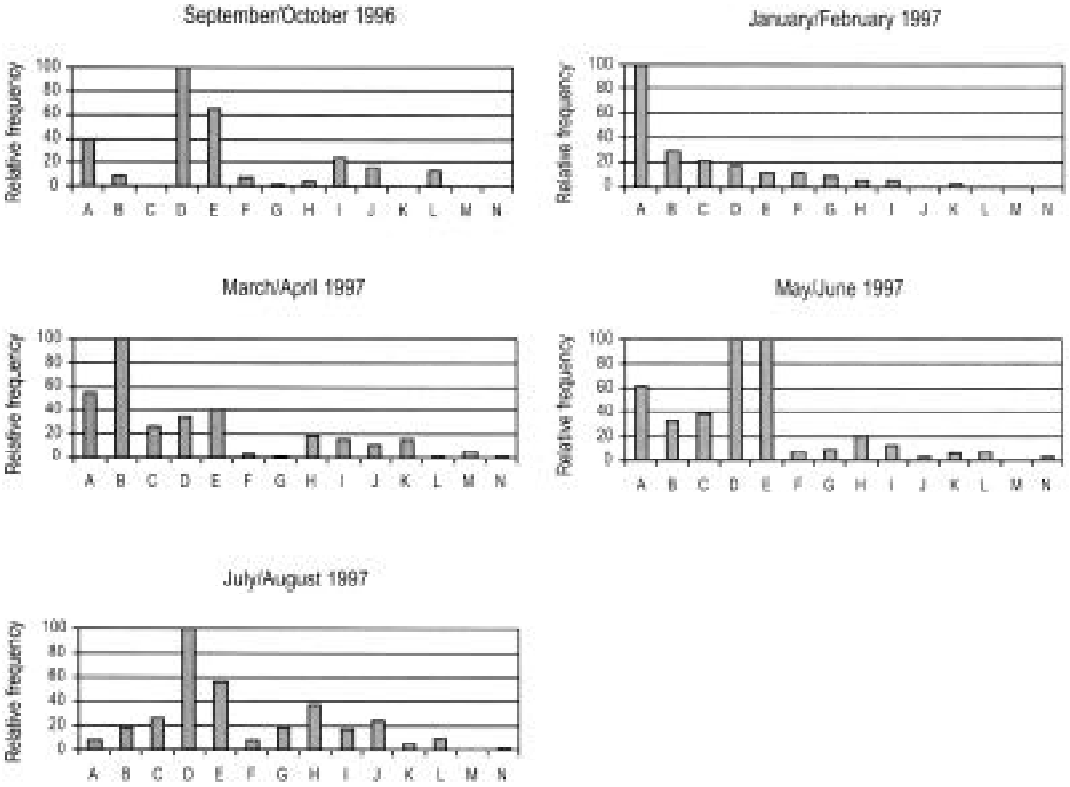
SOCIAL AND ENVIRONMENTAL IMPLICATIONS

Perhaps the most significant benefit is the prestige that the field computer gives to trackers who previously were held in low esteem. Co-authors Benadie and Minye report that using the field computer has given them an incentive to refine their skills and has made their work in the field more meaningful. For the first time they are being recognised for the work they do.

Creating employment opportunities for trackers in national parks provides economic benefits to local communities. In addition, illiterate trackers who have in the past been employed as unskilled labourers can gain recognition for their specialised expertise. The employment of trackers will also help to retain traditional skills, which may otherwise be lost in the near future.

The CyberTracker field computer system may have far-reaching implications for environmental

Figure 1. Trackers Karel Benadie and James Minye tracked the black rhino, *Diceros bicornis,* to record its feeding behaviour. September/October is the end of the dry season and January/February the beginning of the rainy season. From January through to August the feeding patterns shift as plants dry out and mainly succulent species are available. (A) Acacia karroo (B) *Sasola smithii* (C) *Rhigozum* obovatum (D) *Zygophyllum Iichtensteinianum* (E) *Lycium cinereum* (F) *Gre wia robusta (G) Garuleum bipinnatum* (H) *Hermannia desertorum* (I) *Delosperma* sp. (J) *Eberlanzia ferox* (K) *Pteronia adenocarpa* (L) *Lycium oxycarpum* (M) *Salsola calluna* (N) *Rhus lancea.*



monitoring. It not only enables trackers to communicate all their observations to scientists and conservation managers on a day-to-day basis, but will also store the information over time long after the trackers may have forgotten the specific details. It will therefore be possible to monitor long-term ecological trends in much more detail than before. Moreover, computer visualisation will make it possible to analyse vast quantities of data in a meaningful way.

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Web Site: www.cybertracker.co.za

Results of Four Years' Satellite Tracking of Elephants in Northern Cameroon

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INTRODUCTION

Movements and home ranges of two elephant cows have been monitored in the Waza Logone region in north Cameroon during 1994-1997 using satellite and VHF telemetry. The Waza Logone Project, financed by the Netherlands government and implemented in joint co-operation among the Cameroon government, the World Conservation Union (IUCN), Netherlands Development Organisation (SNV) and the Centre of Environmental Science, Leiden University in the Netherlands was initiated in 1990 with the main objective to assist the restoration of the natural floodplain functions in northern Cameroon. In 1994 the project initiated an artificial reflooding by opening a trench of 30 m width in one of the river embankments at Tekele, which resulted in a flooded area of approximately 300 km^2, restoring some 30% of the original natural flood-surface.

The present study aimed to monitor the migration and habitat use by elephants of the southern sub-population in Waza National Park after the artificial reflooding in 1994.

We hypothesised that:

1) improved food supply inside Waza National Park will result in a shift of dry season habitat use by elephants inside the Park;
2) improved food supply inside Waza National Park will induce a longer residence time and a decrease of south- bound migration.

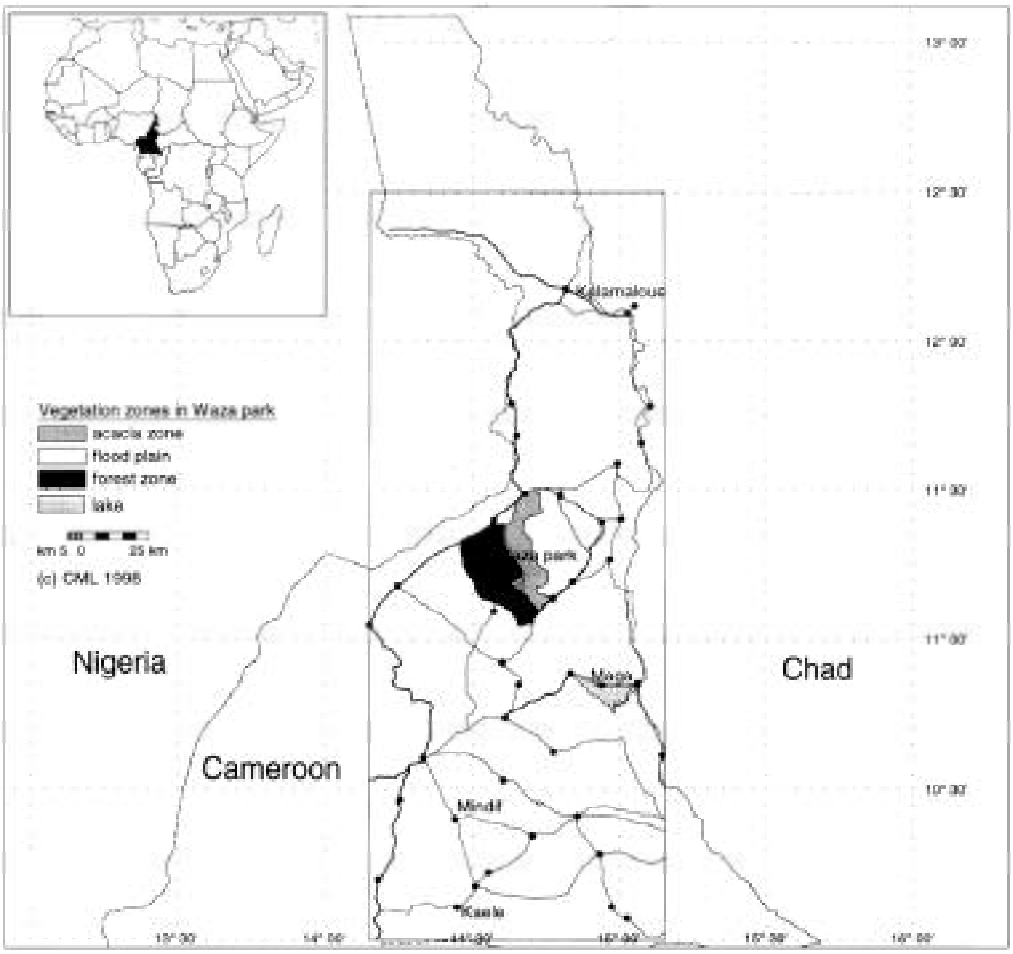
STUDY AREA

The present study was implemented in the extreme north of Cameroon, in the vicinity of Waza National Park and the Logone floodplain (Figure 1). In 1979 an irrigated rice scheme was developed by the Cameroon government with the construction of a dam at Maga. This dam created an artificial lake of at least 120 km^2, and severely impacted the natural floodplain system of the Chari-Logone river systems (4,600-6,000 km^2). Fisheries production and the vegetation cover of perennial grasses in the floodplain decreased and were replaced by annual grasses. Both livestock and wildlife from the nearby Waza National Park suffered from the degradation of the vegetation. Elephant migration to the south gradually increased after the construction of the dam, causing severe damage to agricultural crops around the town of Mindif, with a peak of 2,000 ha affected in 1994. The Waza National Park was devoid of elephants until 1947 when the first groups crossed the Logone river from Chad and travelled to Waza National Park. Since then the population has steadily increased to an estimated 1,100 in 1996, not only due to natural growth, but also to subsequent immigration from Chad and Nigeria. With an elephant density of one per square kilometre, the Waza National Park is likely not to sustain further elephant population growth.

ELEPHANT POPULATIONS

Three elephant sub-populations in Waza National Park have been described. The first sub-population resides in the northern part of the Park during the wet season and migrates to Kalamaloué National Park in the northern-most tip of Cameroon at the beginning of the dry season (January-February) and returns at the end of the dry season (May-June). The second sub-population resides year-round inside Waza National Park. The third sub-population used the central and southern part of the Park before 1994 and migrates to the south at the onset of the rains (June)

Figure 1. The study area in the extreme north of Cameroon.



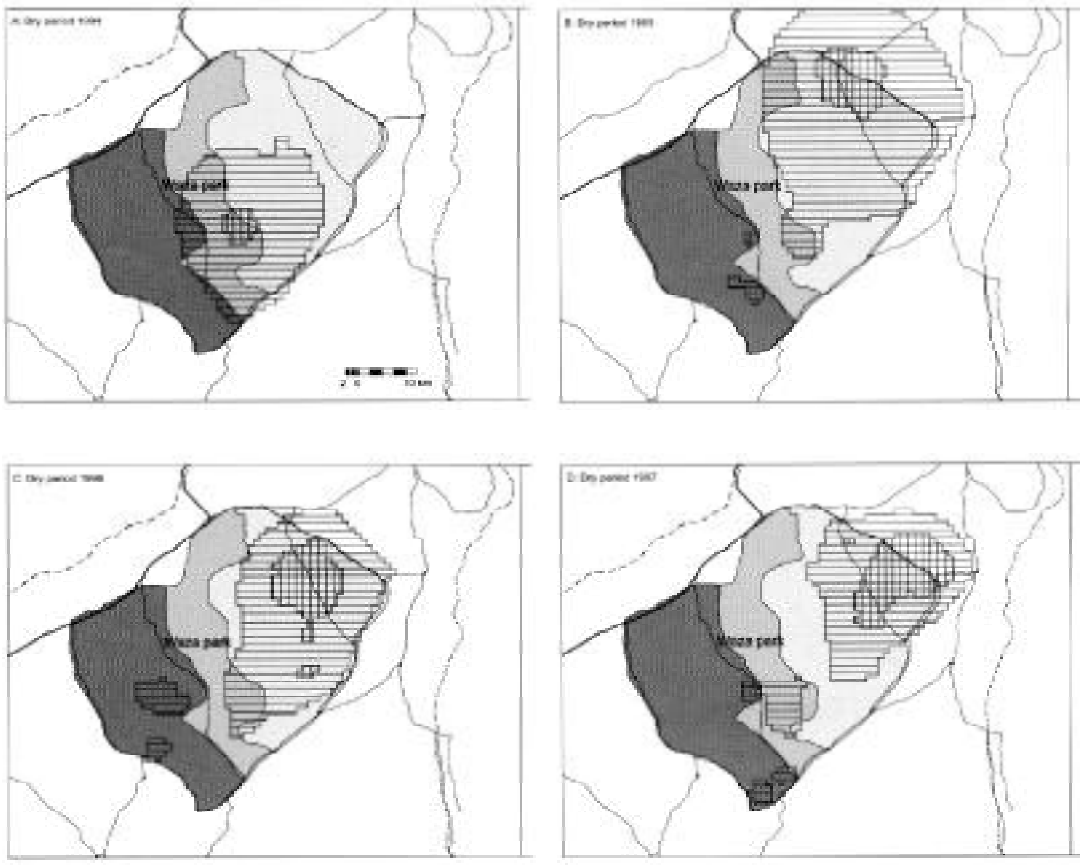
and returns in November-December. These elephants cause extensive damage to crops throughout the wet season in the Mindif area. The mechanisms of the different migrations north and south, and the difference in timing, are still not fully understood, but competition for food between the different sub-populations during the dry season may well play a role.

CHANGES IN HABITAT USE

The analysis of habitat use is based on the 24 hour cycle and 'harmonic mean analysis' of the guaranteed locations of two adult elephant cows of the southern sub-population, during a period of four years. Satellite data showed the movement and habitat use of these individual elephants, and field observations confirmed that the elephants belonged to a mixed family group of cows, sub-adult males and juveniles/babies of variable size (approximately 15-300), due to fission-fusion.

Habitat use and migration was followed before (1994) and after (1995-1997) the artificial reflooding of the plain (Figure 2a-d). The distribution of 'location-cycles' inside and outside the Waza National Park does not indicate a decrease after the reflooding of south-bound wet season migration routes to areas where the elephants cause serious damage to agricultural crops. The distribution of *location-cycles* over the distinct vegetation zones inside Waza National Park during the dry season indicates a pronounced change in habitat use from the *Acacia* zone to the flood-plain. This observa-

Figure 2. Harmonic *mean* of satellite locations representing 50-72.5% and 72.5%+ of respectively (from top to bottom); dry period 1994; dry period 1995;dry period 1996 and dry period 1997.



Vegetation zones in Waza park

acacia zone

flood plain

forest zone

Home range

50 % Harmonic Mean Area

95 % Harmonic Mean Area

(c) CML 1998

tion is supported by the distribution of home ranges, which also indicate a shift of dry season habitat use from the central and southern part of the Park to the northern part of the Park. These changes are attributed to the preferences of elephants for perennial floodplain grasses, which increased dramatically after reflooding, and the presence of water in natural depressions inside the floodplain after the artificial reflooding.

Dry season distribution inside Waza National Park shows a shift in habitat use after 1994. In 1994 most dry season cycles are inside the' *Acacia* zone, while in 1995-1997 most dry season cycles are inside the floodplain. In addition, the cycles reflect a consistent gradually increasing presence in the woodland zone at the end of the dry season. These differences are also reflected in the home range

coverage *(50%* and *95%* harmonic mean) of the different zones inside the Park during the dry season. The home range distribution confirms a shift in dry season home range from the south-central part of the Park to the north-eastern part of the Park.

Studies based on dung pile surveys and direct observations of elephants before the artificial reflooding in 1994, but after the construction of the dam (in 1980) showed that elephants of the resident and southern sub-populations in Waza National Park predominantly foraged inside *Acacia seyal* scrubland during the dry season. During the wet season, the elephants of the resident and northern sub-population dispersed more and the floodplain became the favoured elephant habitat, while the southern sub-population moved southward to the Mindif area. Studies before the construction of the dam indicate a more dominant dry season presence of elephants inside the floodplain, but these are based on limited observations.

In the years before the artificial reflooding in 1994 two artificial waterholes located inside the *Acacia* zone of the Park were the only depressions holding water at the end of the dry season, since the natural waterholes and depressions dried out completely. These two waterholes are probably an important explanation for the intensive use of this zone in the dry season, during the years before the start of the artificial reflooding. It is generally accepted that the availability and distribution of water is a major factor limiting the habitat use of elephants. During the wet season, when water is no limiting factor, elephants prefered the floodplain, due to their preference for perennial grasses. Such changes of diet by elephants are well documented.

The artificial reflooding transect studies of the floodplain vegetation in Waza National Park indicate a gradual but significant change from annual to perennial grasses during 1994-1997.

The increased availability of water in the floodplain has created the necessary condition for a shift in habitat use. The change of habitat use by the Waza elephants after the artificial reflooding has reducing feeding pressure in the *Acacia* zone.

However, the increased forage base in the Park has not resulted in decreased migration to the south, and human-elephant conflicts in the Mindif region are still on the minds of local farmers and authorities in the area.

Thus, although the artificial reflooding has contributed to an improved ecological management of the Waza National Park and its elephant populations, it has not resolved the conflicts between man and elephant. This problem is very complex and requires an approach with a multitude of integrated actions at national, provincial and local levels such as proper legislation, damage assessment, monitoring and damage-compensation-schemes, village extension and participation, physical barriers and disturbance shooting.

Monitoring Human-Elephant Conflict Through Remotely Located Stations

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HUMAN-ELEPHANT CONFLICT IN THE MASAI MARA ECOSYSTEM

The Masai Mara ecosystem is world famous for its rich wildlife resources. It consists of the 1,510 km^2 Masai Mara National Reserve and the sprawling 2,610 km^2 group-owned ranches. To the south is the Serengeti National Park in Tanzania. There are usually more animals outside the reserve than inside for most of the year.

However, trends in human activities within the last three decades are threatening the integrity of the ecosystem. The human population has risen drastically from 125,000 in 1969 to 210,000 in 1979 and to 420,000 in 1989. Increasing population pressure leads to habitat fragmentation, destruction of critical resources such as forests, migratory routes, swamps, etc.

To control human encroachment into the designated wildlife dispersal areas, a huge metal fence was erected in 1970 but farmlands were established on both sides of the fence even before it was completed. In 1975, the farms were approximately 52 km away from the Reserve boundary. This distance was reduced to 40 km by 1991 and to 17 km by 1996. Land sub-division was decreed in 1997 worsening the situation. Human-wildlife conflict has increased within the last ten years and has become a major challenge to elephant conservation. The need to monitor these conflicts is critical for both humans and elephants.

MONITORING ELEPHANTS THROUGH OUTPOSTS

Temporary stations, popularly called outposts, have been established to monitor and respond to the needs of elephants or people. These outposts are located in the areas outside the Reserve and are usually manned by a few rangers who are equipped with the necessary tools and maintain constant radio contact with the regional headquarters for logistical and administrative reasons.

The Mara ecosystem has about 16 such outposts. Some are temporary, established to respond to specific needs that may occur intermittently or seasonally within the ecosystem. Those in more susceptible areas are permanent and may be established in one place for a long period.

Reports of significant events within an area are covered by the respective outpost and are recorded in the occurrence books. Such information includes habitat encroachment, crop damage, livestock depredation, human deaths and injuries, poaching activities, animals killed on control, banditry, disease outbreaks, sightings of endangered species, and any form of wildlife-related illegal activities. Such information can be analysed for different aspects of elephant conservation.

SELECTED DATA MAINTAINED IN THE OUTPOSTS

The following summarizes some of the data collected during ten years (1987-96) in the outposts within the Mara ecosystem. The data provide useful information that can be used to assess the need for conservation action. Though perhaps not living up to scientific standards, this information can be used for conservation decisions because it authentically expresses the practical management issues on the ground.

The data in Table 1 show the number of people killed or injured by wildlife as reported by the outposts. The problem persisted throughout the ten-year period, indicating the need to reassess the conflict management strategies being undertaken. It also shows that elephants were responsible for nearly a quarter of all deaths reported. This figure

Table 1. Number of people killed by wildlife in Masai Mara between 1987 and 1996.

	Year					
Killed by	87/88	89/90	91/92	93/94	95/96	Total
Elephant	2	9	17	19	13	60
Predators	31	15	12	22	20	100
Herbivores	17	14	19	34	7	91
Total	**50**	**38**	**48**	**75**	**40**	**251**

Table 2. Number of animals killed by people under conflict-related circumstances in Masai Mara between 1987 and 1996.

	Year					
	87/88	89/90	91/92	93/94	95/96	Total
Elephant	5	11	17	37	18	88
Predator	22	13	6	18	22	81
Herbivores	629	614	811	457	360	2871
Primates	208	182	121	146	81	738
Total	**845**	**820**	**955**	**628**	**481**	**3778**

is high considering that over 30 species were recorded to have caused death or injury to humans.

The number of elephants killed by people under conflict-related situations (Table 2) are few compared to those of other animals, particularly considering that they kill more people than any other species. Only about two per cent of the animals killed were elephants. However, one has to take into account that incidents involving elephants are more likely to be reported than those involving other animals. The percentage could be expected to be even lower had all conflict reports involving other animals been reported with the same fury and determination as those involving elephants.

Reports show that a pride of lions may kill one or two cows in a herd of 200. The impact of this depredation to the owner is much lower compared to that caused by a herd of elephants invading farmland and destroying the season's crop. According to the records in the outposts, control methods by local people are very limited when dealing with elephants, unlike with other species. Traditional Masai lifestyle does not provide for elephant management measures, as the two coexist peacefully. Conflict is usually minimised by temporal and spatial partitioning of vital resources such as foraging and watering areas. With land increasingly moving from traditional jurisdictions to modem settlements and crop farming, conflict has intensified, while the methods to minimise them have not changed significantly.

RELIABILITY OF OUTPOST DATA

Table 3 shows the number of compensation claims for human deaths and injuries for the period reported. Comparing Table 1 and 3 is like overlaying one table on the another. Compensation was sought for 251 out of the 252 deserving cases.

Reading through the records, it becomes clear that one of the greatest frustrations of the rangers who manage the outposts is that they have to keep appeasing families of the victims of wildlife attacks, even without any hope that the compensation claims will ever be paid. The process of processing claims is painfully slow, and when completed, it usually takes several years before payments are made. By

Table 3. Number of compensation claims for human deaths and injuries in Masai Mara between 1987 and 1996.

	Year					
	87/88	89/90	91/92	93/94	95/96	Total
Elephant	2	9	17	19	13	60
Predators	31	16	12	23	20	102
Herbivores	18	14	19	33	6	90
Total	**51**	**39**	**48**	**75**	**39**	**252**

this time, the victim has made several trips to the city and spent more than half the worth of the claim. Five hundred dollars is the highest value tagged on a person killed by wildlife. No other compensation is paid.

CONCLUSION

Considering the importance of the Masai Mara ecosystem in conserving wildlife, the data show that there is need to reduce the number of animals killed by people and people killed by animals. This calls for a more sustainable conflict management strategy.

Outposts exist in all parts of the country where wildlife faces substantial threat. A wealth of information exists that has not been analysed. This data can be used to establish the general wildlife trends in the country, particularly in areas where scientific data is unavailable. It can also be used to determine localised conservation priorities.

Human Activities on Mount Kenya from an Elephant's Perspective

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INTRODUCTION

The Mt Kenya Forest Reserve covers approximately 200,000 hectares. Climate and vegetation occur in distinct altitude-related ecological belts due to the mountain's wide range in altitude (1,200-5,200 m, Figure 1). Mt Kenya has far reaching national importance as the water catchment area for two main rivers in the country, the Tana and Ewaso Ngiro rivers. Situated on the equator, it also represents a model tropical mountain system of high biodiversity (MKEP, unpubl.). The flora and vegetation of Mt Kenya have been studied since 1885. In the latest study undertaken between February 1992 and August 1994 some 882 plant species, subspecies and varieties belonging to 479 genera in 146 families were identified (Bussmann, 1995). With the exception of an elephant density estimate conducted by Reuling in 1992 (Reuling et al., unpubl.), no specific studies on the elephants of Mt Kenya have been undertaken.

In order to broaden the knowledge on elephants of Mt Kenya, a ground study on "Daily activities, habitat use and movement of elephants on Mt Kenya, Kenya" is currently being undertaken by one of the author's (Hilde Vanleeuwe). In the study, recording is made of human and elephant presence in the mountain forests.

As a response to public outcry on the destruction of Kenya's indigenous forests, an aerial survey of the destruction of Mt Kenya, Imenti and Ngare Ndare Forest Reserves was conducted from February to June 1999 at the request of Kenya Wildlife Service by Bongo Woodley and Christian Lambrechts. The aerial survey was to assess and document the extent and nature of destructive activities on Mt Kenya forests.

Based on the preliminary findings of the ongoing ground study on elephants of Mt Kenya and the data from the aerial survey of Mt Kenya forests, this note will discuss the major constraints to the use of the Mt Kenya forest area by elephants, in particular topographic features and human presence.

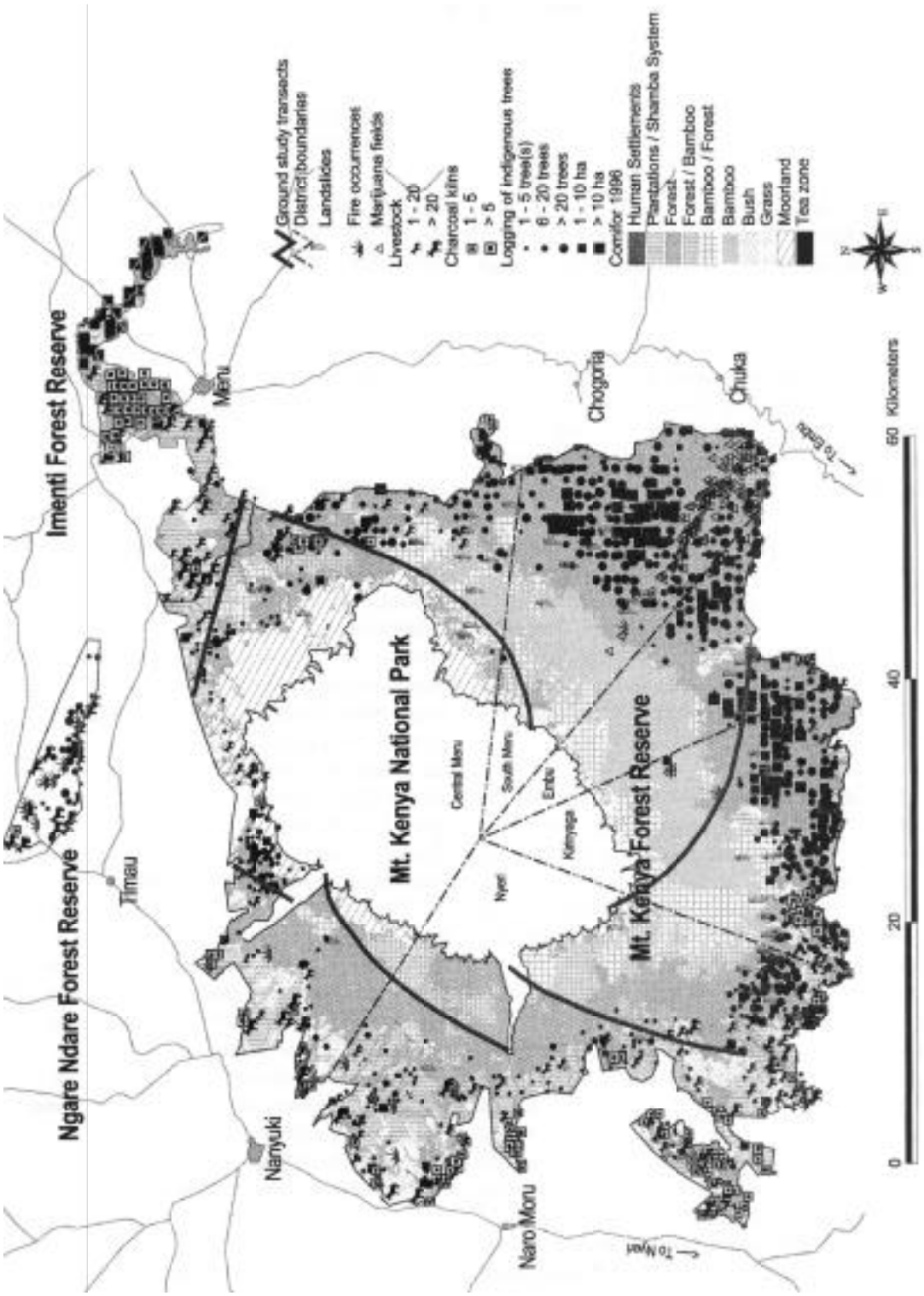
METHODS

The area for the ground study on daily activities, habitat use and movement of elephants on Mt Kenya, comprises Mt Kenya and Imenti Forest Reserves and is divided into four area blocks. For each block, one or two line-transects are walked every season. The transects are positioned to dissect all altitude clines and forest types, and their total length amounts to 263 km (see Figure 1). Along the transects, poaching evidence, logging evidence, elephant paths and dung, and direct observations of mammals are recorded. Poaching evidence includes snares, traps, pitfalls, poaching camps and carcasses of killed animals, whilst logging evidence includes logged trees, logged forest areas and logging camps. For each observation, the extent, the position alongside the transect, the surrounding vegetation type, as well as the distance from the transect are recorded. Position and distance are calculated using the Global Positioning System (GPS) and topofil.

The dung count method of Barnes (1996) and the computer program "Elephant" designed by Dekker and Dawson for dung count data analysis, were used to obtain a preliminary estimate of the elephant population of Mt Kenya.

For the aerial survey, Mt Kenya, Imenti and Ndare Ngare forests were divided into nine blocks. Aerial line transects were flown at 500 m and 1 km intervals depending upon the extent and occurrence of disturbances

Figure 1. Major threats to Mt Kenya forests.



in the surveyed area. Photographs were taken and GPS positions were recorded for each damage or threat observed, including logging of indigenous trees, charcoal production, marijuana *(Cannabis sativa)* fields and livestock grazing. Results were incorporated into a Geographical Information System using the ArcView v.3.0 software.

PRELIMINARY RESULTS AND DISCUSSION

Over time, expansion of human settlements, small scale farm holdings and tree plantations on the lower slopes of Mt Kenya have restricted elephant migration from the mountain. Elephants still migrate to the adjacent Imenti forest in the northeast, although they have to cross a rapidly growing stretch of agricultural land to get there. As such the elephants of Mt Kenya are mainly resident.

Under the non-residential cultivation scheme (known also as the shamba-system), small farmers are allowed to plant annual agricultural crops intertwined with trees within the Forest Reserve as a way to establish forest plantations. The scheme calls for the agricultural crops to be phased out by the third or fourth year of tree growth when the young trees would out-shadow the normal growth of the crops. However, the failure and abuse of the scheme has led to continued presence of small farm holdings in the areas of the Forest Reserve allocated for forest plantations. Some 7,000 ha on the western slopes of Mt Kenya and between Mt Kenya and Imenti Forest Reserves are today covered with solely annual agricultural crops, leading to a substantial reduction of the area under tree cover.

The total area of Mt Kenya forests under tree cover should be large enough to sustain its elephants estimated at approximately 1,000 in 1992 (Reuling et al., unpubl.). However, not all that forest is used by elephants, for two main reasons:

1) We found that elephants avoid steep slopes (Figure 2). Natural barriers, such as the Sirimon, Kathita, Sagana, and Nithi rivers, force elephants to move to lower altitudes where geographical features are less pronounced, in order to cross those barriers and move around the mountain. This often results in conflict with farmers.
2) Elephants tend to avoid areas with intense human presence, such as logging sites. Today, most of the broad-leaved mixed forests of Mt Kenya are affected by logging (see Figure 1). Loggers claim that their activities are legal although no approved licences permitting logging of indigenous trees exist for the Mt Kenya forests (Kinyanjui, pers. comm., 1999).

Results of human and elephant activities were calculated as a percentage of the total number of observations per forest type, and proportional to the transect lengths walked in each forest type. Figure 3 shows that the highest presence of elephants is found in *bamboo/ Podocarpus* forests (28.6%), in open spaces, such as forest clearings (26.9%) and in bushland (20.1%). Least evidence of elephants is found in the moorlands (3.3%). Evidence for poaching activities is most intense in forest plantations located within the boundaries of the

Figure 2. Slope angle and accurrence of elephant paths on Mt Kenya, March - May 1999.

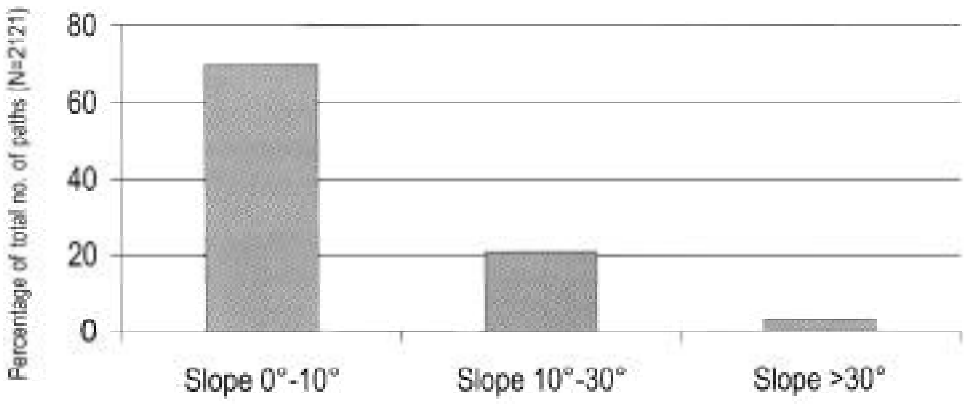
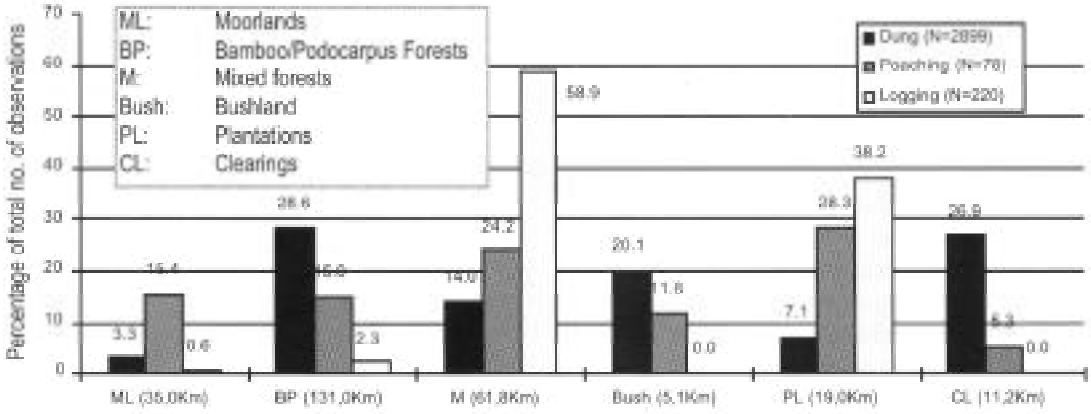


Figure 3. Human and elephant activity per forest type, Mt Kenya, December 1998 - May 1999.



Forest Reserve (28.3%) and in mixed forest (24.2%). Most evidence of logging was found in the same forest types as poaching, i.e. mixed forests (58.9% and plantations (34.2%), suggesting that the two illegal practices may go hand in hand. Due to the difficulties to access areas deep into the forest, loggers build logging houses where they can stay for several days. Snares and other traps are often found at those logging sites. Where logging and suspected poaching activities are intense, elephants are less active. The effect of logging on habitat use by elephants and other mammals may be important, in particular in daytime, because of the physical presence of humans and the of chain saws associated with logging, unlike poaching where evidence consists mainly of snares and traps.

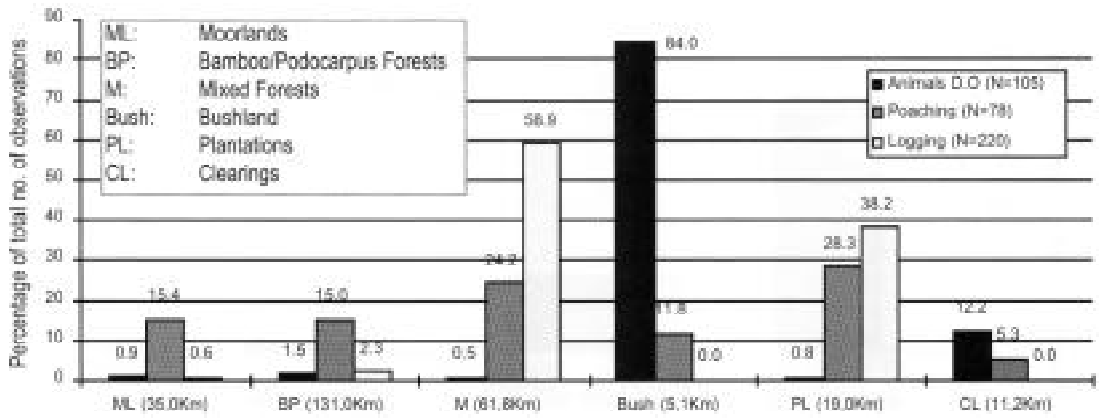
This statement is supported by the low percentage of direct observations of mammals in forest types where logging and poaching are most intense, namely mixed forest and plantations (Figure 4). Mammals observed include buffaloes, waterbuck, bushbuck, elephants, monkeys, one hyena, one group of zebra, and two hyrax.

Figure 4 shows that hardly any animals were directly observed in mixed forests and plantations where logging and poaching are most intense.

From the above preliminary findings, it seems that human presence and the noise of chain saws may prevent animals in general from using an important part of the total forest area. This may have serious implications, especially on Mt Kenya, where almost the entire broad-leaved mixed forest area is affected by logging. Being sealed by agriculture, migration from the mountain has also become almost impossible.

Currently, the impact on vegetation by wildlife

Figure 4. Direct observations of human and mammal presence on Mt Kenya, December 1998 - May 1999.



is negligible compared to human impact. However, it is not certain that the mountain forest can sustain the needs of its wildlife in the long term, especially if they are to avoid an important part of the forest area, either due to extreme geographical features or due to the presence of loggers.

As this study continues more evidence will become available on seasonal habitat use and movement of elephants, and illegal human practices on Mt Kenya.

ACKNOWLEDGEMENTS

We would like to thank the Kenya government for granting permission to conduct research on Mt Kenya. Special thanks go to the Kenya Wildlife Service (KWS) who are providing project finances, Dr Richard Leakey, Paula Kahumbu, Dr lain Douglas-Hamilton, and Bongo Woodley. We would like to thank in particular Dr A. GautierHion, Mr. Bitok Elfes, Daniel Mouange, William Thanui, James Muriuki and Paul Miano for their assistance in the field.

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The Need for Cross-border Monitoring of the Mara Rhinos

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In the last issue of *Pachyderm* we reported an apparent decline in the Masai Mara black rhino population. However, recent observations of an unknown female with a very young calf suggest that more rhinos than are regularly recorded are surviving, either within or adjacent to Masai Mara National Reserve (MMNR). During August 1999 the female was sighted by the MMNR Rhino Surveillance Unit and several times by balloon pilots in an area close to the southern border of MMNR. It is suspected that the female may be an eight-year old which was last seen as a sub-adult in the same area in April 1997, and which *may* have crossed into the northern Serengeti in the intervening years. However, close observation to affect a positive identification has not yet been possible.

This sighting is significant for the MMNR population in two ways. Firstly, this is the first newborn calf to be recorded in MMNR since 1997, when four calves were born to resident females. Secondly, the possible re-appearance of a "dispersed" female rhino suggests that individuals may be surviving to reproductive age outside MMNR.

There has been increasing concern over declining numbers of observed individuals within MMNR in recent years, and it has been suspected that many individuals were crossing into northern Tanzania and areas east of MMNR and failing to return (although there may be explanations other than dispersal for the apparent decline in MMNR rhinos, see *Pachyderm* 26, p.123). Without an equivalent monitoring program across the border in Tanzania, the MMNR Rhino Surveillance Unit has been unable to confirm the location or continued existence of many individuals suspected to have moved south out of MMNR.

This recent sighting is an encouraging sign that the apparent decline in the Mara rhino population may not be as severe as current monitoring records suggest. It also clearly emphasises the need for coordinated surveillance efforts across protected area and international borders, in order to address the issue of suspected 'dispersal' from MMNR, and to identify the true range and size of a population that may not remain conveniently within protected areas or national boundaries.

Note sur 1'Atelier d'Elaboration de la Stratégie de Gestion des E1éphants en Afrique de l'Ouest. Abidjan, 22 - 26 Février 1999

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L'idée de mettre en place une stratégie pour la gestion des é1éphants en Afrique de 1'Ouest est née de la dernière réunion du Groupe de Spécialistes de 1'E1éphant d'Afrique (GSEAf), tenue du 26 au 31 Janvier 1998 à Ouagadougou au Burkina Faso. Lors de cette rencontre, les membres du Groupe, notamment les représentants de l'Afrique de 1'Ouest, ont préconisé la mise en place d'une telle stratégie en vue de promouvoir une gestion durable des é1éphants dans cette région de l'Afrique. Cette proposition se justifie aussi bien au regard de la spécificité des populations d'éléphants et de leurs habitats que de la fragilité des écosystèmes de la sous-région. L'idée a été favorablement accueillie par la présidente du GSEAf qui, après la réunion, a initié le processus de développement de la stratégie dont la première ètape fut la programmation d'un atelier à ce sujet.

Après plusieurs mois de préparation, 1'atelier d'élaboration de la stratègie de gestion des é1éphants en Afrique de 1'Ouest s'est tenu du 22 au 26 Fèvrier 1999 à l'hôtel IBIS d'Abidjan en Côte d'Ivoire. Cette rencontre a été organisée par le GSEAf avec le support financier du WWF (Fonds mondial pour la nature). L'UICN (Union mondiale pour La nature) a offert une assistance technique essentielle pour Le succès de cette rencontre.

Au total, 21 personnes ont pris part aux travaux. Ce fut une équipe restreinte, mais efficace et productive au regard des résultats enregistrés. Les participants étaient des experts identifiés dans les Etats de l'aire de répartition de l'é1éphant en Afrique de l'Ouest. Certains sont membres du GSEAf, et d'autres des personnes-ressources bénéficiant d'une relativement longue expérience en matière de gestion des é1éphants.

Le cadre et l'ambiance dans lesquels se sont déroulés les travaux ont sans conteste influencé la qualité des discussions qui ont permis d'atteindre en cinq jours des résultats fort appréciables. La stratégie a été élaborée en adoptant la procédure du cadre logique; à ce niveau, il convient de souligner le soutien qu'ont su apporter Dr Holly Dublin, Présidente du GSEAf et Ibrahim Thiaw, Représentant régional de l'UICN pour I'Afrique de l'Ouest. Ils ont su jouer leur rôle de facilitateur en mettant à profit leur expérience professionnelle de la conduite de travaux. La représentation du WWF en Côte d'Ivoire a également apporté un soutien considérable dans 1'organisation de la réunion en mettant à disposition toute la logistique requise et des interprètes expérimentés pour la traduction simultanée. La résultante de tous ces apports a permis de définir au bout des cinq jours les composantes essentielles du document de stratégie.

Sans vouloir trop tendre vers l'autosatisfaction, il faut avouer qu'en Afrique de 1'Ouest très peu de rencontres du genre ont connu le succès enregistré. Celui-ci est sans doute lié à la participation active de tous les participants, mais aussi àl'intérêt manifeste que le sujet a suscité aux yeux de toutes les parties prenantes. On ne louera jamais assez l'esprit de réalisme et la qualité des approches qui ont été développées tout au long des travaux de 1'atelier sur la stratégie de gestion des é1éphants d'Afrique de l'Ouest.

REVIEW AND OPINION

Entrepots for Rhino Horn in Khartoum and Cairo Threaten Garamba's White Rhino Population

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THE DECLINE IN RHINOS IN EASTERN AND CENTRAL AFRICA

Traders in Omdurman and Khartoum in Sudan have been buying and selling rhino horns for decades and continue to do so. From the 1960s until the early 1980s most of the horns came from the thousands of rhinos killed in southern Sudan, eastern Africa, the Central African Republic (CAR) and in and around Garamba National Park in Zaire (renamed the Democratic Republic of Congo, DRC in mid-1998). In Omdurman in Sudan, some of the horns were crafted into items such as boxes, cups, walking stick handles and rings (Ian Parker, pers. comm., 1997) and sold to Sudanese people. The majority of the horns, however, were exported from Khartoum and Port Sudan to Yemen for the making of traditional dagger *(jambiya)* handles (Martin et al., 1997).

By 1985, both black *(Diceros bicornis)* and white *(Ceratotherium simum)* rhinos had been probably eliminated from the CAR, Somalia and Uganda and numbers were low in Kenya, Tanzania, Ethiopia, Zaire, Chad and Sudan. As a result, significantly less rhino horn was available for the workshops in Omdurman or was being exported from Sudan to Yemen from the mid-1980s.

From 1985 to the mid-1990s, even less new horn was reaching northern Sudan due to further declines in rhino numbers. Also, in Garamba, the poaching of northern white rhinos *(Ceratotherium simum cottoni)* had been stopped, and in Kenya there was very little rhino poaching. A few black rhinos were illegally killed in Tanzania's Ngorongoro Crater and perhaps in the Selous Game Reserve. Traders probably sent the horns directly from East Africa to Yemen where they could receive a higher price than via Sudan. A few horns could have been taken from rhinos which had died of natural causes in Kenya and Tanzania. Other horns were stolen from government stockpiles in eastern Africa or from private displays or collections. Some of these may have reached northern Sudan, and perhaps also Egypt, for sale. Figure 1 shows protected areas and markets in the region.

Recent poaching of Garamba's rhinos

In the 1970s and early 1980s the heaviest commercial poaching of rhinos in Garamba (DRC) and elsewhere in eastern and central Africa occurred (see Figure 2). In 1984 several international conservation organizations established the Garamba Project to rehabilitate Garamba National Park and to conserve the northern white rhino. Until 1991 Park staff greatly reduced poaching in general; only a small number of animals were killed for their meat in the north of the Park. This concentrated the elephants and rhinos in the better-protected southern sector, close to the headquarters at Nagero. In 1991 the civil war in adjacent Sudan moved to the south of that country. The Sudanese Peoples' Liberation Army (SPLA) took the town of Maridi in April 1991 and government forces and families fled across the border into Zaire, bringing several hundred weapons with them. The Park staff recovered over 600 weapons from people who

Figure 1. Map of protected areas and markets mentioned in the text.

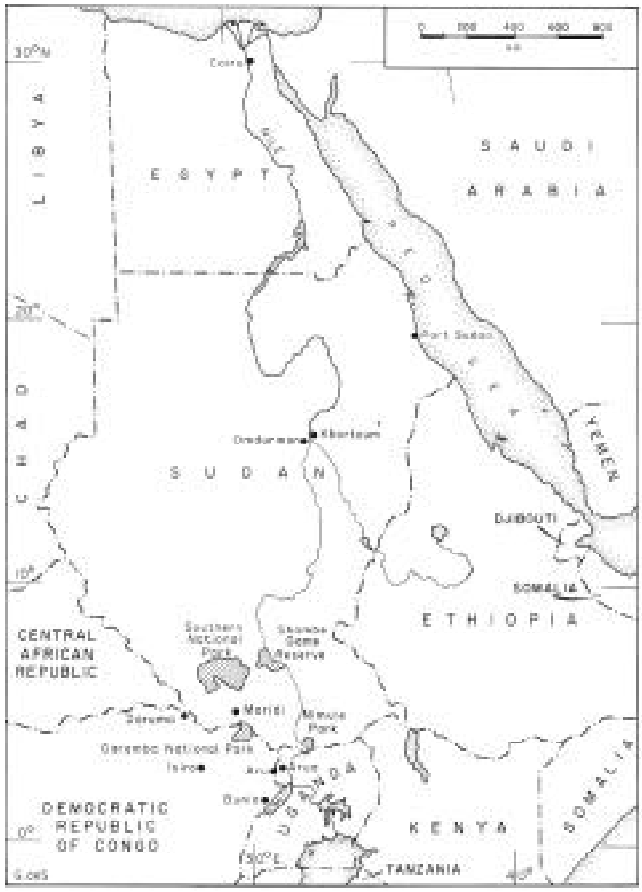
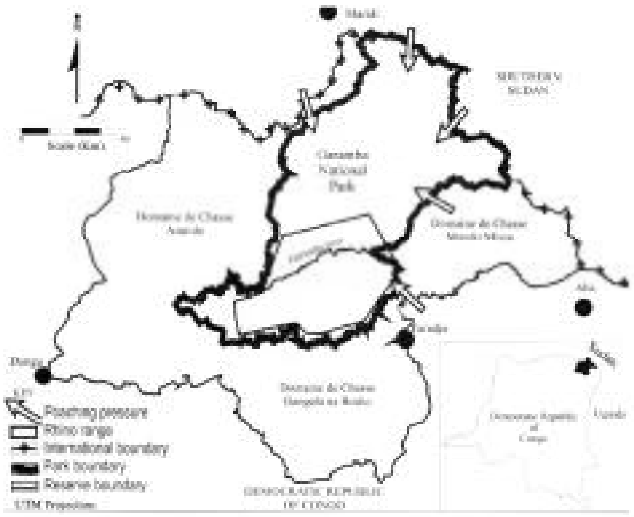


Figure 2. Directions of main poaching pressure.



passed through Garamba (which is on the Sudanese border), but some weapons remained in the area and ammunition was readily available from across the border in Sudan. Between 1991 and 1998, some 80,000 Sudanese refugees were settled in areas bordering the Domaines de Chasse (hunting blocks) that surround the Park. Sudanese, carrying their weapons, moved across the border into Garamba relatively unconstrained. Zairian/Congolese military units who were stationed in the area also increased the number of arms. During this time civil unrest and economic decline in Zaire worsened which further de-stabilised the area.

After 1991, the killing of large mammals increased as there were more people armed with automatic weapons and more ammunition. Poaching gangs increased in size, and since 1994, the gangs also used hand grenades against guards. Results of the monitoring of law enforcement show that in 1995, 1996 and 1997, 71%, 77% and 8l% respectively of the poaching gangs were Sudanese. The principal reason for poaching was for meat from the large mammals, especially buffaloes, which is smoked and sold. The front line of this poaching progressively moved south through the Park as animals were virtually eliminated in the north. This movement towards and into the southern sector of Garamba led to increased opportunities for shooting elephants and rhinos. Elephant poaching continued to be for meat as well as ivory, except for a brief period in early 1996, when nearby Zairian military personnel carried out elephant poaching for ivory alone until stopped by diplomatic pressure in March of that year. In January 1996 Park guards recovered 41 fresh tusks from a Zairian military gang in the south of the Park.

The first known confirmed rhino killing since 1984, the start of the Garamba project, was in February 1996. He was a prime adult male, M5 "Bawesi". Meat as well as horn was taken from him. On 23

March 1996 a young, pregnant female, 3aF "Juillet" ran into poachers and was killed. They only had time to take the horn before escaping from an anti-poaching unit. Not long afterwards, a report was received of rhino horn offered for sale in Maridi.

The Liberation War, from October 1996 to April 1997, which removed President Mobutu's regime, most affected Garamba from February 1997 onwards. In February, the Park guards were disarmed for re-training and 90% of the Park's equipment was looted. Anti-poaching coverage, measured in patrol days, was reduced between February and June 1997 to 14% of that during the same period in the preceding year. Poachers took advantage of the situation and moved south to and beyond the Garamba river. Most of the hippos in the river were massacred by automatic fire, even though it was impractical to take the meat from all of them. A few hippo teeth were taken for their ivory (G. Panziama, a Guard inspector in Garamba, pers. comm., 1997). Data from aerial surveys of the Park made in 1995 and 1998 by the Garamba Monitoring Unit showed declines of elephants from 11,175±3,679 to 5,487+1,339, buffaloes from 25,242+8,299 to 7,772+2,063 and hippos from 3,601±1,294 to 786+207. These were losses of roughly a half, two-thirds and three-quarters of the populations (Hillman Smith et al., unpubl.).

Two rhinos were confirmed killed during and following the Liberation War. In March 1997 a young adult male, la/4aM "Channel 2" was killed and his horns were taken. Two guards were accused and arrested. In November 1997, when Park guards attacked a Sudanese poachers' camp, they found the posterior horn of the adult female, F4 "Boletina". The anterior horn was not recovered and was probably taken by the poachers. A further three sub-adult rhinos may have been lost during the war, but four rhinos were born, taking the population from a minimum of 27 in December 1996 to a minimum of 26 in May 1998. It is thanks to the diligence of the Park guards and continued support from international donors that rhino losses were not more. During the current war, which started in August 1998, anti-poaching efforts are continuing, but one rhino was killed in late 1998. However, the period under examination in this paper ends in late 1997 with the northern Sudan rhino horn survey.

Besides the four previously mentioned poached rhinos and the three lost sub-adults, three adult rhinos disappeared during the 1990s and could potentially have been the source of horns on the market. One adult and one sub-adult were found dead of natural causes in 1993 and 1995 and their four horns were put in the ivory store at the Park headquarters. These rhino horns were temporarily hidden with other valuables in the west of the Park when the senior staff had to evacuate the headquar-

Photo credit: Esmond Martin

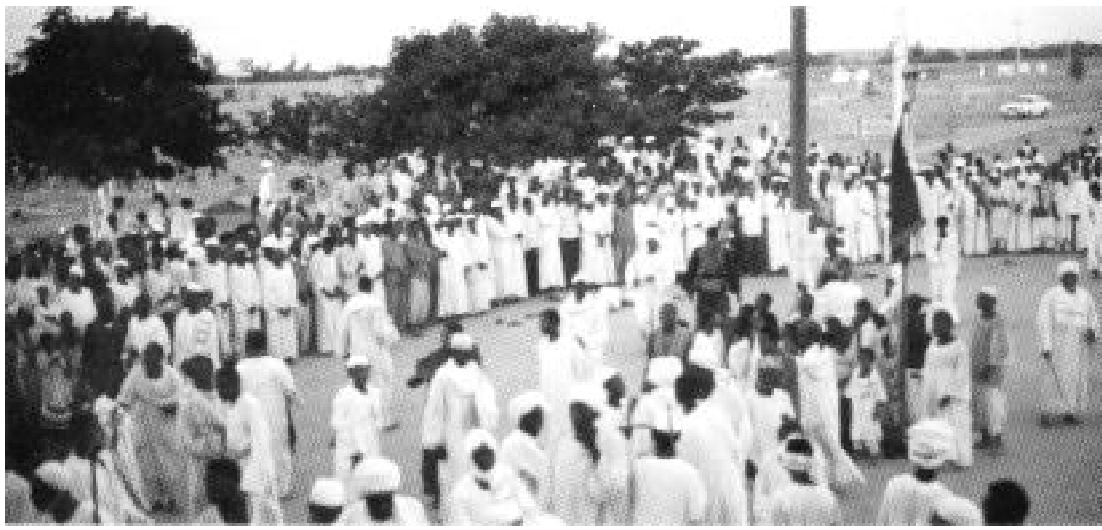


Photo 1. Muslim Sudanese live in the traditional town of Omdurman, a town well known for its wildlife traders and craftsmen.

ters in February 1997 because of the war. A little later, when the horns were returned to Nagero, an occupying army officer requisitioned one of the horns. The other three rhino horns and most of the ivory remained untouched. In October 1997 the three horns were moved to the central store of the Institut Congolais pour la Conservation de Ia Nature, ICCN (the wildlife department), in Kinshasa. In November 1997 the posterior horn of F4 "Boletina", recovered from the poaching camp, was put into Garamba's ivory store at Nagero.

RHINO HORN TRADE SURVEY IN KHARTOUM AND OMDURMAN

In November 1997 one of the authors (Esmond Martin) carried out the first survey of souvenir stores and workshops for rhino horn and ivory in the Omdurman-Khartoum area of northern Sudan (Martin, 1998) and was offered for sale five rhino horns (three of which we saw). This section of the paper reports the results of the survey and examines available information to attempt to answer questions as to where the horns came from, what were the trade routes, and which rhino species were they from.

Rhino horns for sale

The first horn seen was from a white rhino (Table 1). According to the Omdurman broker who brought it to be seen at a souvenir shop in Khartoum, it had been obtained about a year earlier from Nimule town in southern Sudan. (The nearby Nimule National Park has had no rhinos since about 1972). This horn was in very good condition as, according to the broker, it had been taken from the animal while still just alive. Another Sudanese wildlife trader also had said that a horn from a still living rhino was more valuable, claiming that when a rhino is agitated, more blood rises to its head and horn, adding some red colouring to the horn. When the rhino is dead, however, the horn goes blacker, reducing its value in Sudan. The broker claimed he had never tried to sell a rhino horn before. The souvenir shop owner was very nervous that someone might see it, as the sale of rhino horn has been illegal for many years in Sudan.

The second horn was seen in a prominent souvenir shop in Omdurman. The horn was very dry and probably old and could have been either from a black or white rhino (see Table 1). The broker who brought the horn to the shop said it was eight years old. A European visitor then entered the shop and saw the horn on the counter and strongly criticized the shopkeeper, yet the shopkeeper was unperturbed and eventually put the horn in his safe to reduce attention to the incident.

As the shopkeeper spread the word that a western foreigner was interested in rhino horns, the next morning an army officer, acting as a broker, appeared in the shop saying he too could bring a horn, but due to security reasons only at noon. He returned on schedule with a white rhino horn (see Table 1). There were tiny holes at the top and bottom and on the base probably made by horn borers. The horn had probably been found in the bush. Unlike the other two horns, the broker for this one refused photographs to be taken of it in case the authorities found out. The shopkeeper said that most buyers of the rhino horns brought to his shop were South Koreans and Chinese. Later in the day in the same shop, another broker offered to bring the next day two horns weighing 4.5 kilos in total. Apparently, one had been obtained eight months ago and the other a year ago. The shop owner said afterwards that this broker and the army officer were offering their horns on behalf of the same owner.

Besides these three horns seen in 1997, another westerner interested in wildlife conservation and a collector of Sudanese artefacts was shown earlier in 1997 two other rhino horns for sale. One of them was weighed: it was 450 grams. Neither species could be identified.

Prices for rhino horn

The asking price for the 450-gram horn seen in early 1997 was $ 1,960 per kilo. The prices quoted for the three horns seen in late 1997 (Table 1), and the two others offered but not seen, may imply some collusion among the traders at that time as their original prices were the same. Only the first broker was willing to reduce his price slightly. This broker wrongly stated that its price in Yemen was $5,000 a kilo, when in fact it is about $1,200 a kilo. The two other horns that were not seen were, as expected by this stage,

$3,500 a kilo. All horns immediately on receipt so they need to sell them fairly quickly to re-coup their costs. The main poaching gang leader also has to pay off his men, and other relevant expenses, so he too wants his money as soon as possible. Neither is there evidence of businessmen in tropical Africa speculating on a price increase for rhino horn by holding back significant quantities from the market. This has been fortunate for traders since the mid-1980s as the import price for rhino horn in Yemen prices were given in US dollars, never Sudanese pounds nor

Photo credit: Esmond Martin

Photo 2. This rhino horn, weighing 0.23kg, was for sale in late 1997 in Omdurman, the village where most of Sudan's ivory carvers work.

Sudanese dinars. There are several reasons why the price was so high. First, the prospective buyer was a westerner. Second, all negotiations were conducted by a broker visiting a shop who had to give a commission to the shopkeeper and take a percentage for himself before giving the rest to the owner. Third, the brokers were not familiar with the Yemeni and eastern Asian markets. The price for an excellent condition and very large horn in Yemen might reach $1,400 a kilo. Prices in South Korea and China may be slightly higher than in Yemen, but not over $2,500 a kilo. Thus, it seems that the Sudanese brokers had been over-pricing the horns and therefore had not sold them after several months.

African traders try to sell rhino horns quickly. There has been no tradition in tropical Africa for businessmen to stockpile rhino horns. The merchants have

TABLE 1. Prices for rhino horn in Khartoum and Omdurman in November1997.

Hom type in order seen	Weight	Price per kilo
White rhino	**3.25** kg	$3,200
Black/white rhino?	0.23 kg	$3,500
White rhino	2.54 kg	$3,500

Photo credit: Esmond Martin

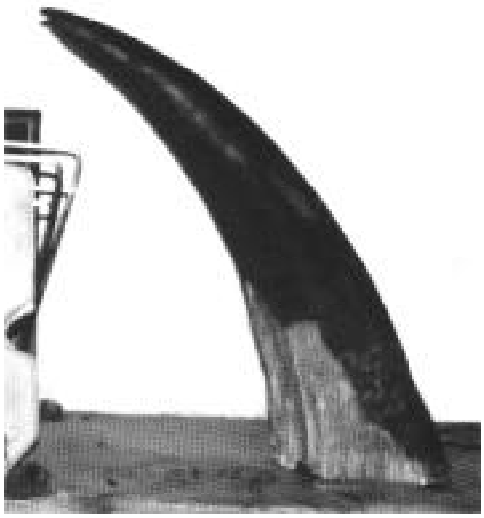


Photo 3. This white rhino horn, recognisable from black rhino horn by its more rectangular-shaped base, was offered for sale in Khartoum in late 1997.

to pay a poacher or his agent for the price has remained the same in US dollars since 1985 and in eastern Asia the price peaked in 1990 and actually fell in the early 1990s. Thus, a Sudanese businessman speculating on the price of rhino horn in Yemen from 1985 to the present would have lost in hard currency by delaying his sale. He needed to sell the horn as quickly as possible to maximize his financial returns.

Rhino horn by-products for sale

Besides the three raw horns seen, two rhino horn by-products were offered for sale in Omdurman/ Khartoum in late 1997: finger rings and powder (from ground up horn). There were four very thin rings seen, weighing less than 10 grams each. They had been crafted in Omdurman probably over 20 years ago, according to the shopkeepers. One souvenir store in Omdurman had three of the rings for $17 each, and a shop in Khartoum offered the other ring for $23. Curiously, both shopkeepers wore

rhino horn rings as well. The store in Omdurman also sold rhino horn powder for $0.37 a gram. The main customers for this are northern Sudanese who mix the powder with water, which they drink to cure snakebite poisoning.

THE RHINO HORN TRADE IN CAIRO

In neighbouring Egypt, the main dealer in rhino horn, who has an ivory shop in Cairo's largest market, the Khan al-Khalili, knows the price for rhino horn in Yemen. During an investigation of the markets carried out by the first author in 1998, the dealer showed an old black rhino horn weighing two kilos. He had bought it a month earlier from a formerly wealthy Cairo family who had the horn displayed as a trophy on their wall. It had come from an animal sport-hunted in 1937 in East Africa. The price was LE 5,000 ($1,465) for the whole horn (working out as $733 per kilo). He said he also received horns from Egyptian dealers. Many of these horns probably have come via Khartoum/Omdurman as does most of the raw ivory reaching Egypt (Martin, 1999). His main buyers are Yemenis and Omanis, and one Kuwaiti who regularly purchases small pieces of horn to make into worry beads in Egypt for export to Kuwait for sale. Another shop owner sells rhino horns in Cairo, but he often overprices them and thus sells his horns slowly. Traditional medicine shops in the Khan al Khalili claim to sell rhino horn powder to Egyptians. They consume it with milk to cure blood poisoning and snakebites, as in Sudan. The shop assistants correctly did not mention the use of rhino horn as an aphrodisiac, but instead named crocodile penises ($1.17 a gram), ambergris ($8.05 a gram) and various plants as sexual stimulants. One of the oldest and largest traditional medicine shops in Cairo, established over 100 years ago, has a drawer labelled in both Arabic and English "Rhinoceros Horn". However, the drawer contained only pieces of antelope horn that were priced at $1.47 a gram; the shop manager said he had no rhino horn any more.

POSSIBLE ORIGINS OF RHINO HORNS ON THE MARKET IN SUDAN AND EGYPT

From the hundreds of northern white rhino horns, largely from Sudan, CAR and Zaire which were put onto the market up to the early 1980s, supplies dried up quickly as the decade continued. The fresh white rhino horn seen for sale in Sudan in late 1997 and possibly the two others not seen probably orig-

Photo credit: Esmond Martin

Photo 5. In a shop in Cairo's Khan al Khalili, the medicine drawer labelled "rhinoceros horn" actually contained antelope horns as a substitute

Photo credit: Esmond Martin

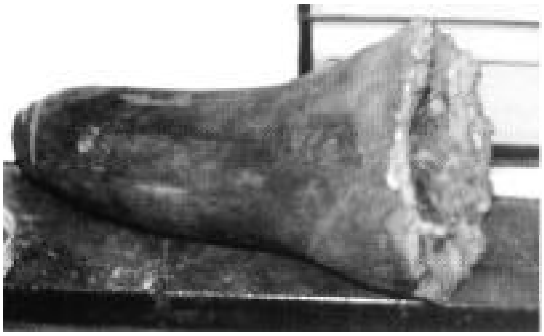


Photo 4. This black rhino horn weighing about 2 kg was for sale in late 1998 in the famous Cairo market called the Khan al Khalili.

inated from the northern white rhinos in Garamba National Park in the Democratic Republic of Congo. It is also possible that horns still sometimes might appear from the few white rhinos that previously existed or may still exist in southern Sudan, especially in the case of found horn. It is probable that some of these horns have filtered through to Egypt for the small demand in Cairo.

In 1980 there were estimated to be under 400 northern white rhinos and considerably less than 300 black rhinos in southern Sudan (Cumming and Jackson, 1984). By 1983 the world population of northern white rhinos was well under 100, of which 13-20 were in Garamba National Park in Zaire, one or two in Uganda and 12 in zoos. There were doubts whether any remained in the CAR and numbers in Sudan were estimated in the low tens (Hillman and Smith, unpubl.; Hillman Smith et al., 1986). Nine years later, the population in Garamba had doubled, the zoo animals had dropped to nine, they were extinct in Uganda and C.A.R., and there were doubts about the continued existence of any in southern Sudan, although occasional reports of sightings or spoor are still received (Hillman Smith et al., unpubl.). One rhino was seen in the Shambe area around August 1997, according to the Wildlife Conservation Administration in Khartoum. Until 1997, there were regular reports too of white rhinos surviving in the Southern National Park in southern Sudan (Philip Winter, Operation Lifeline Sudan, 1990-1995, pers. comm., 1999). ln Kenya, none of the white rhinos (all of the southern subspecies, *Cerarotherium simum simum)* was poached from 1989 through 1997 and no horns were stolen from white rhinos dying of natural causes. A pair of white rhino horns were stolen from the Nairobi Museum in the mid-1990s and never traced. The source of northern white rhino horn was very limited by this time.

Photo credit: Kes Hillman Smith

Photo 6. Young adult male northern white rhino M9 “Notch’ In Garamba National Park.

No white rhinos were known to have been poached in Garamba between 1985 and 1995. Rhino numbers rose over this period from 15 to 31 due to good protection. The first confirmed poaching of rhinos there since 1984 occurred in February and March 1996 when two were killed and there were other losses later. Of the horn seen on the market in 1997, it is probable that old horn, such as that found in the bush with horn borer holes, could have come from southern Sudan, but fresh horn is likely to have originated from Garamba National Park.

Movements of horn from Garamba

Trade routes for rhino horn northwards across the Zaire border, such as through Doruma, to Sudan were well established in the 1970s and early 1980s. The start of increased protection of Garamba in 1984 coincided with the beginning of the second Sudanese civil war. This war probably had a positive effect on rhinos in one way by disrupting the trade routes into southern Sudan as far east as the Garamba area, although poaching for large mammals in eastern CAR has continued and trade routes through this country to northern Sudan are still in use.

Photo credit: Kes Hillman Smith

Photo 7. Posterior horn from an adult female northern white rhino F4 "Boletina", recovered from poachers November 1998, Garamba National Park

There are reports of relatively recent movements of rhino horn and ivory, such as the horn offered for sale in Maridi in 1996 (C. Moore, a road contractor for Terra Firma, pers. comm., 1996) plus a later report in the Maridi area given to Philip Winter in 1998. There are also occasional movements of ivory from Maridi on aid vehicles (Garamba Park guards, pers. comm.). A rhino horn apparently was moved across the border from Aru to Arua in Uganda in 1997 (G. Malamas, Garamba Project, pers. comm., 1997.). Some small pieces of rhino horn were offered to an officer of the ICCN in Kinshasa in 1996. They had apparently come via a businesswoman from the Bunia area in the north-east of the country (A. Mbayma, Conservateur Principal, Garamba National Park, pers. comm., 1996).

Potential trade routes for rhino horn from Garamba to Khartoum/Omdurman could operate directly across the border to southern Sudan or across the border into Uganda. There are no flights from Uganda to Khartoum for political reasons; therefore, horns brought to Uganda could then be taken to Kenya for schedule flights to Khartoum. Garamba horns taken to Maridi in southern Sudan could reach Omdurmanl Khartoum via three routes. One is northwards overland; the second is on aid flights to Kenya; and the third is north-west overland through neighbouring eastern CAR where Sudanese poachers and traders are active.

Sudanese have been travelling to eastern CAR at least since the mid-1970s to poach rhinos, elephants and other large animals. More recently, they could have obtained rhino horns from poachers who bring them north from Garamba. A veterinarian, Richard Kock, who was working in this part of CAR in March and April 1999, reports that large numbers of well-armed hunting gangs of about six men each with camels, horses and don keys are still entering CAR Most of them are Baggaras from northern Sudan who are traditionally aggressive raiders, but there are also

some gangs from southern Sudan. They come into the south-east part of CAR because much wildlife is still abundant there while most of the large animals on the Sudan side have been eliminated. Once inside CAR, the gangs seek out elephants for their tusks and meat, but also poach kob, buffalo, bongo, roan, eland and hippo with their automatic rifles. The meat is dried or smoked and is sold mostly in western Sudan, while ivory and probably sometimes rhino horns are brought to Omdurman and Khartoum for sale. Richard Kock saw a different poaching gang every day (while he was surveying animals from the air). He also saw over 20 recently poached elephants, all with their tusks removed, in six different areas. He estimates that 30 to 40 elephants are killed each week. There are very few resident people in this large area and almost no government presence due to the insecurity brought about by the heavily armed and aggressive Sudanese poaching gangs (R. Kock, pers. comm., 1999).

CONCLUSION

It is probable that some of the fresh white rhino horns for sale in Khartoum, Omdurman and possibly in Egypt in the mid-1990s have come from Garamba National Park's white rhino population in the Democratic Republic of Congo. Since civil disturbances continue in the Garamba area, as well as civil war in neighbouring southern Sudan, Park officials find it difficult to protect the minimum 25 white rhinos counted in April/May 1998. Although the poachers" main purpose is to kill for meat, they also destroy elephants and rhinos for their tusks and horns due to the relatively high price they can obtain for them. Even if prices halved, poachers would still continue to kill rhinos and elephants, along with other large animals, for the sale of meat, as the Congolese and Sudanese in the area are so poor. The protection of Garamba National Park from this heavy poaching pressure thus remains a difficult challenge.

The high prices and therefore slow sales of horns in Khartoum and Omdurman and the continued focus on meat poaching in Garamba National Park indicate that rhino killings in Garamba are still largely a by-product of meat poaching rather than a trade-driven extermination of this species for the horns. If sales of Garamba's rhino horns in entrepots such as Khartoum/Omdurman and Cairo could be decreased significantly, and if the demand for rhino horn in Yemen would further decline with improved law enforcement and the help of substitutes, then the threat of serious future commercial poaching on the rhinos could be reduced. Meanwhile, adequate anti-

Photo credit: Kes Hillman Smith

Photo 8. Adult female northern white rhino F5 "Mama Giningamba" found dead of naturalin Garamba National Park; dead of natural causes in January 1995.

poaching work for Garamba's rhinos remains essential. Only if civil unrest in the area ends soon and sufficient support is received, so that the Park can be protected properly once more, can the rare northern white rhino, the last viable population in Africa, be saved.

ACKNOWLEDGEMENTS

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Rhinoceros Noir du Nord Ouest de l'Afrique *(Diceros bicornis iongipes):* Le Compte à Rebours Continue

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RESUMEE

L'aire de répartition naturelle des rhinocéros noirs incluait autrefois la majorité des savanes d'Afrique occidentale et centrale. Comme partout ailleurs en Afrique, l'espèce a subi de très lourdes pertes dues à la chasse et au braconnage, surtout au début du XX° siècle. Lorsque à partir des années 30 l'administration a mis en œuvre des mesures énergiques de protection, les effectifs du rhinocéros noir du Nord Ouest *(Diceros hicornis longipes)* se sont reconstitués de manière spectaculaire. Les efforts de protection de la faune ont par la suite progressivement diminué et les effets s'en sont fait nettement sentir depuis les années 80 avec notamment l'éradication de la plus grande population de la sous-espèce en République Centrafricaine, la disparition de la petite population du Tchad, et l'amenuisement progressif du dernier noyau qui subsiste encore de nos jours au Cameroun.

Le Cameroun avait demandé une aide pour la protection de ses rhinocéros en 1980. Il n'a malheureusement pas été entendu, et la situation de sa faune en général, qui fut pourtant un axe essentiel de son développement antérieur, n'a cessé de se dégrader. L'effectif actuel de ses rhinocéros, les seuls représentants de la sous-espèce longipes au monde, est d'une dizaine d'individus.

Un programme de sauvetage de ces animaux devait être opérationnel en 1995 sur financement de la Coopération Française. Il a rapidement été englobé dans un vaste programme de gestion de la biodiversité en général dont les financements ne sont toujours pas débloqués après 5 ans de négociations. En conséquence, la majorité des fonds initialement réservés à la protection des rhinocéros a été redistribuée au profit d'autres activités et la sécurité des rhinocéros n'a pas été suffisamment améliorée.

Le petit nombre de rhinocéros qui subsiste se trouve confronté à des problèmes sérieux et multiples: augmentation de la population humaine, faible influence des autorités, inapplication des lois, manque de volonté politique, présence parmi les braconniers de personnages ayant par ailleurs un rôle institutionnel.

Il est très probable que le Gouvernement du Cameroun, à son plus haut niveau, est insuffisamment informé de cette situation et de ses conséquences. Il est aussi permis de penser qu'une modification radicale de la volonté politique pourrait grandement faciliter la mobilisation d'une aide financière et technique conséquente spécifiquement destinée au sauvetage de ces rhinocéros. C'est dans ces directions que tous les efforts doivent se focaliser si l'on ne souhaite pas que l'extinction de la sous-espèce, annoncée depuis 20 ans, devienne une réalité alors que tous les moyens pour l'enrayer sont connus et potentiellement disponibles.

ABSTRACT

ln past times, the natural range of the black rhino included the majority of the West and Central African savannah landscapes. The species, like many other in Africa, has suffered great losses due to hunting and poaching particularly in the beginning of the 20th century. Beginning in the 1930s, when the administration introduced strong protection measures, a spectacular rehabilitation of the numbers of the northwestern black rhino *(Diceros bicornis longipes)* was observed. Afterwards, efforts to protect wildlife declined progressively and the adverse effects have become clearly visible since the 1980s, including the

eradication of the largest population of the subspecies in Central Africa, the disappearance of the smaller population in Chad and the progressing threat to the last nucleus, which still survives in Cameroon.

Cameroon had asked for help to protect its rhinos in 1980. Unfortunately this has not been heard and the situation of its wildlife in general, despite being an important part of its former development, did nothing but degrade. The actual number of its rhinos, which are the only representatives of the subspecies *longipes* on earth, counts a mere ten individuals.

A rescue programme for these animals financed by the Coopération Française should have become operational in 1995. However, the programme was rapidely absorbed in a larger programme for the management of biodiversity in general for which the financing after five years of negotiation is still not forthcoming. As a consequence, a major part of the funds which were initially reserved for the protection of the rhinos, has been redistributed to profit other activities, and the security of the rhinos has not sufficiently improved.

The small number of surviving rhinos is confronted with multiple serious problems: increasing human population, weak influence of authorities, non-application of laws, absence of political goodwill, and poachers who have formerly been in institutional positions.

It is possible that the Cameroon government at its highest level is not aware of the situation and its consequences. A radical change of the political will could greatly facilitate the mobilisation of financial and technical assistance specifically aimed at saving the rhinos. All efforts have to go in this direction if one does not wish the extinction of the subspecies, which has been anticipated for 20 years. All means to avoid this extinction are known and potentially available.

INTRODUCTION

La République du Cameroun est, depuis le milieu des années 80, le dernier pays à héberger une population de la sous espèce longipes du rhinocéros noir. La documentation disponible nous apprend que ces animaux ont fait l'objet d'attentions particulières depuis au moins un siècle pour des raisons variables: exploitation incontrôlée au début, tentatives régulières de protection à partir des années 30.

Des cris d'alarme ont été émis au cours des 20 dernières années, à l'initiative aussi bien des autorités camerounaises que de divers organismes extérieurs: Coopération Française, World Wide Fund for Nature (WWF), Union mondiale pour la nature (UICN), Wildlife Conservation International (WCI), Rhino and Elephant Foundation. A Ia suite d'une requête formelle du Gouvernement du Cameroun (1991), le Fonds d'Aide et de Coopération (FAC) de Ia République Française a mis en œuvre à partir de 1995 des actions de reinforcement institutionnel, de développement des populations périphériques des aires protégées et de recherche/protection au bénéfice du Ministère (camerounais) de l'Environnement et des Forêts (MINEF). Ces activités menées dans la province du Nord (fgure 1) devaient initialement être très centrées autour de la sauvegarde du rhinocéros noir, tandis que d'autres intervenants (MINEF, WWF, Service des Volontaires Néerlandais: SNV) regroupés sous la bannière du Fonds pour l'Environnement

Figure 1. Carte du Cameroun et localisation de Ia province du Nord. *Map of Cameroon* showing *the North Province.*

Mondial (FEM) et partiellement financés par cet organisme devaient être chargés de programmes de gestion de la biodiversité dans un sens plus large: c'est le "volet savanes" ou "'Projet Biodiversité Nord" du '"Projet de Gestion et de Conservation de Ia Biodiversité au Cameroun". Les négociations entre le FEM et le pays bénéficiaire ont connu de grandes difficultés, paralysant jusqu'à ce jour (juin 99) le dèmarrage des volets dépendant du FEM. En conséquence, les activités du FAC ont dû être sensiblement réorientées, au détriment notable des rhinocéros, pour compenser au mieux le retard pris par les autres intervenants. Toutefois, les actions prises en charge sur fonds français ont dans la mesure du possible gardé comme optique le reinforcement de la sécurité de la faune: équipement, formation, encadrement et motivation du personnel, incitation à la participation des populations locales, recherches spécifiques.

EVOLUTION DE LA REPARTITION DES RHINOCEROS NOIRS EN AFRIQUE CENTRALE ET OCCIDENTALE

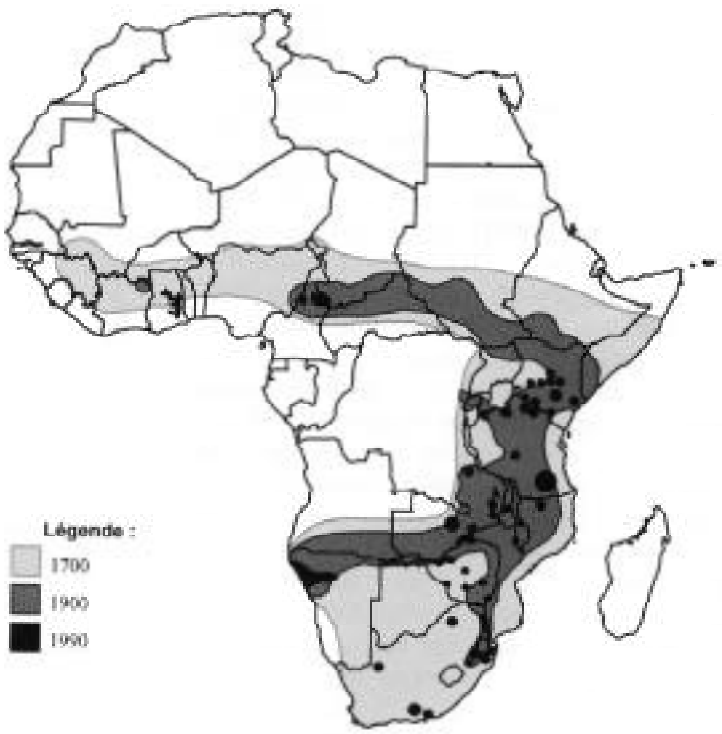
Sur l'ensemble des pays de cette région

La figure 2 schématise les connaissances générales rassemblées par l'UICN dans la seconde moitié des années 80 concernant la période 1700-1987, auxquelles est ajoutée une mise à jour en 1990 pour Ia région qui nous intéresse ici. Il y apparaît clairement que l'aire de répartition de cette espèce, qui couvrait autrefois la majorité des savanes de l'Afrique sub-saharienne, s'est considérablement rétrécie, en Afrique francophone particulièrement. Seule une poignée de pays possède maintenant un nombre "confortable" d'individus de cette espèce, dans les parties orientale et australe du continent uniquement.

Les rhinocéros sont apparus sur la terre il y a plus de 40 millions d'années. Les effectifs estimés, toutes sous-espèces de rhinocéros noirs confondues, sont estimés à plus d'un million d'individus au milieu du 19˚ siècle, et à cent mille vers 1960 (CITES, 1992). Le déclin des effectifs continue ensuite comme le montre la figure 3 (Brooks unpubl. 1989, Planton, unpubl. 1993a, b; 1994; 1996; 1998a), pour aboutir à une stabilisation apparente à partir du milieu des années 90. Précisons que le chiffre de 15,000 retenu par beaucoup comme effectif total vers 1980 est en réalité le haut de Ia fourchette rapportée par 1'UICN à cette époque (Hillman, unpubl.).

L'évolution des effectifs en Afrique centrale et occidentale (figure 4) ne suit pas la courbe générale de l'espèce. Une intense période de destruction durant le premier tiers du siècle extermine la sous-espèce d'Afrique occidentale (Bouna, Cô te d'Ivoire, 1905) (Jeannin, 1951) et

Figure 2. Carte de répartition des rhinocéros noirs entre 1700 (gris clair), 1900 (gris foncé) et 1990 (noir). *Distribution of black rhinos in 1700 (light shading), 1900 (dark shading) and 1990 (black).*



l'amène "au bord de l'extinction en Afrique centrale (Blancou, 1958) où environ 400 individus sont néanmoins encore mentionnés, confinés sur les territoires correspondant actuellement au Nord Cameroun, nord RCA et sud du Tchad. Ces hécatombes suscitent des mesures énergiques de la part de l'administration de tutelle sur toute l'aire de répartition (Bourgouin, 1958). A l'issue de 25 années d'efforts, les scientifiques de terrain d'Afrique centrale rapportent une remontée spectaculaire des effectifs et une extension régulière de l'aire de répartition vers des zones d'où le rhinocéros avait disparu. Il est mentionné plus de 1,000 individus en 1957 (Blancou, 1958, Bourgouin, 1958) dont plus de 300 (450 pour certains) pour le Cameroun (Flizot, unpubi. 1953, Jeannin et Barthe, 1958) ce qui correspond à un accroissement annuel d'environ 3 p.100, chiffre tout à fait plausible pour l'espèce. Après un palier apparent (peut-être lié à l 'insuffisance de données?), l'augmentation du troupeau reprend vers 1960 pour dépasser les 2,000 individus (Hillman, unpubl.) voire 3,000 en 1980 (Gakahu, 1991), soit 4,5 à 6 p. 100 par an, ce qui suppose des performances reproductrices très élevées et illustrerait les capacités de récupération de l'espèce si le dernier chiffre est fiable.

Photo Credit: Hubert Planton

Photo 1. *Diceros bicornis Iongipes,* "Sopen".

Photo Credit: Hubert Planton

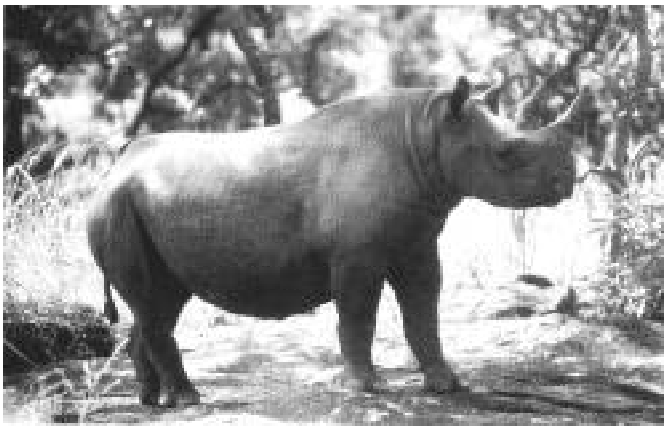


Photo 2. Gros plan d'un *Diceros bicornis Iongipes.*

Au Cameroun

Alors que la situation semble satisfaisante en 1980 en RCA, au Cameroun des actes réguliers de braconnage impliquant des éléments des forces de l'ordre et des services chargés de la faune rendent très inquiets certains responsables (Flizot, unpubI. 1973, Bosch 1976) depuis plusieurs années. Cependant ces exactions restent relativement marginales, sont souvent punies, et la plupart des rhinocéros signalés sont dans la région de Bouba Ndjida, dont le Lamido (Chef traditionnel) est réputé exercer une protection efficace.

Le statut de la sous-espèce bascule alors très vite; certains chiffres rapportés pour les années 80 (Gakahu, 1991), manquent de cohérence, et semblent refléter un désintérêt passager pour cette sous-espèce. La fourchette mentionnée par l'UICN (320-3,000) pour l'Afrique centrale (Hillman, unpubl.) témoigne d'une très médiocre connaissance de ces animaux. En 1980, l'effectif est estimé à 100 individus au strict minimum (Pfeffer, unpubl.) pour

Figure 3. Evolution des effectifs de rhinocéros noirs en Afrique depuis 1900. *Numbers of black rhinos in Africa since 1900.*

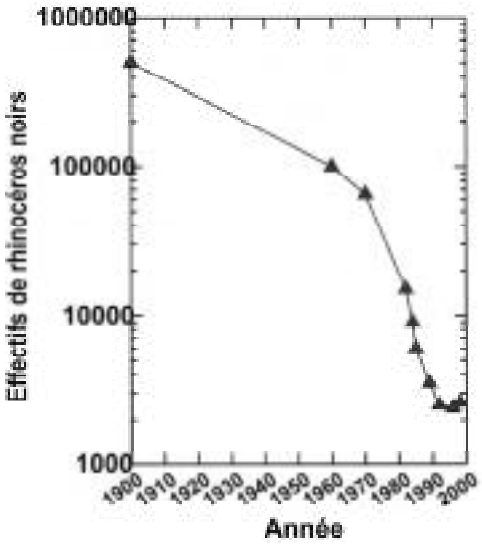
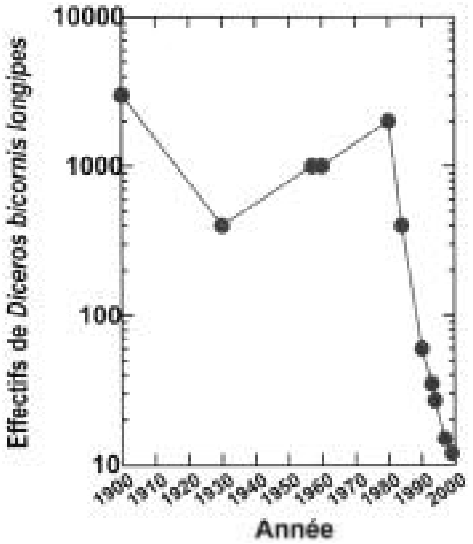


Figure 4. Evolution des effectifs de *Diceros bicornis longipes* en Afrique Centrale depuis 1900. *Numbers of* Diceros bicornis longipes *in CentralAfrica since 1900.*



le Cameroun (l'auteur publie ce nombre par prudence mais est convaincu qu'il y en a plus du double, comm. pers. 1999). Ce pays fait alors preuve d'une réelle volonté d'améliorer la protection et la gestion de sa faune, véritable pôle de développement. A la demande officielle d'assistance formulée par le Ministre de tutelle en décembre 1980, il est répondu par le WWF International en octobre 1981 qu'après évaluation des priorités par l'UICN aucun fond n'est disponible pour cette action. Le laxisme se généralisant au cours des années 80, le braconnage impuni s'intensife au détriment de la faune sauvage en général et des rhinocéros, qui inc sont plus qu'une cinquantaine en 1990. Trente individus sont confirmés l'année suivante (Planton, unpubl. 1991). Parallèlement, une chasse systématique est entreprise en RCA où les rhinocéros sont exterminés en quelques années: aucune observation n'a plus jamais été signalée après début 1985. De même, aucune information en provenance du Tchad n'a plus été vérifiée depuis 1987 (Pfeffer, comm. pers. 1990; Temporal, comm. pers. 1994) sauf celles concernant des individus dont le domaine vital est à cheval sur la frontière Cameroun - Tchad.

A partir de ce moment, le Cameroun devient le seul pays au monde à héberger une population encore viable de ce rhinocéros. Les capacités institutionnelles et la volonté politique du pays ont considérablement diminué. Aucune aide n'est demandée par le pays, ni proposée, malgré l'urgence de la situation. La communauté scientifique elle-même participe à la confusion générale: les effectifs retenus sont très sous-estimés, les chances de sauver cette population sont considérées comme très faibles (Cumming et al., 1990) , aucune suite n'est donnée au rapport de Alers (unpubl.) qui fait écho à ceux de Pfeffer, le cas de *D. b. longipes* est écarté lors du symposium de San Diego, les généticiens croient la sous-espèce éteinte (Planton, unpubl. 1991, Harley, comm. pers. 1994; Harley, 1997).

Les connaissances récentes sur cet animal résultent de recherches de terrain effectuées d'abord avant ce projet par l'auteur entre 1987 et 1995, puis dans le cadre du volet FAC du projet Biodiversité **(** mars 1995-janvier 1999), avec, en plus de la participation de l'administration bénéficiaire, des appuis ponctuels du WWF (Pianton et Walter, unpubl.), et une aide permanente des autorités traditionnelles et des pistèurs. La zone prospectée correspond en gros à celle où se situent les aires protégées du Nord Cameroun. Au sud de cette zone, aucune recherche n'a pu être conduite dans les habitats potentiels bien que

cela soit demandé depuis plus de dix ans.

Les caractéristiques du milieu dans lequel évoluent ces animaux font que peu d'observations directes ont pu être faites chaque année: il n'est pas rare de se trouver à quelques métres d'un rhinocéros sans pouvoir le voir. L'identification des traces et le pistage ont permis d'estimer les effectifs, les domaines vitaux, les principales habitudes de ces rhinocéros et, malheureusement, de suivre la disparition de la plupart d'entre eux.

Au cours des 10 dernières années, les localisations confirmées se situent schématiquement entre 7˚30' et 9˚ nord pour Ia moitié est de Ia province du Nord, et 7˚30' et 8˚30' nord pour la moitié ouest de cette même province, soit un recul vers le sud de 100 km par rapport aux observations crédibles du premier tiers du siècle. Ce recul s'est accompagné d'une fragmentation progressive et constante de l'aire de répartition au Nord Cameroun. La figure 6 illustre cette évolution: l'espèce, jadis répartie de manière continue, s'est scindée en deux groupes au début des annèes 80 par isolement du groupe "Faro", puis le braconnage a progressivement conduit à dix groupes en 1996, sept en 1997 (Planton et Walter, unpubl.; Brett, unpubl.; Planton, unpubl. 1998b), et enfin six confirmés fin 1998 à une période où, Ia végétation rendant le travail particulièrement difficile, il est probable que certains individus n'aient pas ètè localisés. Plusieurs des localisations actuelles ou récentes ne sont mentionnées dans aucune donnée bibliograpbique. Il n'est pas possible de dire si ces aires de présence correspondent à des refuges récents pour l'espèce ou à des zones difficilement accessibles où les rhinocéros vivaient depuis longtemps sans y avoir ètè observés ou mentionnés. Depuis fin 1995, il n'y a plus aucun rbinocéros 'résident' dans les parcs nationaux (avec un doute pour le Faro), tous les individus connus passant la quasi totalité de leur temps en zones de chasse, lesquelles sont presque toutes affermèes à des guides de chasse privés.

LE MILIEU ET L'HABITAT

Habitat et préférences alimentaires

Les lieux que fréquentaient autrefois les rhinocéros noirs au Nord de Garoua comprennent de grands peuplements végétaux dominés par des *Acacia (hockii* et *senegal* pour la plupart). Ce type d'habitat est généralement considéré par les experts anglophones comme nettement plus convenable que celui où ces animaux se trouvent de nos jours.

Actuellement ces rhinocéros vivent dans une bande de savanes arbustives et/ou arborées, en zone soudanienne à soudano-guinéenne, où dominent, selon les milieux, et pour les ligneux, les peuplements à *Isoherlinia, Terminalia, Combretum, A cacia, Burkea, Gardenia, Piliostigma,* les enclaves à *Anogeissus.* Leurs habitats favoris sont vallonnés, le plus souvent proches de reliefs, parcourus par de nombreux cours d'eau, généralement temporaires, et dans lesquels subsistent de nombreux points d'eau permanents tout le long de la saison sèche. Les rbinocéros ne s'èloignent jamais beaucoup de l'eau. Ils boivent normalement chaque nuit, ou au petit matin, et aiment se vautrer dans les bains de boue où ils passent régulièrement les heures fraîches de la matinée. Ils fréquentent aussi régulièrement certaines salines. Ils vont ensuite brouter, puis se reposer à l'abri de la chaleur, souvent dans d'èpais fourrés des galeries forestières, ou dans des bas fonds marécageux couverts de grandes graminées où ils peuvent rester sans bouger jusqu'en fin d'après-midi s'ils ne sont pas dérangés.

Cet attrait pour les milieux humides leur permet de trouver, même pendant la saison sèche, une nourriture variée (malgré un petit nombre d'observations, une trentaine de végétaux appétés différents ont ètè identifiés). Parmi ces plantes figurent de nombreuses légumineuses ligneuses ou sub-ligneuses, le fruit de *Kigelia africana,* des *Vernonia, Hoslundia, Sarcocephalus latifolius,* de rares graminées hautes dont *Echinochloa* sp., de multiples petites herbacées. Nombre de ces dernières n'ont pas encore pu être déterminées et sont pour le moment conservées sous forme de spècimens séchés dont les noms vernaculaires ont ètè relevés.

Lorsqu'ils s'èloignent des points d'eau, ils sélectionnent particulièrement les branches *d'A cacia ataxacantha, A.polyacantha, A.seyal, A.hockii, Gardenia aquala, G.erubescens, Annona senegalensis, Piliostigma thoningii, Vitellaria paradoxa.* Etant tout spécialement friands de *Gardenia,* l'observation atten-

Photo Credit: Hubert Planton

Photo 3. Vue aérienne d'un habitat typique des rhinocéros au Cameroun: mosaïque de savanes arborées, peuplement épineux, plaines herbeuses, avec relief prononcé, cours d'eau, salines et bains de boue.
Aerial view of typical rhino habitat in Cameroon: patchwork of tree and thornbush savannah, grasslands, water courses, salt licks and springs in a rolling terrain.

tive de ces arbustes (traces de coups de dents) est un excellent révélateur de la présence de rhinocéros.

L'abondance de nourriture est souvent momentanément diminuée immédiatement après le passage des feux de brousse annuels. Ceux-ci sont en effet généralement pratiqués de manière irréfléchie et incontrôlée. De la fin de la saison pluvieuse au passage des feux, lorsque les graminées sont hautes, denses, et envahies par de nombreuses herbacées grimpantes, il se peut que l'accès à certaines plantes appétées soit rendu gênant par cette végétation. Cependant, même les individus observès et suivis à cette période semblaient aller de plante en plante sans difficultés apparentes.

Domaines vitaux

Les domaines vitaux naturels observès dépassent largement 200 km^2 pour un animal, plusieurs domaines vitaux pouvant se superposer partiellement. En absence de perturbations, les mouvements semblent nettement plus importants en saison sèche (traces fraîches suivies sur des distances de 30 à 40 km dans la journée) qu'en saison pluvieuse (toujours moins de 10 km). En plus de ces trajets journaliers, des déplacements saisonniers nettement plus amples (100 km et plus) ont été observés; ils pourraient permettre des contacts entre individus que l'on est tenté de considérer comme isolés et ne pouvant plus se reproduire si l'on n'a pas une vue globale sur un cycle annuel.

Dans la situation actuelle: très peu d'animaux environ 10 à 15 au maximum, éparpillés sur une vaste région: 25,000 km^2, et en l'absence de données suffisantes concernant les régimes alimentaires et l'utilisation de l'espace, il est délicat d'avancer un chiffre pour la capacité de charge en rhinocéros de ces savanes. Néanmoins, en partant des informations rapportées dans la littérature, on peut déduire que les densités avoisinaient dans le passé un rhinocéros adulte pour 10 à 20 km^2 selon Ia qualité des habitats. Cette estimation coïncide avec celles qu'avancent des experts rodés aux habitats de l'Est et du Sud du continent (Morkel 1996, comm. pers.; Brett, unpubl.), ceux-ci se basant après leurs visites au Nord Cameroun non pas sur une connaissance des habitudes alimentaires locales de cette sous-espèce, mais sur l'absence d'espèces ou groupe végétaux habituellement consommés par les autres sous-espèces de rhinocéros noirs dans les autres parties du continent. La valeur de un rhinocéros pour 20 km^2 peut être retenue comme une approximation correcte, voire prudente, ce qui correspondrait à une capacité d'accueil potentielle supérieure à 1,000 individus.

BRACONNAGE

Chaque année depuis dix ans, on a constaté la disparition de trois individus en moyenne, révélée soit par des cornes en vente dans le pays, soit par des indices de présence qui ne sont plus observés dans les domaines vitaux. Très peu de cadavres sont trouvés sur le terrain, toujours très longtemps après la mort de l'animal. Si ce chiffre est faible dans l'absolu, il est catastrophique si l'on considère qu'il représente maintenant environ 20 p. 100 de la population.

Un point relativement positif, mentionné depuis longtemps (Pfeffer, unpubl.) et confirmé depuis l 990, est que le braconnage ne semble pas (ou rarement)

spécifiquement orienté vers les rhinocéros et que le marché de la come est peu organisé. L'implantation non surveillée d'une colonie de chinois en bordure des aires protégées a été et reste la principale exception à cette règle. Dans la plupart des autres situations connues, le braconnier a abattu un rhinocéros parce qu'il l'a rencontré et pense pouvoir en tirer un profit, puis le receleur fait du porte à porte en ville dans les quartiers aisés, y compris chez les responsables de la gestion de la faune, à la recherche d'un potentiel acquéreur.

Un point extrêmement négatif est la fréquente implication directe dans le braconnage, ou réaction inadaptée après braconnage, d'agents employés dans les services de la faune, de la justice ou des forces de l'ordre.

Pfeffer (unpubl.) n'écarte pas la possibilité que quelques chasseurs "sportifs" aient abattu des rhinocéros par simple plaisir. D'autres sources rapportent des actes similaires, parfois dans des buts lucratifs. Alers (unpubl.) mentionne l'implication directe de gardes-chasse dans des cas de braconnage de rhinocéros et la grande réticence des services responsables à lui livrer des informations. D'anciens responsables et enseignants évoquent la disparition de comes au sein même de l'Ecole de Faune de Garoua. En l993, les braconniers et receleurs arrêtés dans des circonstances dangereuses juste après 1'atelier sur les rhinocéros sont remis en liberté au bout de quelques heures par les services de Ia faune, et l'un des gardes-chasse impliqués est encore en fonction; début 1996 un garde-chasse abat le dernier rhinocéros du sud du parc de la Bénoué: dénoncé par les villageois et ses collègues, il reste en poste sans sanction.

En août 1996, une femelle équipée d'un émetteur radio dans le cadre des activités de la coopération franco-camerounaise est abattue avec complicité active d'un garde-chasse: les services en charge de la faune refusent d'enregistrer la dénonciation et la plainte de ses collègues et des villageois, les braconniers et complices (tous identifiés) ne font l'objet d'aucune poursuite ni enquête. La saisie des cornes localisées au domicile d'un inspecteur de police grâce à l'èmetteur VHF est refusée, et n'aurait jamais eu lieu sans l'intervention personnelle *in extremis* du Ministre de tutelle, déclarant agir suite à un

Photo Credit: Hubert Planton

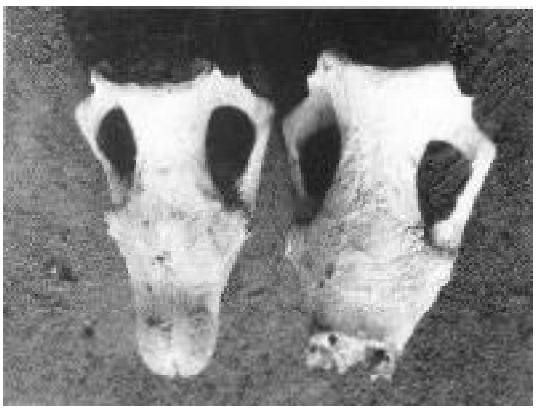


Photo 4. Deux cranes de rhinocéros trouvés dans des parcs nationaux. Sur le plus gros, les traces de coups de machettes donnés par les braconniers pour arracher les cornes sont bien visible.
Two rhino skulls which were found in the national parks. The traces of pan gas used by the poachers to chop off the horn are clearly visible on the larger of the two.

Photo Credit: Hubert Planton

Photo 5. Cornes de la femelle "Sopen", saisiés chez un inspecteur de police. Notez l'emplacement de l'implant radio emetteur dans Ia corne antérieure.
Horns of the female rhino "Sopen", seized from a police inspector. Note the location of the implanted radio transmitter on the posterior horn.

entretien avec le responsable du projet de la Coopération Française et sur ordre personnel du Président de Ia République. L'enquête difficile aboutit à l'arrestation des braconniers et receleurs, tous rapidement remis en liberté. Le procès qui s'en suit, souhaité exemplaire par la Direction de la Faune et

les bailleurs de fonds pour que soit marquée Ia fin du laxisme, décide des peines suivantes: le braconnier, qui a changé d'identité et disparu, est condamné à trois 3 ans de prison et 10 millions CFA (environ 16,000 $US) d'amende; le revendeur (disparu aussi) et l'intermédiaire: six mois de prison avec sursis pendant trois ans; l'inspecteur de police: même peine plus une amende de 200,000 CFA (300 $US). L'inspecteur fait appel et porte plainte contre le revendeur pour tromperie sur la marchandise: le revendeur perd et est à son tour condamné à rembourser à l'inspecteur le prix d'achat de la corne. L'administration fait appel et suspend les activités du projet concenant les rhinocéros: l'interdiction durera un an et demi.

Ces faits et le contexte général suggèrent qu'une simple amélioration de la volonté politique pourrait suffire à protéger efficacement ces rhinocéros. L'essentiel du matériel nécessaire est disponible, il est aisément possible de mobiliser du personnel motivé. Seule l'attitude des responsables chargés de faire effectuer le travail et appliquer les lois encourage les contrevenants et démotive les meilleurs agents.

PRINCIPALES ACTIONS ENTREPRISES EN FAVEUR DES RHINOCEROS

Une conjonction d'efforts (parmi lesquels Lamarque, 1988 à 1992 (Lamarque, unpubl.); Planton et Chardonnet. (unpubl. 1989): Haberhauer et Planton (unpubl. 1991)) aboutit à deux demandes d'assistance de la part du gouvernement camerounais (1991 et 1992), et à la prise en considération par le Ministère (français) de la Coopération d'une aide très ciblée sur la protection des rhinocéros. Comme déjà mentionné plus haut, l'insuffisance apparente de fonds immédiatement disponibles et le souhait de conjuguer les efforts complémentaires de plusieurs intervenants conduisent à englober cette action de protection des rhinocéros dans un projet plus vaste de gestion de la biodiversité: le Projet Biodiversité Nord, rassemblant d'autres organismes (WWF, SNV, FEM) sous la coordination du MINEF et du FEM, et intervenant sur l'ensembles des aires protégées (parcs nationaux, réserves et zones de chasse) de la province du Nord au Cameroun.

La très grande majorité des actions mentionnées ci-dessous a été financée et/ou réalisée par Ia Coopération Française. Chaque fois qu'un autre organisme est intervenu, ce sera précisé dans le texte.

Recherche et localisation

L'aire de répartition au Nord Cameroun a ètè régulièrement parcourue de 1987 à 1990 dans le cadre" de la Campagne Pan Africaine de lutte contre la Peste Bovine (financement européen), puis de 1991 à 1995 à l'occasion de multiples sorties ponctuelles destinées à prospecter les habitats et/ou vérifier les informations qui nous étaient données sur le terrain. Après cette phase en "pointillés", des opérations de recensement ont été effectuées de manière spécifiques et intensives en 1996, 1997 et 1998 dans le cadre du projet FAC Biodiversité Nord, avec parfois participation du WWF. L'ensemble des comptages et suivis a permis de dégager des données de base sur les domaines vitaux et préférences alimentaires de ces animaux et d'en mettre à jour autant les effectifs (figure 5) que l'aire de distribution (figure 6). Les informations retenues sont celles qui sont matériellement vérifiables: elles doivent être fournies avec document (photo ou vidéo) montrant l'indice observé (empreinte, bouse, coup de dent, animal) et un récepteur GPS indiquant les date, heure et lieu. Une prime récompense chaque résultat obtenu.

C'est sur Ia base des observations initiales que le WWF Cameroun a été alerté début l 991 puis tenu régulièrement informé en vue d'une action de protection spécifique. Compte tenu des menaces permanentes et variées qui pesaient sur ces rhinocéros, il a été convenu avec l'ensemble des partenaires que les informations à caractère sensible ne seraient pas diffusées.

Un prélèvement réalisé sur animal récemment braconné a été confié à deux laboratoires spécialisés dans les analyses génétiques sur rhinocéros (Kleberg Genetic Chair, Center for Reproduction of Endangered Species, San Diego, et Department of Chemical Pathology, University of Cape Town) en 1993 mais n'a semble-t-il jamais été exploité. Un second fragment de tissu a été transporté en

Figure 5. Evolution du nombre de rhinocéros noirs *(D. b. longipes)* au Cameroun depuis 1980. *Numbers of black rhinos in Cameroun since 1980.*

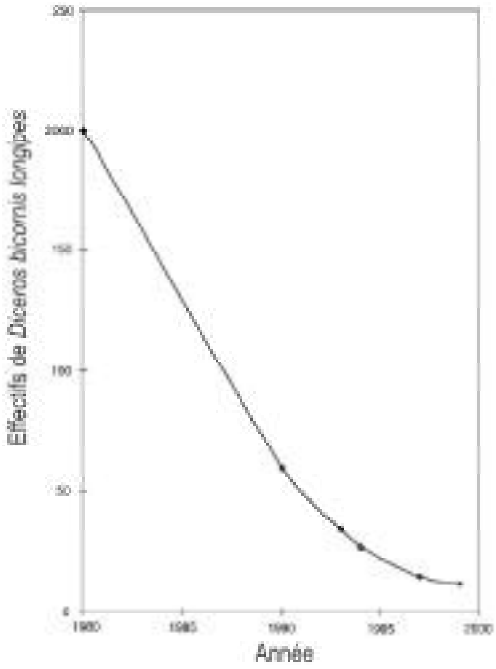
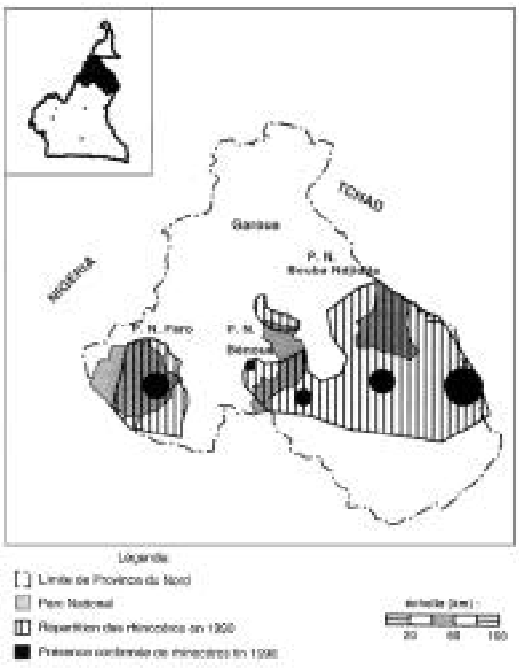


Figure 6. Carte de répartition des rhinos noirs au Nord Cameroun 1980 - 1998. *Distribution of black rhinos in Cameroon between 1980 and 1998.*



juillet 1996 dans les meilleures conditions au laboratoire Sud Africain en vue du séquençage de l'ADN et de préciser la place de ces animaux dans la systématique. Bien que l'analyse n'ait porté que sur un seul individu, le résultat indique clairement une différence marquée entre la sous-espèce *longipes* et l'ensemble des autres rhinocéros noirs: au stade actuel, deux allèles qui n'existent sur aucune des autres sous-espèces ont ètè trouvés sur *D. h. longipes.* Une consanguinitè assez élevée est très probable (Harley, comm. pers., 1988 et 1999).

Dans le programme initial, il était convenu qu'une dizaine de rhinocéros seraient capturés et équipés d'émetteurs VFH afin de permettre leur localisation permanente, leur protection, leur observation, la récolte de données précises sur la biologie de la sous espèce. Une radio a ainsi été placée dans la corne d'une femelle dès rèception du matériel (juillet 1996) avec l'aide du Dr Pete Morkel (National Parks Board, Afrique du Sud). Cet animal a été suivi quotidiennement et l'équipe responsable a rapidement maîtrisé la télémétrie et commencé à récolter des données de saison pluvieuse. Malheureusement cette femelle a été braconnée un mois et demi plus tard, avec complicité d'un garde-chasse selon les rapports. Les villageois et certains gardes ont permis d'arrêter les braconniers, et sans l'èmetteur il n'aurait pas été possible de localiser les comes ni d'identifier le réseau responsable. La nouvelle de ces résultats (saisies et arrestations), qui ont été acquis grâce à l'intervention personnelle du Ministre concerné en dépit de l'avis défavorable des responsables locaux, s'est aussitôt répandue dans toute la province et même au-delà. L'image du projet épaulant les services en charge de la faune s'est trouvée renforcée par ce défi relevé, incitant les braconniers à plus de prudence. Au lieu de profiter de cette nouvelle situation pour poursuivre le programme et renforcer la protection permanente des rhinocéros, les autorités de tutelle ont suspendu ce volet d'activités.

Formation et sensibilisation

La sensibilisation des autorités scientifiques et politiques, déjà engagée par Pfeffer à partir de 1980 puis Lamarque et Alers, a été poursuivie au sein du

nouveau groupe des spécialistes des rhinocéros africains (UICN/CSE) (Planton et Bello, unpubl.), du gouvernement français et de nombreux organismes à vocation de protection de la faune. L'UICN a été tenu au courant de l'évolution de la situation les années suivantes et à chaque réunion de son groupe "rhinocéros d'Afrique" (1994, 1996, 1998). Après 1992, le gouvernement camerounais n'a plus envoyé de représentation à ces réunions.

Dans le cadre des activités du projet Biodiversité Nord, volet FAC, la sensibilisation des autorités du Nord Cameroun a été un souci permanent. Une collaboration satisfaisante a été obtenue de la part du pouvoir traditionnel, par contre l'adhésion des responsables administratifs (justice, forces de l'ordre, MINEF) a été nettement plus laborieuse et partielle.

Les guides de chasse professionnels et opèrateurs privés ont pour la plupart rapidement vu leur intérêt dans l'amélioration de la gestion de la faune sauvage. Ceci est particulièrement important puisque ce sont désormais a priori les seuls à héberger des rhinocéros, exception faite du parc national du Faro. Leur collaboration n'a pas été suffisamment fructueuse à cc jour mais il faut se rappeler que le volet rhinocéros n'était, par la force des choses, qu'une des multiples facctttcs du projet entrepris. Il est certain que les privés ont un rôle capital à jouer dans la survic des rhinocéros (et de la faune cn général) et qu'ils sont prêts à établir un partenariat sur ce sujet s'ils ont confiance en leur interlocuteur.

Photo Credit: Hubert Planton

Photo 6. Parc National de Bouba Njidda: équipe de garde-chasse en patroullle dans le cadre des la coopération France-Cameroun.
Bouba Njidda National Park: group of rangers patrolling in the framework of the France-Cameroon cooperation.

Un manuel de formation aux techniques de suivi et d'observation des rhinocéros (Planton, 1998b) a été rédigé et diffusé aux responsables provinciaux et de terrain. Largement inspiré et adapté d'un document sud-africain, il rassemble les notions de base, accessibles même à des collaborateurs non instruits, utiles pour repérer, observer et recueillir des données fiables concernant les rhinocéros dans le contexte du Nord Cameroun.

Plusieurs catégories de personnel ont bénéficié d'une formation spécifique dans ce but. Parmi les cadres, deux des conservateurs et un jeune ingénieur des Eaux et Forêts ont été particulièrement sensibilisés. Ce dernier, susceptible d'être par la suite employé par le WWF, a fait l'objet d'une formation plus poussée puis a été recruté pour appliquer ces notions sur le terrain dans le cadre d'une recherche d'indices de présence de rhinocéros (Weladji, unpubl.). De plus, dans chaque secteur à rhinocéros, des gardes et surtout des pisteurs villageois ont assimilé de manière satisfaisante ces notions. Les populations rurales ont rapidement compris l'intérêt (tant à court qu'à long terme) qu'ils avaient à collaborer efficacement avec le projet. Plusieurs braconniers parmi les plus redoutables se sont séparés de leurs armes pour se rapprocher des activités de surveillance, et certains comités villageois de vigilance ont adopté des attitudes courageuses dans certaines circonstances difficiles, prouvant leur adhésion à l'esprit de la gestion proposée. Mais ils ont aussi montré qu'en cas de tromperie de la part de certains partenaires, ils étaient capables de redevenir braconniers.

Le personnel du WWF a commencé à investir progressivement sur le site du projet à partir de 1998. Dès ce moment, par souci de continuité après l'arrêt prévisible des financements français, les cadres concernés ont été associés à toutes les activités et réflexions concernant les rhinocéros et le renforcement de la surveillance.

Matériel et fonctionnement

Du matériel a été fourni aux services chargés de la faune dans le but d'améliorer leurs capacités techniques, et la totalité du personnel concerné a été formé à son utilisation. Sans entrer dans le détail, il

s'agit essentiellement de rénovation de bâtiments, achat de véhicules tout terrain, motos, vélos, un aéronef ultra léger, réseau radio HF fixe et mobile, équipement VHF portable dans toutes les unitès, matériel de télémétrie, récepteurs GPS et système d'information géographique, caméras photo et vidéo, matériel informatique. Le budget français a pris en charge l'intégralité du fonctionnement de ces équipements durant toute la période du projet.

Amélioration de la protection

Au moment du dèmarrage du projet, les activités de surveillance étaient pratiquement inexistantes depuis dix ans. Leur réactivation a nécessité une sérieuse reprise en main du personnel.

La première étape a été de définir les besoins matériels et humains nécessaires à la création d'une unité antibraconnage, puis de chercher un financement pour sa mise sur pied. Le WWF a accepté de prendre en charge partiellement cette action. Après une première année très décevante puis des changements dans sa gestion, cette unité a été plus efficace en 1998. L'absence d'encadrement sérieux (initialernent demandé), pour cette équipe où devrait régner une discipline quasiment militaire, se fait nettement sentir.

Pour permettre la mobilité des équipes, le volet FAC a assuré l'entretien des pistes de surveillance durant ses trois années d'activité.

Tous les gardes-chasse ont subi un recyclage comprenant une semaine intensive puis six mois de suivi sur le terrain, ainsi que la fourniture de matériel de terrain et d'équipement pour contrôles routiers. La poursuite d'un encadrement réel par les conservateurs et les services provinciaux serait souhaitable. La majorité des gardes s'est montrée apte aux tâches de surveillance sous réserve d'encadrement sérieux. Certains se sont révélés totalement inaptes et les remarques des formateurs à ce sujet ont été transmises aux autorités hiérarchiques qui semblent n'en avoir pas tenu compte.

Pour inciter le personnel à accomplir au mieux sa tâche, un barème de primes à verser en fonction des résultats réellement obtenus a été officiellement adopté et n'a pu être appliquè qu'au bout de trois ans de négociations. Bien que concrétisées tardivement, ces primes ont eu un effets très positif sur le personnel concerné.

Photo Credit: Hubert Planton

Photo 7. Trace ancièNne de rhinocéros a côté de laquelle est posé un GPS en fonction.
Old rhino spoor with a *functioning GPS next to it.*

Photo Credit: Hubert Planton

Photo 8. Décollage de l'ULM de la Coopération Française pur une surveillance aérienne du Parc National de la Bénoué. Durant tout le vol le contact radio est maintenu avec l'équipe anti-braconnage au sol.
Ultra-light aircraft of the French Co-operation starting on an aerial survey mission of Bénoué National Park. Contact with the anti-poaching ground troops is maintained during the flight.

La mise en service de l'aéronef ultra léger motorisé (ULM) a permis de coupler la surveillance aérienne des aires protégées avec l'intervention conventionnelle au sol. Il a été montré qu'avec cette méthode il était possible de quadriller entièrement une aire protégée en 5 à 6 heures de vol et de communiquer précisément à l'équipe au sol les positions à aller inspecter. Ainsi une aire protégée de 180,000 ha est totalement et efficacement "nettoyée" en deux jours, alors qu'il fallait auparavant trois semaines sans certitude d'avoir délogé tous les braconniers. Cette technique a autant impressionné certains personnels du MINEF que les braconniers.

Mais l'appareil n'est plus utilisé depuis début 1999 sans que la raison en soit connue.

Enfin, le projet a apporté tout son appui aux services juridiques lors de la préparation des dossiers et lorsqu'il a fallu défendre les intérêts du MINEF.

PERSPECTIVES

Le Cameroun reste, en Afrique centrale, et malgré une dégradation considérable de son environnement, un pays qui compte encore une faune sauvage savanicole variée et relativement riche. Le développement du Nord Cameroun s'est toujours appuyé sur ses ressources naturelles, dont la valeur potentielle ne cessé d'augmenter à mesure que des destructions se perpétuent ailleurs. Parmi les espèces que ce pays a le privilège d'héberger, le rhinocéros noir du Nord Ouest est un animal hautement symbolique et médiatique qui a disparu de tous les autres pays faute de gestion appropriée.

Le laxisme qui a prévalu ces derniers temps semble être la principale cause ayant facilité le déclin régulier de ces rhinocéros qu'il aurait été facile de protéger efficacement. Les effectifs actuels de cette sous espèce, dont la validité génétique semble maintenant établie, la mettent à la limite du seuil de viabilité théorique. Sauf changement radical et rapide, l'extinction de cet animal serait l'une des tragédies majeures de notre époque en matière de grande faune sauvage, d'autant que la menace de disparition est connue de tous depuis 20 ans et qu'aucune réaction appropriée n'a été mise en œuvre.

Tout laisse à penser que les plus hautes autorités du pays ne sont pas (ou insuffisamment) informées et conscientes de l'enjeu que représente cette situation, d'où leur immobilisme. Plus bas dans la hiérarchie administrative, l'absence d'instructions fermes et la corruption généralisée, aggravèes par les effets de la dévaluation en 1994, ont conduit à ce qu'aucune mesure adéquate ne soit prise, voire à des complicités de braconnage dans certains cas. De plus, face à l'ampleur des problèmes, la plupart des organismes supposés aider le pays à surmonter ces difficultés se montrent très hésitants.

Il est compréhensible que la situation générale du pays ne lui permette pas de faire face sur tous les fronts à la fois. Il est par ailleurs certain que de nombreux organismes extérieurs sont prêts à apporter au Cameroun un soutien financier, matériel et humain pour relever ce défi sous réserve qu'une réelle volonté politique se manifeste. Lors de sa dernière réunion en Namibie, le GSRAf de l'UICN/CSE a estimé que la situation nècessitait qu'un programme de protection spécifique implique les plus hautes autorités administratives et traditionnelles et soit placé sous la tutelle directe de la Présidence de la République.

Le contenu de ce programme a fait l'objet de réflexions et de propositions (Brett, unpubl.; Planton, unpubl. 1998a, 1999). Sept scénarios principaux ont été envisagés pour le sauvetage de Ia sous-espèce: dans son milieu naturel ou non, au Cameroun ou hors de ce pays. La conception la plus réaliste consiste à mettre en place dès que possible une protection intense et rapprochée, par des équipés disciplinées et elles-mêmes étroitement surveillées, de tous les individus localisés. Le recours systématique à des implants radio émetteurs faciliterait le travail tout en garantissant de ne jamais perdre un seul individu. Parallèlement d'autres équipés tout aussi fiables doivent quadriller, à la recherche d'indices de présence, les habitats potentiels où la présence de rhinocéros n'a pas encore été écartée. Cette démarche présente l'avantage de pouvoir sécuriser très rapidement une bonne part de la population résiduelle sans appel à des financements démesurés, et d'augmenter progressivement le nombre d'individus protégés. Cela n'exclut pas d'opter si nécessaire pour une gestion plus intensive type sanctuaire dont la mise en œuvre nécessité des études sérieuses qui pourraient être initiées dès la phase de protection et bénéficier des constatations établies par les équipés de surveillance. Choisir de manière précipitée la solution du sanctuaire (emplacement, conception, construction) qui représente un investissement et un coût de fonctionnement conséquents pourrait faire courir des risques non négligeables à cette sous espèce qui en endure déjà suffisamment.

Tous les ingrédients matériels nécessaires pour interrompre la "chronique d'une disparition annoncée sont connus et disponibles. Il ne manque plus qu'un détail: que les responsables nationaux et intervenants potentiels décident de s'atteler

Tableau 1. Synthèse chronologique de la gestion de Diceros bicornis longipes au 20ième siècle. Chronology of the management of Diceros bicornis longipes in the 20th century.

Période	Méthode	Effectifs		Evennements majeurs
		Afr. Centrale	Cameroun	
1900	estimation	3000	?	début d'intenses destructions; extermination de plusieurs pays en début de siècl
1930	estimation	500	?	réaction de l'administration : mise en œuvre de protection sérieuse création et gestion réelle de nombreuses réserves
1960	estimation	1000	?	remontée spectaculaire des effectifs suite sax mesures de protection
1970	estimation	1800	650	Pour le Cameroun : estimé par P. Flizot, inspecteur des chasses",
1980	estimation	1000 - 3000	200	La protection a continué à porter ses fruits en RCA depuis 1970; les massacres ont repris en RCA, et é un moindre degré au Cameroun; le Cameroun manifeste sa volonté de protéger et demande une aide; cette aide lui est refusée.
1985	estimation	110	110	L'espéce est érradiquée du Tchad et de RCA
1990	estimation	15 – 50	15 – 50	Le communauté internationale est alertée en 1992.
1993	comptage et estimation	35	35	Les responsables nationaux et internationaux sont réunis à Garoua pour un séminaire sur le rhinocéros. Une stratégie nationale est proposée. Plusieurs organismes extérieurs semblent prêts à aider. Le seul financement annoncé vient du WWF (50 ooo us $ /an)
1995	comptage et estimation	20	20	démarrage du projet "Biodiversité Nord", composante FAG (4 millions de francs français); en comptant les autres financements attendus (FEM, Pays Bas, WWF), le budget devait atteindre 17 à 20 millions FF. Le retard des autres partenaires conduit à saupoudrer le financement français sur des activités ayant un rapport éloigné avec les rhinocéros
1999	comptage et estimation	10	10	fin du financement français; WWF présent sur le terrain depuis 1998; les autres aides sont toujours attendues; seul un programme indépendant et spécifique peut encore tenter de sauver la sous espèce *longipes.*

sérieusement à la tâche, chacun à son niveau. Faute de quoi il sera bientôt possible d'affirmer que la communauté internationale, dont font partie les états d'Afrique centrale, a délibérément laissé cette extinction aller jusqu'à son terme.

REMERCIEMENTS

Les travaux mentionnés ci-dessus ont été réalisés grâce à l'agrément du gouvernement du Cameroun, à la persévérance de la Coopération Française qui a initié ce dossier et financé ces activités, et aux supports de plusieurs organismes à divers stades de l'exécution: Rhino and Elephant Foundation, UICN, WWF, National Parks Board Sud Africain. Les rôles joués par les Chef's traditionnels, par les villageois, seuls véritables spécialistes de la faune, par les gardes et cadres de l'administration et les opérateurs privés qui croient encore à un redressement de Ia situation, ont été essentiels pour l'acquisition de ces données et la faible amélioration amorcée. Qu'ils en soient bientôt récompensés par des décisions heureuses et la poursuite des efforts.

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Elephants and their Woodland Habitats in Northern Botswana

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CURRENT STATUS

The elephant population in northern Botswana is considered the largest remaining herd in Africa. According to official estimates, some 80,000 elephants currently dwell in the region (DWNP, unpubl.) Furthermore it appears that the elephant population maintains a steady increasing trend that has prevailed for over two decades (Calef 1988, Melton 1985).

An adult elephant consumes above 150 kg of vegetation material per day. Although the annual composition of an elephant's diet consists of at least 60% grass species, the bulk of the remaining portion is comprised of woody plant species. Some of the woody plant material consumed originates from tall trees that form mature woodlands. Thus, the combination of high consumption rates per animal, multiplied by the estimated elephant numbers, is suggestive of the prominent role that elephants have in the regulation of ecological processes within the local ecosystem and the profound influence of elephants on their habitats in northern Botswana.

High elephant densities may bring about considerable changes in the vegetation structure and composition, particularly in habitats where woody plants dominate the cover abundance of the vegetation. Already, a considerable number of reports has cautioned against the eminent destruction of habitats in northern Botswana, particularly along the northern Chobe and Linyanti rivers (Child, 1968; Sommerlatte, unpubl.). Although a detailed survey has not been conducted, it appears that mature stands of Ana trees *(Acacia albida)* that dominated the eastern part of the Chobe river front were destroyed as a result of elephant activity (Simpson, 1974). Furthermore, the indigenous Chobe bushbuck *(Tragelaphus scriptus ornatus)* was feared of becoming extinct as a result of elephants alternating the vegetation structure along the Chobe river.

In this paper, the role of elephants as agents of habitat change within the northern Botswana ecosystem will be put into perspective on the basis of eight years' research work. This synopsis will demonstrate that while elephants have a significant role in the regulation of the natural processes in the ecosystem, it is unlikely that a future increase in elephant densities will induce irreversible changes in habitats. On the basis of findings I will propose optional management strategies aimed to retain the viability of the northern Botswana ecosystem under the influence of an even more prolific elephant population.

THE REQUIREMENTS OF ELEPHANTS

Effective management policies for the ecological control of any elephant population should relate to parameters that describe the status of the vegetation at various habitat types. Thus, understanding the ecological scales of ecosystem dynamics in conservation areas is fundamental for the conception of appropriate policies (Waithaka, 1997).

Elephants can be found throughout northern Botswana, including the large islands within the permanent swamps of the Okavango Delta. Elephants maintain seasonal movements and congregate in the northern rivers and parts of the Okavango Delta during the dry season, only to disperse at the onset of the rains. Early research indicated that elephants return and occupy the same home range each year, covering a distance of up to 200 km between the wet and dry season home ranges (Calef, unpubl.). Typically, by the end of October, elephants amass in the vicinity of the Linyanti river, reaching considerable densities of between 4-10 elephants/km2 (Craig, 1990). Therefore, the availability of surface water in this semi-arid environment is a prime fac-

tor that regulates the abundance of elephants and restricts their movements, particularly toward the end of the dry season. Subsequently, the spatial patterns of vegetation utilization are influenced by the extent of local elephant aggregations.

The proximity of water sources is probably the best factor that predicts the extent of utilization rates of woody plant species by elephants in northern Botswana. Nonetheless, high variations in utilization rate, particularly at the watercourse fronts, renders this factor inappropriate to explain elephant induced damage to plants throughout the region. I found that elephant damage to woody plants, which includes trampling of seedlings and scratching against the bark of mature trees, was confined to a distance of several hundred metres from the water sources examined (Ben-Shahar, 1993). Hence, the resulting elephant impact to plants is unlikely to prevent the formation of woodlands beyond the close proximity to the water source.

I consolidated the findings on the damage to woody plants through the provision of a classification of plant communities in northern Botswana with respect to elephant utilization rates of plants and other types of damage that I observed. The classification segregated between three key plant communities dominated by mopane *(Colophospermum mopane)*, Rhodesian teak *(Baikiaea plurijuga)* and camel thorn acacia *(Acacia erioloba)*. These woodland habitats not only differed in plant species composition, but also with respect to prevailing elephant utilization rates, the occurrence of fire and the effects of other large herbivorous species as well as the effects of flooding on plants. Elephants range within each of these habitat types and reach considerable densities in some. However, other than in mopane woodlands, there were no indications that elephants exert considerable influence on woody plants in other habitat types.

ELEPHANTS ARE ONE ECOLOGICAL FACTOR

While elephants have a principal role in the regulation of the northern Botswana ecosystem and probably reduce the standing biomass far more by comparison to other herbivorous species, the role of other factors cannot be ignored. Fire has profound effects on the structure of woodlands and the survival rates of woody plants, particularly in areas where burning is frequent. In East Africa for example, the effect of fire and elephants is synergetic and exacerbate the damage to existing woodlands (Dublin et al., 1990). In northern Botswana, although fire and elephants may jointly affect the vegetation at some habitat types, the synergetic influence of both factors was found to be relatively light (Ben-Shahar, 1998). However, it seems that frequent annual fires, particularly the runaway fires that invade the northern parts of Chobe National Park, accelerate tree mortality in woodland habitats. Other habitats, such as those dominated by mopane and camel thorn, may also endure annual burning. Nonetheless, the heat loads, burning frequency and extent of burnt areas are much reduced because of the generally sparse grass cover. Subsequently, the detrimental effects of fire are less apparent.

SOME MANAGEMENT OPTIONS

The case of elephants in northern Botswana is unique in southern Africa because of the large size and openness of the national parks to even larger buffer zones designated as hunting areas and forest reserves. In spite of the huge range available for elephants the question pertains, how many elephants can northern Botswana sustain? Through the use of mathematical models that incorporated field measurements of plant survival rates and local elephant densities, I found that the northern Botswana region can sustain more elephants than the current estimate for the elephant population without incurring biodiversity loss (Ben-Shahar, 1996a,b). Currently, average elephant densities in northern Botswana approximate 1 elephant/km^2. A year round presence of more than 10 elephants/km^2 will induce an irreversible decline of plant densities and plant biomass. These estimates were derived for worse scenario conditions represented by consecutive years of drought.

If current conditions prevail, the elephant population will continue its growth until food resources become scarce. In the long term, once the elephant population reaches a certain capacity, it will level off and may subsequently decline as a result of increased

mortality and reduced recruitment rates. In this natural process, elephants will change their habitats, namely vegetation structure, but will not induce an irreversible change culminating in the loss of existing biodiversity. It is impossible to predict that the current climate patterns, composition and abundance of fauna and flora and the extent of human pressure will remain for many years thereafter. In any case, my findings exonerated the elephant as a principal factor to induce biodiversity loss. On the contrary, occasional and localized reductions of biodiversity resulting from intensive elephant activity will contribute to the resilience of the ecosystem. From an ecological perspective, the pertaining issue for wildlife managers, thus, will be the acceptable form of vegetation structure, as opposed to the contemporary level of the elephant population.

While severe elephant impact on the vegetation in northern Botswana is unlikely to affect the biodiversity of plant communities, high elephant densities will alter the structure of woodland habitats. A concern is often expressed as to the future welfare of the indigenous Chobe bushbuck. A small population of this subspecies dwells in the thickets that characterize the Chobe river front. With the opening of the vegetation due to elephant browsing and excessive trampling, it is feared that the bushbuck that relies on its food sources and cover protection from the unique vegetation that grows along the south river bank will become extinct. It appears, however, that the dozen or so individuals found along a defined strip on the eastern part of the Chobe river (Ben-Shahar, unpublished data), represent a marginal decline in numbers by comparison to an earlier survey conducted more than two decades before (Simpson, unpubl.). Although the sample size is too small to yield weighty scientific evidence on the population trend of the Chobe bushbuck, it nevertheless suggests that large aggregations of elephants along the Chobe river front did little to affect the indigenous bushbuck.

Even though the change of habitat structure as a result of elephant activities will not bring the demise of plant and animal species, management policies can, rightly, propagate the preservation of present habitat conditions. Such a policy may be anchored for example, in the retention of a landscape form for the maintenance of natural aesthetics for tourists. Alternatively, a particular woodland habitat may present a unique combination of plant communities and a landscape form not found elsewhere in the region.

In northern Botswana, management objectives pertaining for the preservation of a specific plant community and vegetation structure are most effective if they are applied on a localized scale. If the agents of habitat change are identified and the magnitudes of influence of individual factors are verified, it would still be a difficult task to control the factors on a regional scale. Yet, management activities that concentrate on relatively small areas and successfully isolate the obtrusive factors are likely to succeed. Specifically, if current pristine conditions of riverine woodlands along the Chobe river are to be preserved then the protection of defined areas from the activities of elephants and the occurrence of fire are likely to attain the objective. For example, some areas along the eastern part of the Chobe, close to Kasane include pristine woodlands that grow on the rocky slope toward the river front. Although these trees are common elsewhere in Botswana and southern Africa, the landscape formation is unique in the region. If the assemblage of tall crowned trees, such as the Natal mahogany *(Trichilia emetica),* the African star-chestnut *(Sterculia africana)* and the baobab *(Adansonia digitata)* is to be protected from the harmful effects of elephants, then sections of the pristine woodlands can be fenced off with fire barriers to ensure the preservation of this unique and picturesque landscape.

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West Bengal - Committed to Rhino Conservation yet A Major Entrepot for Endangered Wildlife Products

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INTRODUCTION

The town of Siliguri in West Bengal is one of the main entrepots in India for wildlife products. Many types of illegal wildlife items are sent to Siliguri such as rhino horns, elephant tusks and tiger bones for export to Nepal, Bhutan, China, Bangladesh, Thailand and elsewhere. These items come from north-east India, but also from other parts of India, Bhutan, China and Nepal. Siliguri is also noted for selling large quantities of consumer goods at low prices, which have been smuggled into India.

Also in West Bengal, not far from this notorious trading town, are two important rhino populations where rhino numbers have been rising in recent years (in Jaldapara Wildlife Sanctuary and Gorumara National Park). It is surprising, with so much illegal activity in the northern part of the state, that the rhinos are not poached. This has not happened due to the high priority the state government gives to rhino conservation.

However, much more attention must be focused on exposing the main trade routes in the northern region of West Bengal if the rhinos and other endangered wildlife such as the tiger, leopard, snow leopard, clouded leopard and golden cat are to be protected in the future. It is hoped that this article will help to bring more attention to the need to close down the massive illegal trade in wildlife products in and around Siliguri.

WEST BENGAL'S TRADE ROUTES FOR WILDLIFE PRODUCTS, INCLUDING RHINO HORN

In the northern part of West Bengal, the centre for the wildlife trade in north-east India, there are three main towns involved in the illicit commerce in wildlife products: Darjeeling, Jaigaon and Siliguri (see Figure 1).

Darjeeling

Darjeeling is a hill station with a population of about 85,000, located at 2,134 metres. Most wildlife has been eliminated in this area, but in the surrounding Himalayan mountains, especially in nearby Sikkim, endangered and rare wild animals are trapped and hunted for trade, including the red panda, Himalayan black bear, leopard, snow leopard, clouded leopard and musk deer. The hunters are the local people of the region, while the traders in Darjeeling are mostly Tibetans, Nepalese and Marwaris (a successful merchant caste originally from Rajasthan). Very few recent arrests have been made, but on 17 March 1997 two leopard skins and nine other endangered animal skins were seized and one person arrested (Anonymous, 1997). Illicit wildlife products such as these are normally transported to nearby Nepal, Bhutan, China and places within India, especially Siliguri and Calcutta. In 1996 a new route opened from Darjeeling when a regular bus service was started connecting Darjeeling with Nepal. Traders took advantage of this and according to confidential reports exported to Nepal cat skins, rhino horn, ivory and live animals.

The Jaigaon area

Much wildlife passes through Jaigaon, on India's border with Bhutan, to Phuntsholing just inside Bhutan. These twin towns are significant entrepots for illegal wildlife products. Phuntsholing, a market town with businessmen from Nepal, India and Bhutan, is notorious for its trade in rhino horn. Menon (1996) and Martin (1996) have reported this illegal commerce, among others, while Martin (1996) and Breeden and Wright (1996) have documented the India/Bhutan rhino horn connection. It is difficult to obtain much exact information on quantities of rhino horn, destined for Bangkok and

elsewhere farther east, being moved from India (via Jaigaon and Phuntsholing) to Bhutan's international airport at Paro. According to confidential sources in West Bengal, a Taiwanese resident sold ten horns (weighing 4 kilos) to two Koreans in a Phuntsholing hotel in 1995. The horns probably came from Assam's Manas National Park. As well as rhino horn, Phuntsholing traders obtain tiger skins, tiger bones, musk deer pods, bear gall bladders and elephant ivory from Bhutan, India, Nepal and China. Almost all are eventually exported (Wildlife Protection Society of India, Menon et al., 1997, and confidential sources in India).

Siliguri

Siliguri is the main trading town for wildlife in the region. An extremely ugly, dirty, crowded and noisy town, it is conveniently near Bhutan, Nepal and China with good rail and road links and an airport. Siliguri is noted for large quantities of contraband consumer goods, which are usually smuggled in from Nepal. They are sold mainly by Bengalis and Marwaris in the appropriately named Hong Kong

Figure 1. Map showing the locations of Darjeeling, Siliguri and Jaigaon.

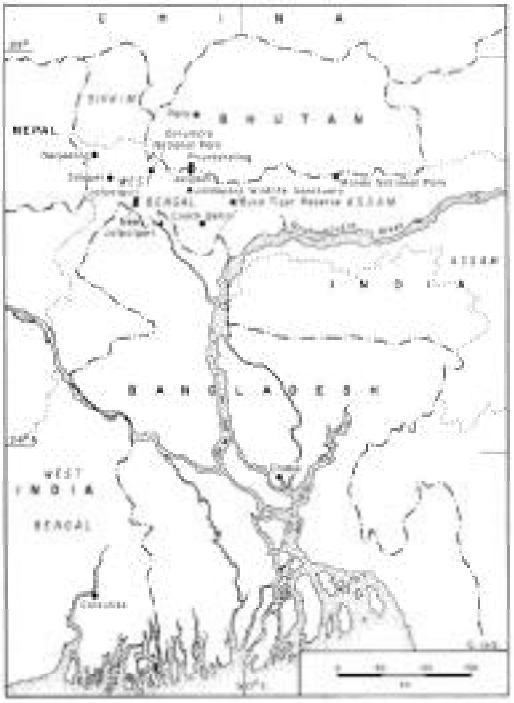

Photo Credit: Esmond Martin

Photo 1. The hill town of Darjeeling is famous as a resort and tourist centre, but is also known for its illegal wildlife traders

Photo Credit: Esmond Martin

Photo 2. Siliguri in the northern part of West Bengai, is the center for the illegal wildlife trade in the region. The town is booming economically, but it is ugly and noisy.

market, a huge retail market in the centre of the town where prices can be 40% less than in other Indian bazaars.

Certain conservationists and government officials in India are aware of Siliguri businessmen who are having a negative effect on wildlife conservation in north-east India, Nepal, Bhutan and parts of China. Siliguri is a major entrepot for elephant ivory, cat skins, musk deer pods, bear gall bladders, live leopards and especially rhino horn.

Ivory

In order to meet the demand for ivory in Siliguri, from 1979 to 1997 at least 27 elephants were poached in West Bengal (at least 15 in the Buxa Tiger Reserve) with a slight increase in the early and middle 1990s compared with the late 1980s (Wildlife Protection Society of India, pers. comm., 1998 and Raha, unpubl. 1996). As well as this ivory, more came to Siliguri from illegally killed elephants in Orissa and Bihar. In 1995 an ivory trader was arrested in Calcutta who admitted selling tusks regularly to a businessman in Siliguri who in turn sent them to Nepal (confidential source in West Bengal). This is very plausible as there is strong evidence that ivory also is moved from Siliguri to Calcutta and then exported (Menon et al., 1997 and confidential sources in Siliguri). Good quality raw ivory sold for 6,000 rupees ($165) to 9,000 rupees ($248) per kilo in 1997 in Siliguri. There is also a trade in Siliguri for fake elephant ivory made out of cow and elephant bone and also real tusks filled with white cement; these are usually made in villages between Jaldapara and Cooch Behar.

Cat skins and claws

Cat skins and claws are frequently traded in Siliguri. A snow leopard skin in excellent condition earned exporters in 1997 30,000r ($826) to 40,000r ($1,102). There have been several arrests of traders in and around Siliguri dealing in cat skins. In late 1994 police arrested four people and seized 89 leopard skins and a tiger skin which had come from Uttar Pradesh by train and were about to be taken by truck to Nepal (Anonymous, 1995 and the Wildlife Protection Society of India, pers. comm., 1998). This gang, partly based in Siliguri, had also been trading in bear gall bladders, musk deer pods and rhino horn (Anony-

Photo Credit: Esmond Martin

Photo 3. Some of the major rhino horn traders in Bhutan have lived in Thimpu, the capital.

mous, 1995b, Anonymous, 1995c). In September 1995 four tiger claws were seized in Siliguri (Belinda Wright, pers. comm., 1999). In early 1996 20 leopard skins and a tiger skin were confiscated at New Jalpaiguri's railway station, just eight kilometres south of Siliguri; skins probably came from Assam and were to be sent to Calcutta businessmen (Anonymous, 1996). There is even a thriving trade in live leopard cubs from the Siliguri area to Nepal and Thailand via Burma (Wright, pers. comm., 1999).

Rhino horn

It is with rhino horn that Siliguri traders make most money, and there is thus a network of middlemen moving them from Assam to Siliguri and then mostly to Bhutan. This network has been active since about 1985, when Calcutta traders became uneasy about handling rhino horn due to increased vigilance by the authorities (Martin, 1996). From 1983 to 1997 18 rhino horns were seized in 22 cases in and around Siliguri compared to only one seized in Calcutta during this 15-year period (in 1995).

In June 1995 three senior members of the biggest syndicate trading in rhino horn were arrested by the Siliguri police after a large quantity of horns were offered for sale. It was the first arrest of its kind in India (Breeden and Wright, 1996; Anonymous, 1995b). The group consisted of a Taiwanese, a person of Chinese origin and a Tibetan. The police also seized two rhino horns weighing a total of 680g in a Siliguri hotel. Under interrogation, the men gave a

Photo Credit: Esmond Martin

Photo 4. Itinerant traders move around West Bengal selling traditional medicines. This Hindu, originally from Uttar Pradesh, was offering at the end of 1993 a tiger 'navel" for $3 to relieve epileptic fits, tiger fat for $3 per 20 grams to cure piles, and other wildlife products.

Table 1. Numbers of rhinos in Jaldapara Wildlife Sanctuary and Gorumara National Park.

Year	Jaldapara	Gorumara	Total
1985	14	8	22
1994	35	15	50
1996	43	17	60
1998	49	19	68

Source:Government of West Bengal, published and unpublished statistics.

Table 2. Government budgets for Jaldapara Wildlife Sanctuary and Gorumara National Park.

	Jaldapara		Gorumara	
Year	Rupees	US dollars	Rupees	US dollars
1992/3	8,500,000	281,271	1,400,000*	46,327*
1994/5	11,200,000	352,423		
1995/6	13,400,000	396,098	3,100,000	91,635
1996/7	15,700,000	438,793	4,000,000	111,794

* Gorumara was then a wildlife sanctuary of only 8.6 km^2.

Source:A.K. Raha, Conservator of Forests (Wildlife), West Bengal, unpublished statistics.

lot of information about their illicit operations. The Taiwanese, who was the group leader, claimed he had 62 horns weighing from 75 g to 1.4 kg each; he had recently sold ten, as mentioned above, to some Koreans in Phuntsholing. All the horns were stored in Phuntsholing, being safer there, as the Indian authorities cannot cross the border and the Bhutanese officials had allegedly been paid off. He further stated that he was planning to sell his horns over the next one or two years. He claimed he had sold 22 rhino horns in 1993 to the Bhutanese Princess, Deicky Wangchuk, in Phuntsholing. She had taken them from Paro airport to Hong Kong and then Taiwan where she was caught as was well documented at the time (Vigne and Martin, 1993).

Despite the arrest of the leaders of this major syndicate, traders in Siliguri are still selling rhino horn, but less as there has been reduced rhino poaching in Assam and West Bengal since 1994. In 1996 middlemen were offering for sale rhino horns at 100,000r ($2,837) per kilo near Siliguri; the same horns landed

Photo Credit: Esmond Martin

Photo 5. In the village of Gairkhata between Jaldapara Wildlife Sanctuary and Siliguri, low quality musk from this musk deer pod was on sale for $25 per ten grams in December 1993.

in an eastern Asian country by an Indian trader would be three times more, priced at about $8,500 a kg (confidential source, 1998).

There is evidence that some former Siliguri rhino horn dealers have left the business because of the large number of fake horns on the market in this northern part of West Bengal. This trade in counterfeit horns starred to increase in the early 1990s. They are made in the same region as the fake ivory from resins, buffalo horns and of bamboo with a heavy material inserted to increase their weight. In March 1997 a person working for the Wildlife Protection Society of India was offered a false rhino horn (made out of resin from a mould) in a house in Cooch Behar for 70,000r ($1,928). The seller said the price was cheap as he claimed he had obtained the horn from a government officer. Traders who hope to pass them off as authentic are exporting some of these spurious horns to Nepal.

THE SUCCESSFUL CONSERVATION OF THE GREATER ONE-HORNED RHINO IN WEST BENGAL

The State's rhino population has expanded rapidly in recent years from 22 in 1985 to 68 in 1998 (see Table 1). This includes two rhinos bought from Assam in 1995 to increase the genetic pool. The Gorumara National Park population is now the highest for over 60 years at 19 animals while the Jaldapara Wildlife Sanctuary population is 49 rhinos. Only two rhinos have died in West Bengal between 1994 and 1998.

In March 1996 a poached female rhino was poisoned inside Jaldapara Wildlife Sanctuary, but its horn was not stolen. In September 1997, a rhino died of unknown causes and its horn was stolen inside the Sanctuary. Several days later, the horn was recovered in a hut nearby through an informer and the two people involved were arrested.

Several reasons for the success in almost eliminating rhino poaching in West Bengal are described below.

High budgets

The State government has allocated increasingly large amounts of money for rhino protection (see Table 2). In Jaldapara, an area of 216 km^2, the government budget has risen from 8,500,000r ($281,271) in 1992/3 to l5,700,000r ($438,793) in 1996/7. This latter figure works out at $2,031 per square kilometre, one of the highest in the world for a government sanctuary. The State budget for Gorumara has more than doubled over the same period from $1,400,000r ($46,327) to 4,000,000r ($111,794), while its size has increased in 1994 from only 8.6 to 80 square kilometres when it was upgraded from a wildlife sanctuary to a national park. Even with Gorumara's considerable expansion in size, the State government is spending $1,397 per square kilometre, a considerable sum.

For Gorumara, the increased budgets are going mostly towards community eco-development projects (such as irrigation schemes, roads, beekeeping and growing mushrooms), for the planting of 100 hectares of grasslands to improve rhino habitat, for the construction of roads and bridges within the Park, and for improved anti-poaching activities. For Jaldapara, the grassland areas have been expanded, and the electric fence has been extended to 80 km (covering 75% of the boundary) to prevent rhinos from wandering out into the neighbouring farmland and to help keep out poachers. Community eco-development projects have been increased for Jaldapara. and the communications' network for anti-poaching has improved.

Effective patrol operations

There has been a high concentration of manpower for patrol work around both protected rhino areas in West Bengal. In Gorumara there are two range officers, six deputy range officers, plus 60 forest guards and game watchers who all patrol the Park. This is almost one person per square kilometre. They have ten double-barrel shotguns and seven .315 rifles. There are also three patrolling elephants. Jaldapara has four range officers, ten deputy range officers plus 60 forest guards and watchers in the Sanctuary. They have 42 double-barrel shotguns, nine single-barrel shotguns and 18 .315 rifles and 16 patrolling elephants. In both rhino areas the patrol camps have modern radio sets to improve communications, and Gorumara has three watch tow-

ers while Jaldapara has five, manned throughout the day and night, which greatly help field staff to detect poaching gangs.

Improved intelligence

Due to the large number of community eco-development projects, especially in the vicinity of Jaldapara, relations between the Forest Department staff and the local people are good. The Forest Department has thus been able to set up a reasonably efficient informal intelligence network among the villagers. Occasionally, the Forest Department pays for information but not officially as there are no funds provided for informers. Senior forest officers have recently applied to the State government for official authorization for financial assistance to pay informers, as it is now considered a high priority (A.K. Raha, Conservator Forests (Wildlife) West Bengal government, pers. comm., 1998). Forest Department officials are making a special effort around Gorumara to encourage villagers to support the Park and thus the villagers are preventing poachers from passing through their land (N. Singhal, DFO, Wildlife Division, Jalpaiguri, pers. comm., 1998).

High staff morale

Due to the government giving priority to wildlife conservation in Jaldapara and Gorumara, staff morale is high compared with most wildlife areas of India and the field staff are bard working. The West Bengal authorities try to put their most experienced and dedicated staff into these two protected rhino areas and fully support them politically and economically (Raha, pers. comm., 1998).

Rhino poaching has been insignificant for many years in West Bengal as poachers perceive that the dedicated staff protect the State's rhinos extremely well. Jaldapara's 49 rhinos and Gorumara's 19 rhinos are not worth the risk pursuing, compared with 1,250 in Assam's Kaziranga National Park, which is close by. And recently, Kaziranga's budget has been cut and the dedicated staff are struggling in their work, so attempts at rhino poaching there make far better sense to a would-be poacher than in West Bengal.

Further requirements for Jaldapara and Gorumara

There are, however, more requirements if this rhino conservation success is to continue. According to N. Singhal (pers. comm., 1998), who is the DFO in charge of Gorumara, the Park needs improved staff quarters, more vehicles to add to the existing two, two or three more domesticated elephants for patrol work, and perhaps cash rewards to give to the junior staff for outstanding work. The staff want to maintain support to the villagers by helping to alleviate their economic problems. These problems include grazing for their large number of cattle, a lack of adequate supplies of firewood and timber, plus damage by wild animals to domestic stock and crops, as well as injuries and deaths to humans. In 1997, elephants in and around Gorumara killed five people (Singhal, pers. comm., 1998). For Jaldapara, an area nearly three times larger than Gorumara with over double the size of Gorumara's rhino population, West Bengal's Conservator of Forests (Wildlife) believes (pers. comm., 1998) the following strategies are the topmost priority in order to conserve the rhinos. Due to the change in the course of the Torsa river, the grasslands favoured by the rhinos have dried up and have been invaded by non-palatable grasses. Water and soil moisture conservation is thus necessary to regenerate the palatable grasses as preferred by rhinos. As for Gorumara, more domesticated elephants, perhaps six, and two more vehicles to make a total of four are wanted for patrol work, and repairs are required for roads and more staff accommodation. A formal intelligence network must also be established with a fund of about l00,000r ($2,500) a year to pay informers for bringing reliable information on potential poachers and rhino horn traders around Jaldapara.

CONCLUSION

The West Bengal government, from the Chief Minister downwards, has given much greater importance recently to rhino conservation *in situ* than in the past, and as a result the rhinos have done very well (Ashok Kumar, Wildlife Protection Society of India, pers. comm., 1998). The expansion in size of Gorumara by almost tenfold in 1994 illustrates the State's com-

mitment. This is especially surprising considering that the human population around this Park has been rising due to the influx of many people from Bangladesh and Nepal. The population density in the district is over 350 people per square kilometre (Singhal and Gupta, unpubl.).

There is a major contradiction in West Bengal's rhino conservation policy. The State government pays particular attention to rhino protection *in situ* in Jaldapara and Gorumara, but very little effort has gone into eliminating the rhino horn traders in Siliguri, Darjeeling and Jaigaon. Apart from the June 1995 arrest of syndicate members in Siliguri, which was initiated by an NGO, no traders in wildlife products in northern West Bengal have been convicted and jailed. Even the three arrested in 1995 with the two horns were not jailed for long. The West Bengal authorities are aware of these shortcomings in arresting and convicting illegal wildlife traders. The Management Plan of Jaldapara Wildlife Sanctuary West Bengal (Raha, unpubl. 1997), written by officials of the wildlife wing in 1997, recommends that a fully fledged legal cell be established to help "draw up the charge sheets and pursue the cases in court."

Far more needs to be done to apprehend wildlife traders in India. Extremely few are ever convicted and put into prison for more than a few days. For the moment, it appears that the wildlife trade syndicates in the Siliguri area are satisfied with the numbers of rhino horns they are receiving from rhinos poached in the neighbouring state of Assam, but this may change in the future putting added pressure on West Bengal's rhinos. It is therefore imperative that officials in West Bengal put a high priority on arresting and convicting illegal wildlife traders, as they do on protecting the 68 rhinos in Jaldapara and Gorumara.

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BOOK REVIEWS

THE RHINOCEROS IN CAPTIVITY: A LIST OF 2439 RHINOCEROSES KEPT FROM ROMAN TIMES TO 1994

L.C. Rookmaaker
SPB Publishing bv, The Hague, 1998
lv, 410 pp, 166 illustrations, $120.00.
ISBN 90 5103 134-3

Reviewed by Lucy Vigne
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Dr Kees Rookmaaker is the curator of the Rhino Museum at Melkrivier in the Northern Province, South Africa. He has collected detailed information on rhinos in captivity (or as he prefers it 'in human hands') for 25 years or more and now makes available, to all who are concerned with the rhino, the record he has compiled. The book is a great achievement and is to be commended for its fulfilment of its purpose of conveying information about every traceable individual rhino kept in captivity from earliest times. It also brings a secondary gain in the increase to our knowledge of the animal and the benefit thereby to its status as a species that has declined in numbers alarmingly in the wild. It 'has always fascinated us by its prehistoric bulk, its massive power, and its lack of conventional beauty'. Dr Rookmaaker's book adds much to that fascination.

He has divided the book into ten sections starting with a clear introduction, a chapter of demographic and reproduction statistics, and a chapter on early rhinos mostly of unknown species in captivity (going back to Alexandria in 275 BC until 1699) in Rome, China and the Near-East. The next five chapters list the 397 Indian, 22 Javan, 96 Sumatran, 775 black and 1,105 white rhinos recorded in captivity. Within each chapter is a table of collections where the species has been exhibited, a table of population changes, a chronological list of all known species, and a list about the specimens which covers the main body of the data. These chapters are followed by a 16-page bibliography and an excellent index.

Captive Javan rhinos are very few due to their rarity and inaccessibility in the wild - only four finally made it to be exhibited in distant zoos, in Adelaide, Calcutta and, the earliest, London in 1874. The first white rhino was held in a zoo only as recently as 1946, but 479 (42%) have been born in captivity since 1967. As both the northern and southern subspecies of the white rhino have neared extinction at different times, breeding programmes in zoos, sanctuaries and parks have played, and will play, their part in their survival. Of the black and Indian rhinos, 292 (38%) and 137 (35%) respectively were born in captivity while only four Sumatran (4%) and no Javans were. Captivity has also benefited research into the rhino's physiology and habits. Dr Rookmaaker does not stress this point but then one of the strengths of his book is that he does not stray from his basic purpose, which is to list, identify and locate all captive rhinos on record. He says that there are omissions in his record, notably for China where data is hard to collect. This leaves scope for follow-up work. It could have also been helpful to have had graphs showing the rise and fall of captive wild and bred species world-wide through history. Perhaps Dr Rookmaaker could consider such work for a future *Pachyderm* piece. He included details of certain rhinos translocated into sanctuaries - this is interesting but extraneous material as not all such rhinos in sanctuaries are listed, as he admits on page 2: this could be another book in itself. There is another small digression when he considers the need to differentiate taxonomically correct subspecies of

rhinos. He quotes Raoul du Toit's contributions to *Pachyderm* in the 1980s on the black rhino subspecies.

Even within the rather limited confines of his subject matter, there is much to interest the general reader, not least in the plentiful and fascinating illustrations (although these are unsourced). The famous Dürer woodcut was based on a merchant's drawing done in Lisbon in 1515, and the Pietro Longhi rhino painted in Venice in 1751 may have been a Javan. The tufted-eared Sumatran in Fig. 78 makes clear the naming of 'Rapunzel' in the Bronx Zoo. Surprising facts are many throughout this book - Joymothi, the Basel matriarch, had 70 descendants at the time of writing, and Clara from Assam, who toured Europe in 1758 was priced too high even for Sun King, Louis, XIV's elastic purse. Such subtext gives the book a third gain: it entertains while it instructs.

LE RHINOCÉROS DANS L'ART DE LA PRÉHISTOIRE A NOS JOURS.

Pierre Millet
Paris, privately published, 1995, pp, i-v, 1-83, illustrated. Price not stated.

Reviewed by Kees Rookmaaker
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In that wonderfully chatty and informative newsletter *Really Rhinos!* which is already in its twelfth year, the editor Judyth Lessee regularly includes profiles of people affected by some kind of 'rhinomania' and who collect everything 'rhinocerotic' obtainable. That such people are not only found in the Americas is obvious, and Pierre Millet of Paris, France is a case in point. Although he would have liked to state in truth that he was drawn to rhinoceros horn in search of an ingredient which could give a local brand of cigarettes some kind of aphrodisiacal property, his hobby in fact started when searching for a nicely esoteric way to occupy his ailing wife. Soon the house was filled with hundreds of these solitary animals in all shapes and kinds. His book, a slim volume of 83 pages, is a rather more comprehensive tour through realms of rhinocerotic art. One chapter is devoted to the animal in rock engravings, found in France and in Africa. The second chapter deals with rhinos in China, in the Indus valley, in Egypt and in comparison with unicorns. He continues with the rhinoceros depicted by Dürer and its manifold derivations. A last chapter is a mixed bag of more recent images, including the life-size bronze rhinoceros made by Alfred Jacquemart in 1877 and now standing in front of the Musée d'Orsay in Paris, another in mahogany by Mateo Hemandez found in the gardens of Armande Béjart in Meudon, just outside Paris, and a 1979 painting of a rhinoceros being carried on a bier by Stanislas Lepri. Zoological notes, a chronology of paleontological styles, an extract of a traditional Chinese medicine, the unicorn passages in the Bible, and a bibliography of 58 items conclude the volume. Millet did not aim his book to be as comprehensive as T.H. Clarke's *The Rhinoceros from Darer to Stubbs* (1986) and it would fall short in many other respects as an academic treatise. The French text is intricate, the plates interesting but often poorly reproduced. This book will appeal to any rhinoceros affoncianado looking for the esoteric, the eccentric, the unusual, not least because the book, privately published, seems to be just about unobtainable.

LE RHINOCÉROS: AU NOM DE LA CORNE.

Alain Zecchini
Paris, Editions l'Harmattan, 1998. pp. 1-270, with 8 monochrome plates.
ISBN 2-7384-6677-x. Price in UK: STg: 22.95.

Reviewed by Kees Rookmaaker
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Disgraceful, antediluvian, anachronistic, heavy, homely, stubborn, solitary, irascible, dangerous, but more than this, essentially lovable. That is how the author starts this book stated to be the first monograph on the rhinoceros in the French language. For once, that claim rings a bell of truth, unless one would consider Claude Guérin's extensive (118Spp.) treatise, primarily on extinct species, but

with many interesting comparisons with the recent rhinos (Les Rhinoceros du Miocene terminal au Pleistocene superieur en Europe occidentale, 1980). Alain Zecchini works as a scientific journalist specialising in nature and wild animals. I am one of those people who starts reading a book at the end. Here one notices the absence of an index, but a reasonably comprehensive and up-to-date bibliography, unformatted, with one hundred titles in English as well as French. The text itself is indeed comprehensive, consisting of many short chapters on different subjects, including systematics, morphology, social structure, role in the ecosystem, interspecific relations, interactions with man, the recuperation of the white rhinoceros, trade and even a special chapter on the Bhutanese princess who was arrested in Taiwan in 1993 with 22 rhino horns in her luggage. It is refreshing to find the book arranged by subject matter than in the traditional species oriented approach. Zecchini did not intend to present new facts or new insights, but he has achieved a remarkably readable and well-researched overview of the biology and conservation of five recent species of rhinoceros. Following the French tradition of publishing, the book is a paperback, with well reproduced but uninteresting illustrations all combined on eight plates, and with rather unimaginative computer typesetting. Zecchini's text is a welcome addition to the rhinoceros literature as it introduces animals to a wide public in francophone countries.

THE AFRICAN ELEPHANT AS A GAME RANCH ANIMAL

Proceedings of a symposium, 29-30 April 1991
Re-edited by J. van Heerden and B.L. Penzhorn, 1995
South African Veterinary Association: Wildlife Group, Ondersteport, 0110, RSA
ISBN 1-875088-02-4

Reviewed by Thomas W. deMaar, D.V.M.
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This publication is a re-edited version of the 1991 symposium, part of a series that pulls together a wealth of information from wildlife scientists and managers from southern Africa. This well executed series contains much new information presented by professionals directly from their own research and observations. Other titles that would interest wildlife managers are on buffaloes, sable antelopes, cheetahs, lions and leopards. Of particular interest to the readers of *Pachyderm* would be the proceedings of the 1994 symposium, "Rhinos as Game Ranch Animals". The entire series is a necessary component of every wildlife manager's library.

The elephant book starts with a historical perspective of the elephant in southern Africa, population numbers, ranges and elephant's relationship with man. Several chapters discuss elephant habitats, the positive and negative effects of elephants on their ecosystem and how these factors affect the creation of elephant sanctuaries. There are guidelines for determining minimum space requirements, minimum group size, herd structure and minimum facilities needed to create new elephant populations. Advantages and disadvantages of placing elephants on game ranches are discussed.

Two chapters contain a discussion of the hardware necessary for electric fencing and boma construction. The fencing, boma and ecosystem chapters will assist those who wish to maintain elephants in enclosed or semi enclosed areas as well as those wishing to exclude elephants.

Certain articles such as those regarding capturing, culling, and hunting of elephants will inflame some individuals involved in the elephant debate. However the writers are cognizant of the controversies which surround their topics and present the information as thy should; as professionals who have grown up and lived with elephants. They are aggressively exploring all the options that man has in order to live in harmony with elephants. Their experiences should be taken into account.

A collection of physiology and veterinary topics are presented including: 1) health conditions during capture and boma operations (a summary of 761 individuals), 2) blood values of elephants under a variety of anaesthetic regimens, 3) digestive physiology, 4) post mortem protocols, and 5) infectious diseases (or the lack there of except for anthrax). All together this impressive collection represents direct measure-

ments from well over 1,000 African elephants. Occasionally important omissions can be found where supporting information or references are lacking, citations are incomplete, and statistical comparisons would be useful.

One subject that is not addressed is research into the psychological well being and possible behavioural changes of elephants that are subjected to: conflicts with man, translocation or culling. The family structure of the elephant is well documented and disturbance of that may have long lasting effects. An Africa-wide retrospective study of the behaviour of elephant populations that have been modified by man certainly needs to be done.

The principal flaw in the book is its age. It defines the state of the art in 1991. As the world debate about elephants is so active, information quickly becomes dated. The chapter regarding legal and ethical aspects was written prior to the 1992 CITES conference. The re-edit of 1995 does not sufficiently compensate for the 4 years that transpired. Several other excellent works on elephants were published during that time and they have not been included (see below). The legal, ethical, and CITES issues have continued to evolve. This problem defines one of the rules of science; publish worthwhile results, then promote the publication.

Capture techniques have improved greatly One article states that only animals up to a maximum shoulder height of 2 m could be successfully moved. Eight years later successful translocations have been performed with fully grown males. (An indication of how fast this science is growing.) Considering the book's age a serious caution must be issued against quoting it directly. In the fast moving and opinion-laced world of the elephant, new information must be continuously sought before decisions are made.

As with each volume of this series an impressive bibliography has been assembled; these enrich the value of the books. In the elephant's case 1,212 references have been compiled and cross indexed by subject. All student of elephants should have access to this bibliography. Regardless of the age factor of this publication it should be included in the reading list of any serious elephant manager or researcher.

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LETTERS TO THE EDITOR

On Bibliographies and unpublished Reports

One of the tenets of science, essential to its universal and objective nature, is that results of experiments are reproducible and each step in an argument can be verified. Conservation surely is considered a branch of science. If an author finds it necessary to copy a fact or a conclusion from another source, it is customary to refer to that source, to avoid repetition and to allow the reader to verify that the passage is used accurately. When one examines a bibliography or a list of references, it is my firm belief that one should be able to go to a library and consult those sources. Of course, we have all experienced that it is never as easy as it should; one may have to visit multiple libraries or even write to the publishing authorities. However, diligent researchers should ultimately be able to verify the facts quoted from the items in the bibliography. It is an unfortunate tendency in papers relating to conservation issues to refer increasingly to documents, which are not available to the general public. In the latest number of *Pachyderm* at my disposal, for instance, there are eight papers on rhinoceros related subjects which include a list of references (115 items in total). When one analyses these references, one finds that 64 are publications (56%) as books, papers in journals or chapters in books. There are another 51 references (44%) to dissertations or theses (2), manuscripts (3) personal communications (10) and unpublished reports (37). I am sure that I am not the only one to experience that most of the items in the latter category of unpublished items are practically unobtainable: authors are unknown or have moved, and issuing bodies often do not make copies available. This has the unfortunate consequence that the data recorded as from these 51 sources are largely unverifiable, which defeats the purpose of quoting from them. There is no reason to argue against the production of internal reports and confidential papers, or to disallow the use of facts obtained privately. However, authors should be aware that the contents of these unpublished papers cannot be verified, unless of course one belongs to that elitist inner circle which is allowed to examine them. Science claims to be egalitarian rather than elitist. Reports should as much as possible be prepared for publication, at least stating the most important results, to appear in journals and books, to allow general dispersal and growth of knowledge.

Dr Kees Rookmaaker PO Box 124,
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Dear Editor,

Thank you very much for publishing the article on the community development projects in Nepal *[Pachyderm* 26, 88-99]. I fully endorse the observations and recommendations of the author. Community development outside the park boundaries is a most useful long-term investment, but as long as there is a demand for rhino horn and vast sums are being offered for it, the threat of poaching will continue to exist despite all the goodwill of the neighbouring people that may be created through such community effort. These endeavours will no doubt help reduce poaching, but it will not eradicate it and the moment you pull out the army and the protective staff which currently is one person per square kilometre in Chitwan and two persons per square kilometre in Bardia as the author has mentioned, I am quite convinced that poaching will increase. This situation applies not only to Nepal but also to India and we should not be prepared to take the risk. This is my frank and considered opinion and if you wish you could quote me. Good intentions are one thing and most welcome, but they cannot always stand in for temptation for lucre and one should not be starry-eyed.

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Pachyderm

Guidelines to contributors

Aim and scope

Pachyderm publishes papers and notes concerning all aspects of the African elephant, the African rhino and the Asian rhino with a focus on the conservation and management of these species in the wild. At the same time the journal is a platform for dissemination of information concerning the activities of the African Elephant -, the African Rhino - and the Asian Rhino Specialist Groups of the IUCN Species Survival Commission (SSC).

Submission of manuscripts

Where possible, manuscripts should be submitted both in hard copy and on floppy disk. Alternatively, the text can be submitted by e-mail. Whatever media are used, the hardcopy of the m/s must be identical to floppy and e-mail versions.

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Preparation of manuscripts

Manuscripts are accepted in both the English and French language. Where possible, an abstract should be provided in both languages.

Title page: The title page should contain the following: 1. Title, 2. Name(s) of author(s), 3. Full postal address(es), 4. Name of corresponding author to whom proofs and editorial comments will be sent.

Research and Methodology:
These should be not more than 5,000 words and be structured as follows: 1. Title page (as above), 2. Abstract of not more than 200 words (giving the scope of the paper, but not detailed results), 3. Introduction, 4. Materials and Methods, 5. Results, 6. Discussion, 7. Conclusions as appropriate), 8. Acknowledgements (optional, but brief), 9. References, 10. Tables, 11. Figure and photo captions, 12. Figures and photos.

Preferably figures should be provided in their original form, i.e. Excel files; maps as eps or tif files (l7xl5cm, 300dpi), when submitted in electronic form. The author/source of figures, maps and photographs must be clearly indicated.

Review and Opinion:
These should not be more than 5,000 words and must be clearly structured using headings. Third person narrative style is not recommended. In contrast to papers under "Research and Methodology", papers in this section focus more on the socio-economic aspects of conservation than on biology. They may include original research, like market surveys, but the main focus is on conclusions from long-term observations.

Notes from the Field:
The journal welcomes notes from the field. They may contain one figure and/or one table but should be brief.

Book reviews:
Pachyderm invites reviews of newly published books, which should contain no more than 1,500 words.

Letters to the Editor:
Letters commenting on articles published in *Pachyderm* or any other issue relating to the subject of elephant and rhino conservation in the wild are welcome.

Journal conventions:
- Vernacular names should be in lower case and accompanied by the scientific names in italics

on first mention. The authority for the name should also be included.
- Foreign words are italicized.
- All headings in lower case. No capitalisation of words like "government", "province", "river", etc.
- The plural with an 's' is used for describing more than one animal, e.g. rhinos, elephants.
- "z' instead of 's' is used in words like 'analyzed', 'immobilized', etc.
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- Measurements should be given in figures, e.g. 12 cm, except when at the beginning of a sentence.
- A number which is not a unit of measurement is spelt out unless it is greater than ten.
- Large figures are written with comma separator, e.g. 1,750.
- A full stop is put after initials and abbreviations (e.g. et al., pers. comm., i.e., etc...).
- No full stop in capital abreviations e.g. PO, country names like DRC, CAR, USA, titles like Dr, M, Ms, and Mt.
- Two authors are cited as X and Y, more than two authors are cited as X et al.

References:

Regardless of the type of paper references should be cited as follows:

Anonymous (1995b) Seizures and Prosecutions, *TRAFFIC Bulletin*, 15(3), 118.

Dobson, A.P. and May, R.M. (1986) Disease and conservation. In: *Conservation Biology: The science of scarcity and diversity* (Ed. M.E. Soulé). Sinauer Associates, Sunderland, MA, pp. 123-142.

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Unpublished reports are cited as follows:

Tchamba, M.N. (unpubl.) Elephants and their interactions with people and vegetation in the Waza-Logone region, Cameroon. PhD Thesis, 1996. University of Utrecht, The Netherlands, pp. 142.

Woodford, M.H. (in press) [Title]. [Journal].

- Not accepted are: "in prep."
- Government reports, reports to Wildlife Departments, MSc theses, PhD theses, etc. are to be cited as "unpubl."
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