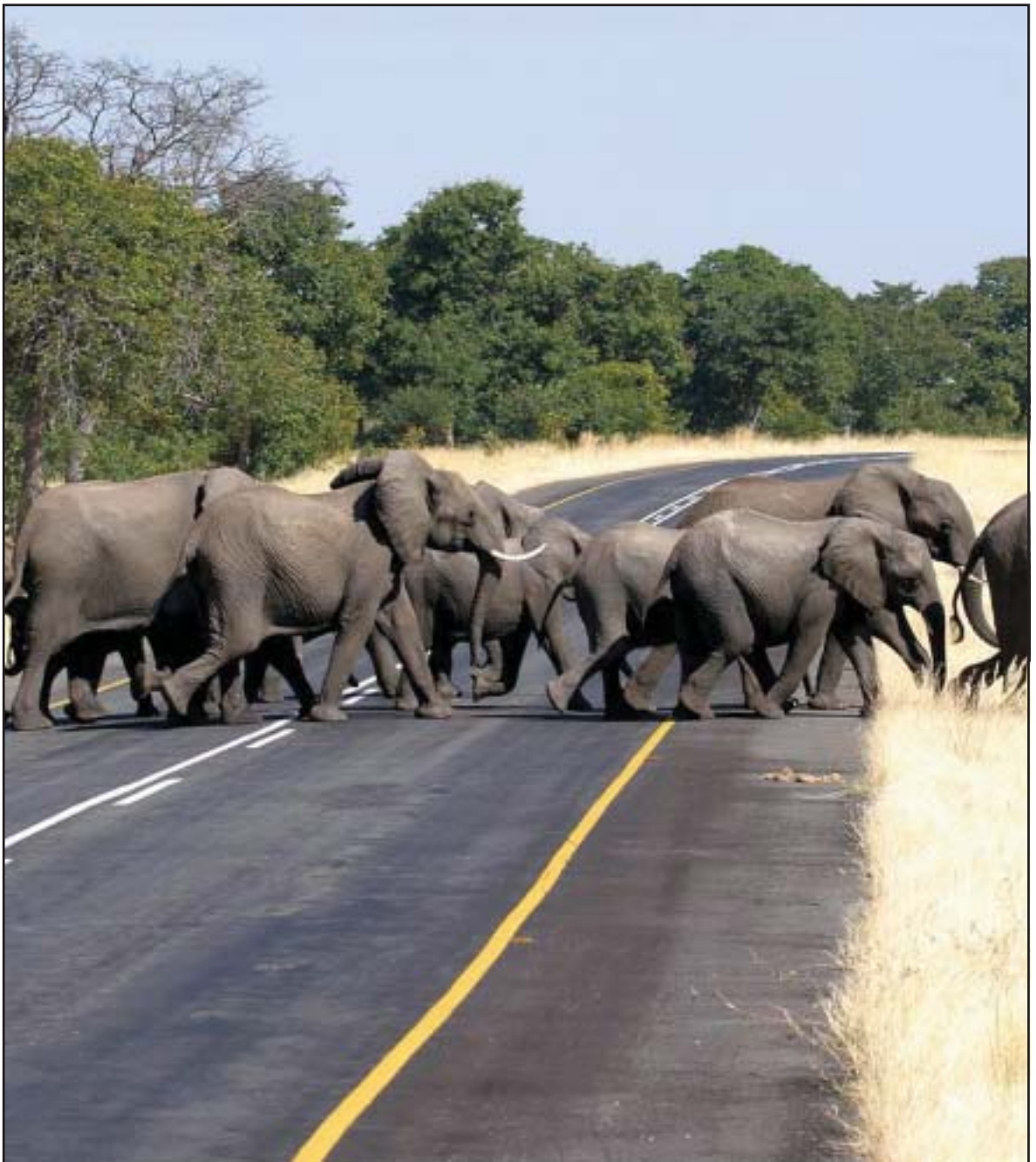


Pachyderm

January – June 2006

Number 40



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Pachyderm

journal of the African Elephant, African Rhino
and Asian Rhino Specialist Groups

January – June 2006

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CHAIR REPORTS

RAPPORTS DES PRESIDENTS

African Elephant Specialist Group report

Rapport du Groupe Spécialiste des Eléphants d'Afrique

Holly T. Dublin, Chair/Président

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This issue of *Pachyderm* was funded primarily from individual donations made through a new online fundraising system on the AfESG website. We extend many, many thanks to all those who contributed.

I am also deeply grateful to the UK Department for Environment, Food and Rural Affairs (DEFRA) who have just announced a £75,000 funding package to support our core activities! We are now hoping that other supporters will follow suit with similar contributions.

Re-appointment of the AfESG membership

The process for re-appointing the AfESG membership for the 2005-2008 quadrennium has now been completed. The 38 members (31 re-appointees and 7 new members) come from 20 different elephant range states. Each member brings a unique set of skills and experience which will undoubtedly help to maintain the AfESG on the cutting edge of elephant conservation. I would like to give an especially warm welcome to our new members: Mr. Emmanuel Danquah (Ghana), Dr Keith Leggett (Namibia), Dr. Esmond Martin (Kenya), Mr John Mason (Ghana), Dr Barbara McKnight (Kenya), Mr Awo Nandjui (Côte d'Ivoire) and Mr Joseph Tiebou (Cameroon). I look forward to working with all of you in the coming months. The full list of AfESG members can be found at the back of this issue.

Ce numéro de *Pachyderm* est principalement financé par les donations de particuliers, grâce à un nouveau système de récolte de fonds en ligne, sur le site du GSEAf. Nous remercions beaucoup, beaucoup, tous ceux qui y ont contribué.

Je veux aussi exprimer toute ma reconnaissance au département britannique de l'Environnement, de l'Alimentation et des Affaires rurales (DEFRA), qui vient d'annoncer un subside de 75.000 £ pour financer nos activités de base ! Nous espérons aujourd'hui que d'autres supporters suivront cet exemple avec des contributions similaires.

Appointement des nouveaux membres du GSEAf

Le processus de nomination des membres du GSEAf pour les années 2005–2008 est maintenant terminé. Les 38 membres (31 anciens et 7 nouveaux) proviennent de 20 états différents de l'aire de répartition des éléphants. Chacun d'eux amène un set unique de compétences et d'expériences qui serviront à coup sûr à maintenir le GSEAf à la pointe de la conservation des éléphants. Je voudrais accueillir très chaleureusement nos nouveaux membres : M. Emmanuel Danquah (Ghana), Dr. Keith Leggett (Namibie), Dr. Esmond Martin (Kenya), M. John Mason (Ghana), Dr. Barbara McKnight (Kenya), M. Awo Nandjui (Côte d'Ivoire) et M. Joseph Tiebou (Cameroun). Je me réjouis de pouvoir travailler avec vous tous dans les prochains

All AfESG members will for the first time be requested to input further information about themselves directly onto the new IUCN Commission Online Registration System. This system will enable members to manage their personal membership profile and to search for other members of the six IUCN Commissions and their contact details. IUCN Headquarters will shortly be sending all members an electronic "invitation to join", together with login and password information to access the system.

The African Elephant Database

With the entry of all new data into the African Elephant Database (AED) now completed, Julian Blanc, the AED Manager, has shifted his focus to the preparation of the African Elephant Status Report 2006 (AESR 2006), which is expected to be completed and released later this year. However, a number of logistical and financial challenges still lie ahead. Although a number of donors have been approached, we still have insufficient funds to print and distribute hard copies of the AESR 2006. Plans are underway, however, to hold a final editorial meeting of the Data Review Working Group in early July. To fill remaining funding gaps, we are currently exploring various online fundraising options, including novel approaches to printing and distributing the AESR, such as using 'print-on-demand' technology, which could substantially reduce the cost of producing the journal and allow a limited number of hard copies.

In view of the uncertain financial situation, and the potential impact on the continuity of the AED, we are also exploring a number of possible future scenarios. Among these is the suggestion to join forces with other SSC Specialist Groups to develop a database similar in scope and characteristics to the AED, but geared towards the monitoring of multiple species for which rich and detailed data are available. In a related development, we have made some headway towards reducing, or altogether eliminating, the high costs of maintaining GIS software licenses. Enlisting the help of a community of volunteer programmers, we have started a project to migrate the AED to an open source platform. The platform of choice is PostgreSQL, a powerful open source database that provides capabilities for the storage and analysis of spatial data. The objective of the project is to develop an application that can be used to maintain information on the distribution and abundance of any species,

mois. La liste complète de tous les membres du GSEAF se trouve au dos de ce numéro.

Tous les membres du Groupe seront priés, pour la première fois, de donner de plus amples informations sur eux-mêmes sur le nouveau système d'enregistrement en ligne de la Commission de l'UICN. Ce système permettra aux membres de gérer leur profil personnel en tant que membres, et de trouver ce qui concerne les autres membres des six commissions de l'UICN et leurs contacts. Le QG de l'UICN va bientôt envoyer à tous les membres une invitation électronique à rejoindre le système, avec un login et un mot de passe permettant d'y accéder.

Base de données de l'Eléphant africain

Comme toutes les nouvelles données ont été intégrées dans la Base de données de l'Eléphant africain (BDEA), Julian Blanc, qui en est le gestionnaire, se consacre désormais à la préparation du Rapport 2006 sur le Statut de l'Eléphant africain (RSEA 2006) qui devrait être terminé et diffusé plus tard, cette année. Néanmoins, un certain nombre d'obstacles logistiques et financiers se dressent encore. Bien que nous ayons contacté un certain nombre de donateurs, nous manquons encore de fonds pour imprimer et distribuer des copies papier du RSEA 2006. Il est prévu d'avoir encore une dernière réunion éditoriale du Groupe de travail pour la Révision des données, début juillet. Pour combler le manque de fonds, nous explorons actuellement diverses options de récolte de fonds en ligne, y compris de nouvelles approches pour l'impression et la distribution, telles que la technologie d'impression sur demande, qui pourraient sensiblement réduire les coûts de production du journal et limiter le nombre de copies papier.

Vu la situation financière incertaine et son impact possible sur la continuité de la BDEA, nous explorons aussi plusieurs scénarios envisageables. Parmi ceux-ci, il y a la possibilité d'unir nos forces avec celles des autres Groupes de spécialistes de la CSE, pour développer une base de données de portée et de caractéristiques semblables à celles de la BDEA, mais orientée vers le monitoring de multiples espèces pour lesquelles des données abondantes et détaillées sont disponibles. Parallèlement, nous avons fait quelques pas vers la réduction, voire l'élimination du prix élevé des licences pour le matériel SIG. En faisant la liste de toute une communauté de programmeurs

not just elephants. For more details, please visit the project site at www.pgfoundry.org/projects/wilddb/ where you can sign up to join the project and its mailing list.

Updates on conservation and management strategies and action plans

Sub-regional strategies

CENTRAL AFRICA

The Central African Elephant Conservation Strategy (CAECS) was finalized in late 2005 and the final document has now been disseminated to the wildlife authorities of Central African elephant range states, NGOs, donor agencies and other conservation partners. It is also available in Portable Document Format, in French and in English, at <http://iucn.org/afesg/tools>.

The CAECS was brought to the attention of the relevant ministers of all seven Central African elephant range states at a meeting organized by COMIFAC (Commission des Forêts d'Afrique Centrale) in Libreville, Gabon, in March 2006. We have recently been informed by the IUCN Regional Office for Central Africa that the Executive Secretary of COMIFAC will be contacting us soon on the next steps in getting this strategy integrated into the Convergence Plan of the Yaoundé Heads-of-State Process. We hope these efforts will not only increase political backing for the initiative, but also help generate funds for implementation, including the means to hire a dedicated AfESG Programme Officer to ensure the necessary technical support and coordination.

WEST AFRICA

A Letter of Agreement has now been finalized between the AfESG and the Convention of Migratory Species (CMS) on a detailed workplan for the implementation of the inter-governmental Memorandum of Understanding on conserving elephants in West Africa, which was signed into effect by 12 of the 13 West African elephant Range States at the meeting of the 8th Conference of the Parties to CMS in November 2005. The total CMS contribution of US\$ 50,000 towards the AfESG's operational budget for West

volontaires prêts à nous aider, nous avons lancé un projet visant à déplacer la BDEA vers une plate-forme ouverte. La plate-forme de choix est PostgreSQL, une puissante base de données ouverte qui offre la possibilité de stocker et d'analyser des données spatiales. L'objectif du projet consiste à développer une application qui pourra être utilisée pour conserver les informations sur la distribution et l'abondance de toutes les espèces, et pas seulement les éléphants. Pour de plus amples détails, veuillez visiter le site du projet sur www.pgfoundry.org/projects/wilddb où vous pourrez vous inscrire pour vous joindre au projet et figurer sur sa *mailing list*.

Mises à jour des stratégies de conservation et de gestion

Stratégies sous-régionales

AFRIQUE CENTRALE

La Stratégie de Conservation de l'éléphant en Afrique Centrale (SCEAC) a été finalisée fin 2005, et le document final a été distribué aux autorités en charge de la faune, aux ONG, aux agences donatrices et aux autres partenaires de la conservation dans les Etats de l'aire de répartition de l'éléphant en Afrique Centrale. Il est aussi disponible en format pdf, en français et en anglais, sur <http://iucn.org/afesg/tools>.

La SCEAC a été portée à l'attention des ministres concernés de chacun des sept Etats lors d'une réunion organisée par la COMIFAC (Commission des Forêts d'Afrique Centrale) à Libreville, au Gabon, en mars 2006. Le bureau régional de l'UICN pour l'Afrique Centrale nous a informés récemment que le Secrétaire exécutif de la COMIFAC nous contacterait prochainement au sujet des prochaines étapes requises pour intégrer cette stratégie dans le plan de convergence du Processus des Chefs d'Etat de Yaoundé. Nous espérons que ces efforts augmenteront l'appui politique de l'initiative et qu'ils aideront à récolter des fonds pour la mettre en œuvre, y compris les moyens pour engager un responsable de programme dévoué afin d'en assurer le support et la coordination techniques indispensables.

AFRIQUE DE L'OUEST

Une lettre d'agrément est maintenant finalisée entre le GSEAf et la Convention sur les Espèces Migratrices (CEM), avec un plan de travail détaillé pour la mise

Africa, together with the recent contribution from the French Government, ensures that the AfESG should be able to continue providing technical support and coordination for implementation of the West African Elephant Conservation Strategy (WAECS) over the next few years.

National strategies

The development and implementation of national elephant conservation strategies continues in many Range States. Progress has been particularly impressive in West Africa where 11 of the 13 range states now have national strategies in various stages of planning or readiness. Some notable recent developments include the following:

- Implementation of Burkina Faso's and Ghana's strategies is fully underway. So far activities have focused primarily on surveying elephant populations and various transfrontier conservation initiatives.
- Funds are currently being sought for implementation of the national strategy for Togo, which was finalized in 2003 with support from the USFWS.
- Strategic planning workshops have been held in Benin, Guinea, Liberia and Niger. All four range states are in the process of finalizing their strategy documents.
- The AfESG is in the process of assisting Mali and Sierra Leone on funding proposals for the development of their respective national strategies.
- In Kenya, the Kenya Wildlife Service's special technical advisory committee on the development of a national strategy met for the first time in late 2005 to discuss procedural matters. In April 2006 'expressions of interest' were invited from suitably qualified consultants, to help consolidate the inputs from planned stakeholder consultations into a detailed strategy document. A shortlist of suitable candidates is being prepared.

Transfrontier initiatives

SOUTHERN AFRICA

The potential for range expansion as a management option for the elephant 'overpopulation problem' was the main topic of discussion at the workshop on Rationalizing Transboundary Elephant Management and Human Needs in the Kavango–mid-Zambezi Region, which took place on 23 and 24 May in

en œuvre d'un protocole d'accord sur la conservation des éléphants en Afrique de l'Ouest. Il a été signé pour effet par 12 des 13 Etats de l'aire de répartition à la Huitième Conférence des Parties à la CEM, en novembre 2005. La contribution de la CEM au budget opérationnel du GSEAf en Afrique de l'Ouest s'élève au total à 50.000 dollars EU et, avec la dernière contribution du Gouvernement français, elle garantit que le Groupe pourra continuer à fournir un support technique et à coordonner la réalisation de la Stratégie de Conservation de l'éléphant en Afrique de l'Ouest pendant les prochaines années.

Stratégies nationales

Le développement et la réalisation des stratégies nationales de conservation des éléphants se poursuivent dans de nombreux états de l'aire de répartition. Les progrès ont été particulièrement impressionnants en Afrique de l'Ouest où 11 des 13 Etats disposent maintenant d'une stratégie nationale, à un stade plus ou moins avancé. Voici certains développements récents remarquables :

- Le Burkina Faso et le Ghana sont complètement impliqués dans la réalisation de leur stratégie. Jusqu'à présent, les activités se sont surtout concentrées sur des études de population d'éléphants et sur diverses initiatives de conservation transfrontalière.
- On recherche des fonds pour la mise en place de la stratégie nationale togolaise, qui a été finalisée en 2003 avec le soutien du *Fish and Wildlife Service* américain.
- Il y a eu des ateliers de planning stratégique au Bénin, en Guinée, au Liberia et au Niger. Ces quatre Etats de l'aire de répartition sont occupés à finaliser les documents de leur stratégie.
- Le GSEAf aide le Mali et la Sierra Leone à préparer des propositions de financement pour développer leur stratégie nationale.
- Au Kenya, le comité spécial de conseil technique du *Kenya Wildlife Service* pour le développement d'une stratégie nationale s'est réuni pour la première fois fin 2005 pour discuter des procédures. En avril 2006, on a invité des consultants qualifiés à présenter leur « expression d'intérêt », pour aider à consolider les inputs des consultations prévues avec les parties prenantes en un document de stratégie détaillé. On prépare une liste restreinte des candidats souhaités.

Gaborone, Botswana. This workshop, organized by Conservation International's Southern Africa Wilderness and Transfrontier Conservation Programme, was attended by representatives from five Southern African elephant range States, as well as numerous NGOs, individual elephant researchers, and even a few private sector partners. The main objective was to help formulate recommendations for the conservation and establishment of elephant corridors in the proposed 300,000 km² Kavango-Zambezi Transfrontier Conservation Area (KAZA TFCA) straddling the boundaries of Angola, Botswana, Namibia, Zambia and Zimbabwe. Leo Niskanen, AfESG's Senior Programme Officer also attended, as did AfESG members Tom Milliken (TRAFFIC East and Southern Africa) and Loki Osborn (Elephant Pepper Development Trust).

The workshop consisted of a series of technical presentations and working group sessions addressing the main challenges to, and opportunities for, range expansion in the KAZA TFCA. At present, the most promising transboundary corridor leads from northern Botswana through the Caprivi Strip in Namibia into south-east Angola. Recent research suggests that elephants are already using this corridor, even though a part of it is quite heavily impacted by human activities. The presence of landmines and the lack of infrastructure, resources, and capacity for conservation and management of elephants in Angola are some of the challenges to the long-term viability of this corridor.

Three other potential elephant corridors were also identified at the workshop. All of these link the Chobe elephant population in northern Botswana to Kafue National Park in Zambia. However, extensive studies will be needed to determine the feasibility of establishing these corridors, especially as they are likely to bring elephants and other wildlife near human settlements, thus increasing the risk of human-wildlife conflict. Generally, it is agreed that the acceptance of the affected communities of the planned range expansion is a necessary prerequisite without which the scheme has little chance of succeeding. The costs and benefits of free movement of wildlife into areas currently settled by people must therefore be carefully evaluated, and the communities residing in these areas must be involved in the planning from the very beginning.

WEST AFRICA

Since my last Chair's report, steady progress has been made with various transfrontier initiatives. First, a

Initiatives transfrontalières

AFRIQUE AUSTRALE

La possibilité d'étendre l'aire de distribution comme option pour résoudre le « problème de surpopulation » des éléphants a été le principal sujet de discussion de l'atelier « Rationaliser la gestion transfrontalière des éléphants et les besoins humains dans la région Kavango-moyen Zambèze », qui a eu lieu les 23 et 24 mai à Gaborone, au Botswana. Organisé par le Programme de *Conservation International* « *Southern Africa Wilderness and Transfrontier Conservation* », cet atelier réunit des représentants de cinq Etats de l'aire de répartition des éléphants en Afrique australe, ainsi que de nombreuses ONG, des chercheurs indépendants, et même quelques partenaires du secteur privé. Le principal objectif était d'aider à formuler des recommandations pour conserver et établir des corridors pour les éléphants dans les 300.000 km² de l'Aire de Conservation transfrontalière Kavango – Zambèze (KAZA TFCA) qui chevauche les frontières de l'Angola, du Botswana, de la Namibie, de la Zambie et du Zimbabwe. Leo Niskanen, le Responsable de programme du GSEAF y a assisté, ainsi que d'autres membres du Groupe dont Tom Milliken (TRAFFIC Afrique de l'Est et Australe) et Loki Osborn (*Elephant Pepper Development Trust*).

L'atelier consistait en une suite de présentations techniques et de sessions en groupes de travail qui abordaient les principaux obstacles à l'extension de l'aire de distribution dans la KAZA TFCA, et aussi les possibilités de la faire. A présent, le corridor transfrontalier le plus prometteur va du nord du Botswana au sud-est de l'Angola, *via* la bande de Caprivi, en Namibie. Des recherches récentes laissent à penser que les éléphants empruntent déjà ce corridor, même si les activités humaines sont parfois intenses sur certains tronçons. La présence de mines et le manque d'infrastructures, de ressources et de capacités pour conserver et gérer les éléphants en Angola sont certains des problèmes à régler si l'on veut que ce corridor soit viable à long terme.

Trois autres corridors possibles ont aussi été identifiés lors de cet atelier. Tous relient la population d'éléphants de Chobe, au nord du Botswana, au Parc National de Kafue, en Zambie. Il faudra cependant réaliser des études approfondies pour déterminer si l'établissement de ces corridors est faisable, spécialement parce qu'ils sont de nature à amener des éléphants et d'autres animaux près

consultative workshop to discuss the conservation of the Nazinga–Kabore Tambi–Red Volta elephant corridor, which links important elephant populations in Burkina Faso and Ghana, took place in the town of Pô in south-eastern Burkina Faso in late December 2005. This workshop was organized by the AfESG's West Africa Programme Office and funded by the Institute of Environmental Sciences in Leiden, the Netherlands, and Centre for Environment and Development in Cameroon, under their joint initiative *Regional Network for the synergy between the United Nations Convention on Biological Diversity and the United Nations Convention to Combat Desertification in West and Central Africa*. The main output of this workshop, which brought together more than 40 participants from government agencies, NGOs, and local communities, was the establishment of a local management committee for the elephant corridor. Although funding constraints did not allow Ghanaian participation at this workshop, the participants firmly resolved to develop closer cross-border cooperation and build stronger linkages with similar efforts currently underway on the Ghanaian side.

Preparations are currently underway for another important transfrontier planning exercise to help design an action plan for the Ziama Forest Reserve–North-East National Forest elephant corridor on the border of Guinea and Liberia. This workshop will be funded by the Keidaren Nature Conservation Fund and Germany's Kreditanstalt für Wiederaufbau (KfW). The AfESG will compile and synthesize the inputs into a comprehensive conservation action plan.

Finally, the future viability of an elephant corridor linking the Sahel area in Burkina Faso with Gourma in Mali is currently being investigated as part of a broader transfrontier conservation programme coordinated by the IUCN national offices in Burkina Faso and Mali. We are eagerly awaiting the results of an assessment, recently carried out by Dr Richard Barnes, a long-time member of the AfESG, which is expected to produce preliminary recommendations for the management actions needed to safeguard the future of this important transfrontier elephant population.

Human–elephant conflict

The United Nations Development Programme's Global Environment Facility has finally given us the go-ahead for a US\$ 50,000 Project Development Fund grant to draft a detailed proposal for designing and test-

d'installations humaines, augmentant ainsi le risque de conflits hommes-faune sauvage. On reconnaît généralement que les communautés touchées devront accepter l'extension prévue, sans quoi le projet aurait peu de chances de réussir. C'est pourquoi il faut soigneusement évaluer les coûts et bénéfices de la liberté de mouvements de la faune dans les zones actuellement occupées par des gens, et il faut que les communautés qui résident dans ces régions soient impliquées dans la planification dès le départ.

AFRIQUE DE L'OUEST

Depuis mon dernier rapport de présidente, diverses initiatives transfrontalières ont connu de grands progrès. D'abord, un atelier consultatif pour discuter de la conservation du corridor à éléphants Nazinga – Kabore Tambi – Volta rouge, qui relie d'importantes populations du Burkina Faso et du Ghana, a eu lieu dans la ville de Pô, dans le sud-est de Burkina Faso, fin décembre 2005. Il était organisé par le Bureau du programme du GSEAf en Afrique de l'Ouest et financé par l'Institut des Sciences environnementales de Leiden, aux Pays-Bas, et par le Centre pour l'Environnement et le Développement au Cameroun, dans le cadre de leur réseau conjoint d'initiative régionale pour la synergie entre la Convention des Nations unies pour la diversité biologique et la Convention des Nations unies pour la lutte contre la désertification en Afrique de l'Ouest et Centrale. Le principal résultat de cet atelier, qui avait réuni plus de 40 participants de diverses agences gouvernementales, d'ONG et de communautés locales, fut l'établissement d'un comité local de gestion du corridor des éléphants. Bien que les contraintes budgétaires aient empêché les Ghanéens d'assister à cet atelier, les participants ont fermement résolu de développer une collaboration transfrontalière plus étroite et d'établir des liens plus solides avec des efforts similaires, du côté ghanéen.

Les préparatifs sont en cours pour un autre exercice de planification transfrontalier, afin d'aider à préparer un plan d'action pour le corridor des éléphants entre la Réserve forestière de Ziama et la Forêt Nationale du Nord-est, sur la frontière guinéo-libérienne. Cet atelier sera financé par le *Keidaren Nature Conservation Fund* et par le *Kreditanstalt für Wiederaufbau* (KfW) allemand. Le GSEAf se chargera de la compilation et de la synthèse des inputs en un plan d'action complet de la conservation.

ing national human–elephant conflict management systems in Burkina Faso and Tanzania. We are discussing the modalities of disbursing the funds and we hope to be in a position to hire a consultant in the next few months to develop the final proposal for a Medium-Sized Project (up to US\$ 2 million over five years).

In the meantime, with the funding already secured from WWF's African Elephant Programme, AfESG's project coordinators, Dr Richard Hoare and Mr Frédéric Marchand, have begun preliminary investigations into developing vertically-integrated HEC management actions in Tanzania and Burkina Faso, respectively. The main conflict zones and potential collaborating agencies have been identified, and background information on key legislation is being gathered. In addition, a handful of HEC managers will be selected from both countries for further training in the latest mitigation practices, using the new AfESG-certified HEC training course currently being developed in collaboration with AfESG member, Dr Loki Osborne's Elephant Pepper Development Trust.

Local overpopulation guidelines

The AfESG's Local Overpopulation Task Force has continued working on the 'best practice' guidelines for managing local overpopulation of elephants. These are being developed in response to the urgent demand from a number of range states, primarily from southern Africa, for technical guidance on the various management options available for addressing local overpopulation problems. A meeting of the Task Force will be convened in the near future to put final touches on the draft document before it is put on the AfESG website for public review.

Update on the CITES MIKE programme

As explained in my last report, over the last several months the MIKE programme has been operating on a bridging fund arrangement with very restricted activities, pending new funding becoming available from the European Commission. In March 2006 the member states of the African, Caribbean, Pacific region (ACP) finally approved the EC ACP/EDF (European Commission's European Development Fund for ACP) funding for MIKE activities in Africa and Asia. The immediate focus of these activities will be on site visits to bring data sets up to date and to pre-

La viabilité d'un corridor pour éléphants reliant la région sahélienne du Burkina Faso à Gourma, au Mali, est à l'étude, dans le cadre d'un programme plus vaste de conservation transfrontalière coordonné par les bureaux nationaux de l'UICN au Burkina Faso et au Mali. Nous attendons avec impatience les résultats d'une évaluation menée récemment par le Dr. Richard Barnes, membre de longue date du GSEAF, qui doit fournir les premières recommandations pour les activités de gestion nécessaires afin de sauvegarder l'avenir de cette importante population transfrontalière d'éléphants.

Conflits hommes – éléphants

Le Fonds pour l'Environnement mondial du Programme des Nations unies pour le Développement a finalement donné le feu vert pour que nous recevions un subside financier de 50.000 US\$ afin de préparer une proposition détaillée pour concevoir et tester des systèmes nationaux de gestion des conflits hommes – éléphants au Burkina Faso et en Tanzanie. Nous discutons actuellement les modalités pour employer les fonds et nous espérons être en mesure d'engager un consultant au cours des prochains mois, pour développer la proposition finale pour un projet de taille moyenne (jusqu'à 2 millions de dollars sur cinq ans).

Pendant ce temps, grâce aux fonds déjà reçus du Programme pour l'éléphant africain du WWF, les coordinateurs de projet, le Dr. Richard Hoare et M. Frédéric Marchand, du GSEAF, ont commencé à étudier les possibilités de développer des activités de gestion des CHE verticalement intégrées, le premier en Tanzanie et le second au Burkina Faso. Les principales zones de conflits et les agences qui pourraient collaborer ont été identifiées et on est en train de rassembler toutes les informations nécessaires sur les points clés de la législation. De plus, une poignée de gestionnaires des CHE seront sélectionnés dans les deux pays, pour recevoir une formation aux plus récentes pratiques en matière de mitigation, en employant le nouveau cours de formation en CHE, certifié GSEAF, qui est actuellement mis au point en collaboration avec le *Elephant Pepper Development Trust* du Dr. Loki Osborne, membre du GSEAF.

pare a report on baseline status at the various sites.

In the meantime, a decision has been taken by the CITES Secretariat to move the MIKE Central Coordinating Unit (CCU) from its current location next door to the AfESG Secretariat offices, to the United Nations Environment Programme headquarters in Nairobi, by 1 August 2006. MIKE CCU staff positions, which have been given UNEP project post status, will have to be re-advertised, after which standard UNEP recruitment processes will be followed. The current MIKE Director, Nigel Hunter, has announced his decision to step down at the end of July, after helping to finalize the transition arrangements. This change obviously also has a bearing on the Sub-regional Support Officers (SSOs) who have until now been operating on IUCN staff contracts. However, the details pertaining to the future institutional arrangements for the SSOs are yet to be finalized by the CITES Secretariat.

The long-awaited recommended MIKE standards and guidelines for conducting elephant population surveys in forest situations have now been finalized and will be posted soon on the MIKE website <http://www.cites.org/eng/prog/MIKE/index.shtml>.

AfESG website

Judging by feedback received from users, as well as our own downloading records, the AfESG website <http://iucn.org/afesg> continues to serve as a valuable tool for the over 2,000 visitors who access this site each day. The most recent addition to the website is a report on the human-elephant conflict situation in Angola. Many thanks to Joe Heffernan of Fauna and Flora International for giving permission to make this interesting report available.

The future of *Pachyderm*

Even though *Pachyderm* is the journal of three IUCN SSC Specialist Groups, for the past decade raising funds to produce and disseminate this journal, as well as the day-to-day editing and distribution, have been handled almost exclusively by the Secretariat of the AfESG. In light of current realities, this situation is clearly no longer viable, and discussions are currently underway with the Chairs of the African and Asian Elephant and Rhino Specialist Groups on arrangements for greater sharing of the burden. Options under consideration include a possible merger with the

Directives en cas de surpopulation locale

La Force spéciale du Groupe chargée des cas de surpopulation locale poursuit son travail sur les Directives des « meilleurs usages » pour gérer les surpopulations locales d'éléphants. Elles répondent à la demande urgente venant d'un certain nombre d'états de l'aire de répartition, principalement d'Afrique australe, pour une guidance technique concernant les diverses options de gestion possibles pour traiter les problèmes de surpopulation locale. La Force spéciale organisera très prochainement une réunion pour mettre la touche finale au document avant de le mettre sur le site Internet du GSEAF pour une révision publique.

Mise à jour du programme MIKE/ CITES

Comme je l'expliquais dans mon dernier rapport, le programme MIKE fonctionne ces derniers mois sur un fond-relais, avec des activités très limitées, en attendant le nouveau financement de la Commission européenne. En mars 2006, les Etats membres de la Région ACP (Afrique – Caraïbes – Pacifique) ont finalement approuvé le financement CE ACP/FED (Fonds européen de développement) pour les activités de MIKE en Afrique et en Asie. Le point central de ces activités consistera en visites de terrain pour mettre à jour les sets de données et préparer un rapport sur le statut de base des différents sites.

Entre-temps, le Secrétariat CITES a décidé de déménager l'Unité centrale de coordination (UCC) de MIKE de son emplacement actuel près des bureaux du Secrétariat du GSEAF vers le QG du Programme des Nations unies pour l'Environnement (PNUE), à Nairobi. Le 1^{er} août 2006, les postes du personnel de l'UCC de MIKE, qui ont reçu un statut d'après-projet UE, feront l'objet de nouvelles offres d'emploi suite à quoi les processus standards de recrutement seront suivis. Le directeur actuel de MIKE, Nigel Hunter, a annoncé sa décision de se retirer à la fin de juillet après avoir aidé à finaliser les accords de transition. Ce changement a évidemment aussi un impact sur les responsables du support sous-régionaux qui travaillaient jusqu'à présent avec des contrats de personnel de l'UICN. Les détails concernant leurs futurs accords institutionnels doivent encore être finalisés.

Les standards et les directives de MIKE pour mener des études de population d'éléphants en forêt,

Asian Elephant Specialist Group's journal *Gajah*. However, irrespective of the outcome of these discussions, we will make every effort to ensure that the dissemination of information on the conservation and management of African elephants can continue through one mechanism or another.

The overall outlook for the future of the AfESG Secretariat

Since the beginning of the year, the AfESG Secretariat has been on 'overdrive' searching for funds to cover its core operating costs. However, despite great efforts directed at every conceivable source of funding, the kind of long-term resources required to put us on an even keel has simply not materialized. As a final attempt to drum up support, an "emergency appeal" was sent to our main donors and partner agencies in March 2006. This was also posted on the AfESG website.

In April 2006, some of our members approached Mr. Valli Moosa, President of IUCN, for assistance and guidance on our funding predicament. Mr. Moosa kindly agreed to contact the Department of Environmental Affairs and Tourism of South Africa and to request the South African government for support. I am most grateful to Mr. Moosa for his help and to our members for making such a high-level approach.

Although the financial prospects for the immediate future look brighter than they did a few months ago, the continuing uncertainty over the long-term funding situation has taken a great toll on the staff of the AfESG Secretariat. While the recent contribution from DEFRA will help to keep the AfESG Secretariat afloat a little bit longer, maintaining the *status quo* seems increasingly untenable, and some sort of scaling back of activities and staffing in the near future may be inevitable.

que l'on attendait depuis longtemps, sont enfin finalisés et ils seront très bientôt mis sur le site de MIKE : <http://www.cites.org/eng/prog/MIKE/index.shtml>

Site du GSEAF

A en juger par le feedback des utilisateurs, ainsi que par l'enregistrement du nombre de téléchargements, le site du GSEAF <http://iucn.org/afesg> est toujours un outil très utile pour plus de 2000 personnes le visitent chaque jour. La plus récente addition qui y fut faite est un rapport sur la situation des conflits hommes – éléphants en Angola. Merci beaucoup à Joe Heffernan, de *Fauna and Flora International*, qui nous a donné l'autorisation de disposer de cet intéressant rapport.

L'avenir de *Pachyderm*

Même si *Pachyderm* est le journal de trois Groupes de spécialistes de la CSE/UICN, au cours des 10 dernières années, la récolte des fonds destinés à sa publication et à sa diffusion, ainsi que l'édition et la distribution au jour le jour, ont été presque exclusivement assurées par le Secrétariat du GSEAF. Face aux réalités du quotidien, cette situation n'est assurément plus viable, et des discussions sont en cours avec les Présidents des Groupes spécialistes des éléphants et des rhinos africains et asiatiques pour s'accorder sur un meilleur partage des tâches. D'autres options sont envisagées, comme la possible fusion avec le journal du Groupe spécialiste des éléphants d'Asie, *Gajah*. Quelque soit le résultat de ces discussions, nous ferons tous les efforts possibles pour garantir que les informations sur la conservation et la gestion des éléphants africains soient diffusées par quelque media que ce soit.

Perspectives générales pour l'avenir du Secrétariat du GSEAF

Depuis le début de l'année, le Secrétariat du GSEAF met les bouchées doubles car il doit chercher des fonds pour financer ses frais de fonctionnement élémentaires. Pourtant, malgré les grands efforts en direction de toutes les sources de financement imaginables, le genre de ressources à long terme nécessaires pour stabiliser notre fonctionnement ne s'est tout simplement pas matérialisé. Dernier appel pour nous aider, un message urgent a été envoyé à

nos principaux donateurs et aux agences partenaires en mars 2006. Il fut aussi lancé sur notre site Internet.

En avril 2006, certains de nos membres ont contacté M. Valli Moosa, Président de l'UICN, pour qu'il nous aide et nous guide dans cette situation financière difficile. Il a eu l'amabilité de contacter le département sud-africain des Affaires environnementales et du Tourisme pour demander l'aide du Gouvernement sud-africain. Je lui suis très reconnaissante de son aide et je remercie aussi nos membres pour leurs démarches de haut niveau.

Bien que les perspectives financières semblent plus favorables dans l'avenir immédiat qu'il y a quelques mois, l'incertitude persistante quant au financement à long terme pèse lourdement sur le moral du personnel du Secrétariat. Si la récente contribution de DEFRA aidera à le maintenir à flot un peu plus longtemps, le simple maintien du statu quo semble de plus en plus impossible, et une certaine réduction des activités et du personnel semble inévitable dans un avenir proche.

African Rhino Specialist Group report

Rapport du Groupe Spécialiste des Rhinos d'Afrique

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The AfRSG's recent activities have been particularly focused on the two most *Critically Endangered* African rhino taxa—the northern white rhino, *Ceratotherium simum cottoni*, and the West African black rhino, *Diceros bicornis longipes*, both of which are on the very brink of extinction. Other important initiatives have included appointing the new membership and planning the eighth AfRSG meeting, scheduled for Swaziland in mid-2006. This meeting will include important strategic workshops on CITES reporting requirements, rhino reintroduction guidelines and the proposed East African Community Rhino Management Group.

Northern white rhino in the Democratic Republic of Congo

In *Pachyderm* 39 I reported that the government of the Democratic Republic of Congo (DRC) had outsourced the management of Garamba National Park for the next five years to African Parks Foundation, with the priority activity being the development and implementation of a recovery plan for this last remaining wild population of northern white rhino. As a logical point of departure, African Parks Foundation identified the need to establish the status of the population, and it commissioned AfRSG to design appropriate aerial and ground surveys to determine population size and distribution, and to secure appropriate personnel to undertake the work. AfRSG's Scientific Officer, Dr Richard Emslie, undertook this major planning and coordination exercise with assistance from a number of rhino and survey experts, and was tasked with compiling the final report.

The surveys were undertaken between 16 and 30 March 2006 and were coordinated on site by Ezemvelo KZN Wildlife's Craig Reid and Park Director Jose Tello. Replicated aerial total counts were undertaken

Les récentes activités du GSRAf se sont concentrées particulièrement sur les deux taxons les plus « en danger critique d'extinction » de rhinos africains — le rhino blanc du Nord *Ceratotherium simum cottoni* et le rhino noir de l'Ouest *Diceros bicornis longipes* — qui sont tous deux à la limite de l'extinction. Parmi d'autres initiatives importantes, nous citerons la nomination des nouveaux membres et la planification de la 8^{ème} réunion du GSRAf, qui se tiendra au Swaziland à la mi-juin 2006. Cette réunion sera l'occasion d'ateliers stratégiques importants sur les nouvelles exigences de la CITES en matière de rapports, sur les lignes directrices pour la réintroduction de rhinos et sur la proposition du Groupe est-africain de gestion communautaire des rhinos.

Le rhino blanc du Nord en République Démocratique du Congo

Dans le *Pachyderm* 39, je rapportais que le gouvernement de la République Démocratique du Congo (RDC) avait délocalisé la gestion du Parc National de la Garamba pour les cinq prochaines années et l'avait confiée à la *African Parks Foundation*, l'activité prioritaire étant le développement et la mise en œuvre d'un plan de restauration pour cette population de rhinos blancs du Nord qui est la dernière qui subsiste à l'état sauvage. Point de départ logique, la Fondation a identifié le besoin de préciser le statut de la population et elle a demandé au GSRAf de définir les études aériennes et de terrain appropriées pour déterminer la taille et la distribution de la population et de réunir le personnel approprié pour faire ce travail. Le Responsable scientifique du GSRAf, le Dr. Richard Emslie, entreprit cet exercice majeur de planification et de coordination avec l'aide d'un certain nombre d'experts des rhinos et de la recherche et il fut chargé de compiler le rapport final.

in southern Garamba as well as in about two-thirds of the Domaine de Chasse Gangala na Bodio using a four-seater Cessna 182 and a two-seater Super Cub (kindly supplied at cost by Conservation Action Trust). Areas were flown intensively using parallel transects with most areas being flown twice or three times. Conditions and visibility were ideal. The aerial surveys were also supported by foot surveys of selected areas by a ground team led by an experienced tracker from KwaZulu-Natal, South Africa.

Despite the very intensive search effort and replicated counts only two different rhinos—an adult cow and an adult bull—were seen in the south-west of the park. No rhinos or rhino signs were seen in the Domaine de Chasse. Each animal was seen only once, which was a significantly lower sighting frequency than on past counts in the late 1990s. However, the figure of two represented a minimum, and for a number of reasons the presence of one or a small number of additional rhinos could not be discounted. Additional survey work was therefore recommended as a matter of urgency to provide clarity as to whether the worst-case scenario (only two rhinos left) prevailed, or whether there were additional rhinos still surviving in the area. Subsequent to the survey, an additional rhino was identified by ground staff in April bringing the minimum number to three (two adult males, one adult female).

In contrast to the very disappointing rhino count results, numbers of surviving elephant (3840), giraffe (70), buffalo (7700) and hippo (2290) were encouraging. Also no poacher camps were found in the 1600 km² south of the Garamba River; and while 539 elephant carcasses older than a year were counted only five carcasses from poaching over the last year were found. Two rhino carcasses were found, but these were also over a year old. Although one gang poached an additional eight elephants during the survey, survey results indicate that there appears to have been a significant reduction in poaching since Africa Parks Foundation took over. It is hoped that this improvement in security has not come too late for the northern white rhino.

West African black rhino in Cameroon

Lack of an appropriately designed survey in recent years has prevented the development and implementation of a survival programme for the last *Diceros bicornis longipes*, which have for many years been thinly scattered throughout northern Cameroon. The

Les études eurent lieu entre le 16 et le 30 mars 2006 et furent coordonnées sur place par Craig Reid d'*Ezemvelo KZN Wildlife* et Jose Tello, Directeur du parc. Des comptages complets répliqués eurent lieu dans le sud de la Garamba ainsi que dans à peu près les deux tiers du Domaine de chasse Gangala na Bodio, avec un Cessna 182 à quatre places et un Super Cub de deux places (dont les frais étaient aimablement couverts par *Conservation Action Trust*). Les zones furent survolées intensément en faisant des transects parallèles, et la plupart des zones ont été survolées deux ou trois fois. Les conditions de visibilité étaient idéales. Les survols ont été complétés par des recherches à pied réalisées dans les zones choisies, par une équipe de terrain menée par un pisteur sud-africain expérimenté venu du KwaZulu-Natal.

Malgré un effort de recherche très intense et des comptages répétés, seuls deux rhinos différents — une femelle et un mâle adultes — furent aperçus dans le sud-ouest du parc. Aucun rhino, aucune trace de rhino, n'ont été vus dans le Domaine de chasse. Chaque animal ne fut aperçu qu'une seule fois, ce qui est une fréquence d'observation significativement plus basse que lors des comptages précédents, fin des années 1990. D'autre part, ce chiffre de deux a représenté un minimum, et pour différentes raisons, on ne peut pas exclure, la présence d'un ou de quelques rhinos supplémentaires. Un travail de recherche supplémentaire a été recommandé d'urgence pour déterminer clairement si le pire scénario (seuls deux rhinos survivent) est correct ou si d'autres rhinos subsistent dans la région.

Contrairement aux résultats très décevants des comptages des rhinos, les nombres d'éléphants (3.840), de girafes (70), de buffles (7.700) et d'hippos (2.290) étaient encourageant. Aussi, dans les 1.600 km² du parc qui se trouvent au sud de la rivière Garamba on n'a pas vu aucun camp de braconniers ; et si l'on a dénombré 539 carcasses d'éléphants anciennes d'au moins un an, il n'y en avait plus que cinq pour la dernière année. On a trouvé deux carcasses de rhinos, mais elles dataient de plus d'un an. Bien qu'un gang ait braconné huit éléphants de plus pendant la durée de l'étude, les résultats indiquent qu'il semble que le braconnage ait connu une baisse significative depuis que la *African Parks Foundation* a pris les choses en mains. On espère que cette amélioration de la sécurité n'arrive pas trop tard pour le rhino blanc du Nord.

role of AfRSG has largely been to encourage MINEF (Cameroon's conservation authority), the French IUCN Committee, and various initiatives such as Association Symbiose, Kilifori and proponents of the 'Black Ghosts' approach, to collaborate and undertake a joint survey. While a fully cooperative approach did not result, AfRSG has been able to provide technical advice to a survey undertaken by Drs Isabelle and Jean-Francois Lagrot, drawing on the expertise of a number of our members. Because the dense vegetation and tall grass make sightings difficult in northern Cameroon, the survey, with the help of a specialist tracker, Jackson Kamwi from Zimbabwe, emphasized spoor identification. At the time of writing, the survey is still in progress and so the final results are not available; however, indications are not encouraging.

The black rhino in Zambia

Efforts are continuing to augment the black rhino population in North Luangwa National Park, Zambia, to ensure that the founder population is genetically viable. Under a regional cooperation initiative being promoted by the SADC (Southern African Development Community) Regional Programme for Rhino Conservation, it appears that conservation authorities within South Africa will provide at least five rhinos. Additional animals are being sought from Zimbabwe and Namibia through a swap agreement to ensure rhinos of the correct subspecies are used.

AfRSG membership

The appointment of members for the 2005–2008 period is almost complete. The AfRSG currently comprises a secretariat of a Chair and Scientific Officer and 33 other members, including representatives from the following rhino range states: Botswana, Kenya, Malawi, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe. Attempts to secure representation by Cameroon and the DRC have, so far, proved unsuccessful. This membership provides an effective blend of scientific expertise and field practitioners so necessary for effective rhino conservation.

AfRSG meeting in Swaziland

Preparations are well advanced for the eighth AfRSG meeting scheduled for 27 June–2 July 2006 in

Le rhino noir d'Afrique de l'Ouest au Cameroun

Le manque de recherche appropriée au cours des dernières années a empêché le développement et la mise en oeuvre d'un programme de survie pour les derniers *Diceros bicornis longipes*, qui sont depuis de nombreuses années disséminés dans le nord du Cameroun. Le rôle du GSRAf consistait en grande partie à encourager la MINEF (l'autorité de la Conservation au Cameroun), le Comité français de l'UICN et diverses initiatives, comme l'Association Symbiose, Kilifori et les partisans de l'approche « Black Ghosts » à collaborer et à entreprendre une recherche conjointe. Une approche de coopération complète n'a pas abouti, mais le GSRAf a pu fournir un conseil technique pour une étude entreprise par les Dr Isabelle et Jean-François Lagrot qui ont bénéficié de l'expertise de plusieurs de nos membres. Etant donné que la végétation dense et les hautes herbes rendent les observations difficiles dans le nord du Cameroun, l'étude, avec l'aide d'un pisteur spécialisé, Jackson Kamwi, du Zimbabwe, a insisté sur l'identification des traces. Au moment de rédiger ces lignes, l'étude est encore en cours et les résultats finaux viendront plus tard ; mais jusqu'ici, ce n'est pas très encourageant.

Le rhino noir en Zambie

Les efforts se poursuivent pour augmenter la population de rhinos noirs dans le Parc National de Luangwa Nord, en Zambie, pour s'assurer que la population fondatrice est génétiquement viable. Dans le cadre d'une initiative de coopération régionale encouragée par la SADC (*Southern African Development Community*), le Programme régional pour la conservation des rhinos, il semble que les autorités de la conservation en Afrique du Sud vont fournir au moins cinq rhinos. D'autres animaux ont été demandés au Zimbabwe et en Namibie, par un accord d'échanges, pour garantir qu'il s'agit bien de rhinos de la sous-espèce correcte.

Membres du GSRAf

La nomination des membres pour la période 2005 – 2008 est presque complète. Le GSRAf comprend pour le moment un secrétariat avec un Président, un Responsable scientifique et 33 autres membres, y compris des délégués des états suivants de l'aire de

Mlilwane Game Reserve, Swaziland. A full program of more than 50 presentations on rhino status, support programs, strategies, focal populations, techniques and CITES is in place, and in addition five workshops are planned. We plan to further our efforts to form a Rhino Management Group for the East African Community (Kenya, Tanzania and Uganda), draft reintroduction guidelines for African rhinos, address the rhino decisions taken at CITES CoP 13 and the subsequent 53rd meeting of the Standing Committee to ensure appropriate response by AfRSG and TRAFFIC, develop a funding strategy for the AfRSG Secretariat and biennial meetings, and explore community-based rhino conservation models further. We may also host a SADC Rhino Recovery Group meeting. Approximately 45 members and observers are expected, depending on our success in securing funding to support the attendance of a number of key participants.

Appreciation

The AfRSG is extremely grateful to the International Rhino Foundation, WWF-South Africa, US Fish and Wildlife Service, and Save the Rhino International for their significant and very valuable support of the Secretariat and its activities, without which it would not have been possible to operate effectively.

répartition des rhinos : Afrique du Sud, Botswana, Kenya, Malawi, Namibie, Swaziland, Tanzanie, Zambie et Zimbabwe. Les tentatives pour obtenir une représentation du Cameroun et de la RDC sont jusqu'ici restées infructueuses. Tous ces membres apportent un brassage efficace d'expertise scientifique et de praticiens de terrains, si nécessaire à la bonne conservation des rhinos.

Réunion du GSRAf au Swaziland

Les préparatifs de la 8^{ème} réunion du GSRAf, prévue du 27 juin au 2 juillet dans la *Mlilwane Game Reserve*, au Swaziland, sont en bonne voie. Nous avons déjà le programme complet qui comptera plus de 50 présentations sur le statut des rhinos, les programmes de support, les stratégies, les populations focales, les techniques et la CITES, et cinq ateliers sont aussi prévus. Nous envisageons de poursuivre nos efforts en vue de former un Groupe de gestion des rhinos pour la communauté d'Afrique de l'Est (Kenya, Tanzanie, Ouganda), de préparer des directives pour les réintroductions de rhinos africains, de répondre aux décisions prises à la CoP 13 et au meeting subséquent du Comité permanent de la CITES au sujet des rhinos, pour nous assurer que le GSRAf et TRAFFIC apportent une réponse appropriée, de mettre au point une stratégie de financement pour le Secrétariat du Groupe et pour les réunions bisannuelles, et d'explorer plus avant les modèles de conservation communautaire des rhinos. Nous devons aussi accueillir une réunion du *Rhino Recovery Group* de la SADC. Nous attendons environ 45 membres et observateurs ; cela dépendra des résultats de nos recherches pour pouvoir financer la présence d'un certain nombre de participants clés.

Remerciements

Le GSRAf remercie chaleureusement l'*International Rhino Foundation*, le WWF-Afrique du Sud, le *Fish and Wildlife Service* américain et *Save the Rhino International* pour leur support significatif et appréciable du Secrétariat et de ses activités, sans lequel il n'aurait pas été possible de fonctionner efficacement.

Asian Rhino Specialist Group report

Rapport du Groupe Spécialiste des Rhinos d'Asie

Nico van Strien,¹ Co-chair for South-East Asia, and Tirtha Maskey,² Co-chair for South Asia

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In consultation with key rhino conservationists and scientists, especially from the South Asian region, Tirtha M. Maskey, PhD, was unanimously selected as the most appropriate choice for the still-vacant position of the South Asia Co-chair of AsRSG. As of 2006, Dr Maskey retired as Director General, Department of National Parks and Wildlife Conservation, Nepal, and he gracefully accepted the invitation of the SSC Chair to lead the South Asia section of the Asian Rhino Specialist Group.

Now that the South Asia Co-chair position is filled, the group will be reconstituted and the candidate members for the new AsRSG quadrennium will soon be contacted. Unfortunately, planned meetings to finalize the candidate lists for India and Nepal had to be postponed because of the recent political unrest in Nepal. Now that peace has returned the process of identifying candidate members will resume soon.

The office of the South-East Asia Co-chair is supported by the International Rhino Foundation (IRF) and will be hosted by the Indonesian Rhino Foundations (YMR/YSRS). The South Asia Co-chair is supported by WWF's Asian Rhino and Elephant Action Strategy (AREAS) and hosted by WWF-Nepal. Both Co-chairs are in the process of recruiting office assistance.

Two young female Sumatran rhinos at the Sumatran Rhino Sanctuary in Way Kambas National Park, Sumatra

The two young female Sumatran rhinos that were rescued from unviable, even threatening situations and moved to the Sumatran Rhino Sanctuary (SRS) in Way Kambas National Park, Sumatra, Indonesia, at the end of last year have settled in well.

Suite à la consultation de conservationnistes et de scientifiques clés des rhinos, spécialement pour la région de l'Asie du Sud, Tirtha M. Maskey, PhD, était, de l'avis de tous, le choix le plus approprié pour le poste encore vacant de co-président du GSRAs en Asie du Sud. En 2006, le Dr. Maskey a pris sa retraite du poste de Directeur général du département des Parcs Nationaux et de la Conservation de la Faune sauvage, au Népal, et il a aimablement accepté l'invitation du président de la CSS de diriger la section d'Asie du Sud du Groupe Spécialiste des Rhinos d'Asie.

Maintenant que ce poste de co-président est pourvu, le groupe va être reconstitué, et les candidats membres du nouveau GSRAs pour les quatre prochaines années seront bientôt contactés. Malheureusement, les réunions prévues pour finaliser la liste des candidats pour l'Inde et le Népal ont dû être postposées en raison de l'instabilité civile qui a touché le Népal dernièrement. La paix étant revenue, le processus d'identification des candidats va bientôt reprendre.

Le bureau du co-président en Asie du Sud-Est est soutenu par l'*International Rhino Foundation* (IRF) et il sera accueilli par les *Indonesian Rhino Foundations* (YMR/YSRS). Le co-président pour l'Asie du Sud est soutenu par la *Asian Rhino and Elephant Action Strategy* (AREAS) du WWF et accueilli par le WWF-Népal. Les deux co-présidents sont occupés à recruter les assistants pour leur bureau.

Deux jeunes rhinos de Sumatra femelles au Sanctuaire des Rhinos de Sumatra dans le Parc National de Way Kambas, à Sumatra

Les deux jeunes rhinos de Sumatra femelles qui ont été sauvées de conditions invivables et dangereuses

Rosa, the young female from Bukit Barisan Selatan National Park, is still being treated for the parasites, intestinal worms and liver fluke that she apparently contracted from cattle when she ventured into the fields and villages outside the park. Until all infection has been cleared she will remain in quarantine. The heavy parasite loads that were found after she was moved to SRS indicated that the move was timely and probably life saving.

Ratu, the female rhino that was wandering around outside Way Kambas National Park in September 2005, has settled in completely and has recently been released into one of the spacious 10-hectare SRS yards.

Information from villagers provided to the Rhino Patrol Units in Way Kambas indicate that it was the repeated confronting of large groups of people entering the park for fishing that caused Ratu to panic and that drove her from the safety of the park into unknown territory. Frequent encounters with people, even if they do not intend to harm the rhino, is a serious danger for the animals and may also disturb reproduction. This may also be a significant factor in the poor performance of the Javan rhino population in Ujung Kulon.

The reproductive cycles of both females are now being regularly monitored, with ultrasonography examinations and hormonal analysis, and it has been established that both are cycling and could breed. The health of the old resident male, Torgamba, in SRS is rather unstable, and he has not shown any interest in either of the females for quite some time. The SRS veterinarian staff is trying to restore his vitality, but so far with limited success. Fortunately help is on its way.

Sumatran Rhino Global Management and Propagation Board

The Sumatran Rhino Global Management and Propagation Board (GMPB) was established in September 2005 to 'decide on the management of the Global Sumatran Rhino Captive Population as a truly global population to maximize the options for reproduction and to improve its vitality and viability'. The board comprises representatives of range state authorities, institutions holding Sumatran rhinos, major sponsors, AsRSG, and independent rhino experts.

à la fin de l'année dernière et ont été placées au Sanctuaire des rhinos de Sumatra (SRS) se sont bien acclimatées dans le Parc National de Way Kambas, à Sumatra, en Indonésie.

Rosa, la jeune femelle du Parc National de Bukit Barisan Selatan, est encore en traitement contre les parasites, vers intestinaux et douves hépatiques qu'elle a apparemment attrapés auprès du bétail lorsqu'elle s'est aventurée dans les champs et les villages en dehors du parc national. Tant qu'elle n'aura pas été guérie de ses infections, elle restera en quarantaine. L'infestation massive que l'on avait découverte chez elle quand elle a été placée au SRS prouve bien que son placement s'est fait juste à temps et lui a probablement sauvé la vie.

Ratu, la femelle qui errait autour du Parc National de Way Kambas en septembre 2005, s'est tout à fait adaptée et elle a été relâchée récemment dans un des spacieux parcs de 10 hectares du SRS.

Les informations que les villageois ont fournies à l'Unité de patrouille des rhinos indiquent que ce qui a causé la panique chez Ratu, ce sont les confrontations répétées avec les grands groupes de gens qui pénètrent dans le parc pour pêcher et c'est ce qui l'a éloignée de la sécurité du parc vers un territoire inconnu. Des rencontres fréquentes avec des gens, même s'ils n'ont aucune mauvaise intention, sont un sérieux danger pour les rhinos et peuvent même perturber leur reproduction. C'est peut-être aussi un facteur significatif expliquant les piètres performances de la population de rhinocéros de Java à Ujung Kulon.

Les cycles de reproduction des deux femelles sont maintenant contrôlés régulièrement, avec ultrasonographie et analyses hormonales, et il fut établi que toutes deux avaient des cycles et pouvaient se reproduire. La santé du vieux mâle résidant au SRS, Torgamba, est plutôt instable, et il n'a manifesté aucun intérêt pour aucune des femelles depuis un certain temps. Le personnel vétérinaire du SRS essaie de lui redonner de la vitalité, avec des succès limités jusqu'à présent. Heureusement, de l'aide arrive.

Conseil de gestion mondiale de la reproduction assistée et de la propagation des rhinos de Sumatra

Le Conseil de gestion mondiale de la reproduction assistée et de la propagation des rhinos de Sumatra (GMPB) a été créé en septembre 2005 pour « décider

The second GMPB meeting was held in Jakarta on 1 March 2006 to discuss a proposal to enhance the breeding potential by moving some of the rhinos. At the request of the Indonesian authorities the GMPB Technical Committee developed a proposal involving two of the rhinos. It was recommended that the young male Andalas, the first offspring of Emy and Ipuh in the Cincinnati zoo, now nearing sexual maturity, be moved to the SRS to be paired with the two young females, Ratu and Rosa.

It was recommended that the older female, Bina, be moved from Indonesia to the USA to be paired with Ipuh, the only proven breeder in the captive population. Bina has unsuccessfully mated with Torgamba for several years in SRS and current disturbance in her oestrous cycle is sign of declining fertility. She is assessed to be potentially reproductive, but time for her to reproduce is getting short, and therefore pairing with Ipuh is the option judged to have the highest possibility of success.

The GMPB meeting endorsed these moves and preparations for transport have started. It is expected that first Andalas will move, in October or November this year, then Bina several weeks later. This is a wonderful development and will benefit both the *in situ* programme in Indonesia and the *ex-situ* programme in the US, in both the short and the long term. It is hoped that all parties involved will be able to expedite the movements of these animals as much as possible.

Update of the Indonesian Rhino Conservation Strategy

On 28 and 29 February 2006 a workshop was conducted in Jakarta to review and update the Indonesian Rhino Conservation Strategy of 1993 as well as the IUCN Asian Rhino Specialist Group's Asian Rhino Conservation Strategy (1997). The workshop was supported technically and financially by AsRSG, IRF and WWF, with additional financial support from the USFWS Rhino and Tiger Conservation Fund.

During the workshop the achievements of the existing Rhino Conservation Strategies were evaluated, long-term targets were formulated, and immediate and attainable priorities for conservation action were identified. Managers of protected areas holding rhinos, the central government's Forestry ministry, academic institutions, and all major international non-governmental organizations active in rhino conservation par-

de la gestion des populations de rhinos de Sumatra en captivité partout dans le monde, en les considérant comme une population vraiment globale, afin de maximiser les options de reproduction et d'améliorer sa vitalité et sa viabilité ». Le conseil comprend des représentants des autorités des états de l'aire de répartition, des institutions en charge des rhinos de Sumatra, des principaux sponsors, du GSRAs, et des experts indépendants des rhinos.

La deuxième réunion du GMPB s'est tenue à Jakarta le 1^{er} mars 2006 pour discuter une proposition de relance du potentiel reproducteur par le déplacement de certains rhinos. A la demande des autorités indonésiennes, le Comité technique du GMPB a développé une proposition concernant deux des rhinos. Il fut recommandé que le jeune mâle adulte Andalas, le premier rejeton d'Emi et d'Ipuh au Zoo de Cincinnati, qui a à peu près atteint la maturité sexuelle, soit envoyé au SRS pour s'accoupler avec les deux jeunes femelles Ratu et Rosa.

La femelle plus âgée, Bina, devrait, elle, quitter l'Indonésie pour les USA pour s'accoupler avec Ipuh, le seul reproducteur confirmé de la population en captivité. Bina s'est accouplée sans succès avec Torgamba pendant plusieurs années au SRS, et les perturbations constatées maintenant dans son cycle oestral sont des signes du déclin de sa fertilité. On estime qu'elle pourrait encore se reproduire, mais le temps presse ; c'est pourquoi l'accoupler avec Ipuh semble l'option qui a le plus de chances de succès.

La réunion du GMPB a approuvé ces déplacements, et les préparatifs de transports ont commencé. Normalement, c'est Andalas qui devrait bouger le premier, en octobre ou novembre de cette année, suivi par Bina, quelques semaines plus tard. C'est un progrès merveilleux qui va profiter aussi bien au programme *in situ* en Indonésie qu'au programme *ex situ* aux USA, à court et à long terme. On espère que toutes les parties impliquées pourront activer ces déplacements le plus possible.

Mise à jour de la Stratégie indonésienne de conservation des rhinos

Les 28 et 29 février 2006, un atelier eut lieu à Jakarta pour réviser et mettre à jour la Stratégie indonésienne de conservation des rhinos qui date de 1993, ainsi que de la Stratégie asiatique de conservation des rhi-

anticipated. A draft report has been produced and is now being refined by a Rhino Task Force, which will also catalyse and oversee implementation of the new strategy.

Currently Indonesia holds in three main areas about two-thirds of the world population of Sumatran rhinos, estimated at about 300, and in a single area virtually all the 50 surviving Javan rhinos. Although better protection against poaching has resulted in prevention of further losses and early recovery in some populations, the number of rhinos of both species is far below the recommended minimum numbers for long-term survival.

The workshop endorsed the long-term goal of restoring the populations of each of these species to at least 1000 animals each in Indonesia. This will require continued strict protection, preservation and safeguarding of significant areas of suitable habitat, and reintroduction of rhinos in areas where they have been exterminated. This is a long-term programme that will require substantial inputs from all parties concerned, but the goals are achievable as is demonstrated by the recovery of the Indian rhino in India and Nepal, and the southern white rhino in South Africa. Both were one time as critically endangered as the South-East Asian rhinos are now.

Since achieving the goals of viable and secure population of both the Sumatran and Javan rhinos will take a long time, probably as much as a century, the programme has tentatively been called 'Rhino Century Programme' and the plan is to have a high-profile launching later in the year.

Danum Valley rhino survey, Sabah

In March the summary results of the rhino survey in Sabah's Danum Valley were released. The survey had been conducted several months earlier with 120 people in 16 teams from the Sabah Wildlife Department, the Sabah Forestry Department, Sabah Parks, the Sabah Foundation, WWF-Malaysia, the Kinabatangan Orangutan Conservation Project, SOS Rhino, the University Malaysia Sabah, and Operation Raleigh.

The survey covered the Greater Danum—the interior parts of the huge Yayasan Sabah concession. Rhino signs were found in several locations over a large area, and the evaluation team concluded that tracks of probably 13 different rhinos were detected. This is a good result, especially as there was heavy

nos du GSRAs/UICN (1997). L'atelier fut soutenu financièrement par le GSRAs, l'IRF, et le WWF, avec un support financier supplémentaire du Fonds pour la Conservation du Rhino et du Tigre du USFWS.

Pendant cet atelier, on a évalué les progrès des stratégies actuelles de conservation des rhinos, on a formulé les objectifs à long terme et identifié les priorités immédiates réalisables en matière de conservation. Les gestionnaires des aires protégées qui hébergent des rhinos, le ministère de la Foresterie du gouvernement central, des institutions académiques et toutes les organisations non gouvernementales internationales majeures, actives dans la conservation des rhinos, y ont participé. Un projet de rapport a été rédigé et il est actuellement affiné par une Unité spéciale Rhino, qui va aussi superviser et catalyser la réalisation de la nouvelle stratégie.

Actuellement, l'Indonésie héberge dans trois aires principales près des deux tiers de la population mondiale de rhinocéros de Sumatra, estimée à 300 animaux environ et, au sein d'une seule aire, pratiquement tous les rhinos de Java encore en vie, au nombre de 50. Bien qu'une meilleure protection contre le braconnage ait empêché de nouvelles pertes et permis un début de restauration dans certaines populations, le nombre de rhinos des deux espèces est bien inférieur au minimum recommandé pour une survie à long terme.

L'atelier a adopté comme objectif à long terme une restauration des populations à 1000 individus au moins pour chaque espèce, en Indonésie. Ceci exigera une protection stricte de longue durée, la mise en réserve et la sauvegarde des aires d'habitat propice, et la réintroduction de rhinos dans les zones où ils ont été exterminés. C'est un programme à long terme qui exigera des inputs substantiels de toutes les parties concernées, mais les objectifs sont réalisables comme l'ont montré la restauration du rhinocéros unicolore de l'Inde, en Inde et au Népal et celle du rhino blanc du Sud, en Afrique du Sud. Les deux espèces furent un temps aussi menacées que le sont les rhinos du Sud-Est asiatique aujourd'hui.

Etant donné qu'il faudra très longtemps, probablement un siècle, pour atteindre cet objectif de populations de rhinos de Java et de Sumatra viables et en sécurité, le programme a été appelé « Programme rhino du siècle » et il est prévu de le lancer de façon spectaculaire plus tard dans l'année.

rain during the survey, making it much more difficult to find rhino tracks. Previous surveys indicated at most half of this number.

The tracks found were far apart and no compelling evidence of reproduction was found. Therefore, more needs to be done to monitor the rhinos in Danum to verify that it is a viable reproducing population and not only a number of isolated survivors that have no chance of meeting and reproducing.

Conservation organizations are currently setting off a number of patrolling teams to continue the monitoring and increase the protection of the Greater Danum rhinos.

In most press coverage it was suggested that the 13 rhinos in Danum were the only ones to survive in all of Borneo, ignoring the other known populations, in particular that in Tabin Wildlife Reserve, which may have more rhinos than Danum. More precision in releases to the press is recommended.

Rhino campaigns from European and American zoos

The zoo associations of Europe and North America have both launched major campaigns to popularize rhinos and to generate funds for rhino conservation.

The European Association of Zoos and Aquaria (EAZA), together with Save the Rhino International, started their one-year campaign in September 2005. EAZA has 292 members in Europe, who will present the Save the Rhinos campaign to their visitors and organize special rhino events.

The main focus of Save the Rhinos is to raise funds in support of a minimum of 13 selected rhino conservation projects in Africa and Asia, directly supporting the conservation and survival of rhinos in the wild. The campaign has made a very promising start and it may well surpass its target of 350,000 euros.

The North American Save the Rhinos campaign was launched in January 2006 by IRF in partnership with the Rhino Advisory Group and Species Survival Plans of the American Zoo and Aquarium Association (AZAA) and Ecko Unlimited.

The campaign will leverage existing pledges to increase funding from zoos, corporations, foundations and individuals by raising awareness and increasing commitments to rhino conservation. Campaign activities will focus on three critically endangered species of rhino—black, greater one-horned (Indian) and Sumatran.

Etude du rhino dans la Vallée de Danum, à Sabah

En mars, le résumé des résultats de l'étude du rhino dans la vallée de Danum, à Sabah, a été communiqué. Cette étude avait été réalisée plusieurs mois plus tôt par 120 personnes, composant 16 équipes, venues du département de la Faune sauvage de Sabah, du département des Forêts, des Parcs de Sabah, de la *Sabah Foundation*, du WWF-Malaisie, du Projet de Conservation des Orangs-outans de Kinabatangan, de SOS Rhino, de l'*University Malaysia Sabah* et de l'Opération Raleigh.

L'étude a couvert le grand Danum — les parties intérieures de l'énorme concession de Yayasan Sabah. On a trouvé des signes de rhinos à plusieurs endroits couvrant une grande superficie, et l'équipe d'évaluation a conclu que les traces correspondaient probablement à 13 rhinos différents. C'est un bon résultat, surtout lorsque l'on sait qu'il a plu beaucoup pendant l'étude, ce qui a rendu la découverte des traces de rhinos beaucoup plus difficile. Des études antérieures indiquaient tout au plus la moitié de ce nombre.

Les traces découvertes étaient éloignées les unes des autres, et on n'a trouvé aucune preuve d'une quelconque reproduction. C'est pourquoi il faut encore surveiller davantage les rhinos de Danum pour vérifier qu'il y a une population reproductrice viable et pas seulement un certain nombre d'individus isolés qui n'ont aucune chance de se rencontrer et de se reproduire.

Les organisations de conservation sont occupées à organiser un certain nombre d'équipes qui patrouilleront pour poursuivre le monitoring et augmenter la protection des rhinos du grand Danum.

Dans la plus grande partie de la presse, on a pu lire que les 13 rhinos de Danum étaient les seuls survivants pour toute l'île de Bornéo, ignorant les autres populations connues, en particulier celle de la Réserve de Faune de Tabin qui pourrait abriter plus de rhinos encore que Danum. On a recommandé de fournir plus de précisions lors des conférences de presse.

Campagnes rhinos dans les zoos européens et américains

Les associations des zoos d'Europe et d'Amérique du Nord ont lancé des campagnes importantes pour rendre les rhinos populaires et pour récolter des fonds pour leur conservation.

Both AsRSG and AfrSG have been intensively involved in setting up the campaigns and in identifying the beneficiaries.

Many zoos have contributed significantly to rhino conservation in the past, and the current campaigns are very much appreciated and will generate much needed funds for future rhino conservation programmes. Rhino conservation is very long term, with a century being an appropriate project cycle rather than the usual five-year cycle. Therefore we hope and expect that the support generated through the zoo campaigns will continue with long-term institutional support for rhino conservation in the wild.

Conservation in conflict in Nepal

In the last 30 years, Nepal has set aside over 19% of its land mass in protected areas ranging from lowland terai in the south to the high Himalayas in the north of the country to conserve its endangered wildlife and spectacular landscape and preserve its rich culture. Altogether there are 16 protected areas under different management systems. Management style ranges from strict protection to a totally community-based system with revenue sharing, and from conservation aimed towards a single species to holistic conservation of the landscape.

Nepal has successfully revived populations of endangered species like rhino, tiger and wild elephant. For example, the rhino population increased from fewer than 100 animals in the late 1960s to 612 in 2000. Nepal has also initiated a translocation programme that has led the way in Asia with its proactive conservation management of rhino populations. Animals that are primarily concentrated in one area are translocated to re-establish viable populations—82 rhinos have been translocated from Royal Chitwan National Park to Royal Bardia National Park and the Suklaphanta Wildlife Reserve.

A buffer zone programme has effectively motivated and empowered communities by developing local institutions, diversifying opportunities to generate income, and reducing dependency on using park resources for their livelihood. Landscape-level conservation has dissipated the isolation of the protected areas, which are considered gene pool repositories. Also, wildlife can now safely roam beyond protected areas, which will help sustain genetically strong populations in days to come.

L'Association Européenne des Zoos et Aquariums (EAZA) et *Save the Rhino International*, ont lancé leur campagne d'un an en septembre 2005. L'EAZA compte 292 membres en Europe qui présenteront la campagne *Save the Rhino* à leurs visiteurs et organiseront des événements spéciaux.

Le principal objectif de *Save the Rhino* est de récolter des fonds pour supporter un minimum de 13 projets de conservation des rhinos en Afrique et en Asie, en soutenant directement la conservation et la survie des rhinos dans la nature. La campagne a connu un début très prometteur et elle pourrait bien dépasser son objectif qui est de 350.000 euros.

La campagne *Save the Rhino* en Amérique du Nord a été lancée en janvier 2006 par IRF, en partenariat avec le *Rhino Advisory Group*, les Plans de Survie des Espèces de l'Association américaine des zoos et aquariums (AZAA) et Ecko Unltd.

La campagne va renforcer les promesses actuelles d'augmenter les fonds provenant des zoos, des corporations, des fondations et des particuliers, en sensibilisant davantage et en augmentant les engagements envers la conservation des rhinos. Les activités de la campagne se concentreront sur trois espèces de rhinos en danger critique d'extinction – le rhino noir, le rhinocéros unicolore de l'Inde et le rhino de Sumatra.

Le GSRA et le GSRAf se sont beaucoup impliqués dans la préparation de ces campagnes et dans l'identification de leurs bénéficiaires.

De nombreux zoos ont contribué significativement à la conservation des rhinos dans le passé, et les campagnes actuelles sont très appréciées et rassembleront des fonds bien nécessaires pour les futurs programmes de conservation des rhinos. La conservation des rhinos porte sur le très long terme, une durée d'un siècle étant plus appropriée pour un cycle de projet que la durée habituelle de cinq ans. C'est pourquoi nous espérons que le soutien généré par les campagnes des zoos va se prolonger par un support institutionnel à long terme de la conservation des rhinos dans la nature.

Conservation en temps de conflit au Népal

Ces trente dernières années, le Népal a mis de côté plus de 19% de son territoire sous forme d'aires protégées, allant du terai de basse altitude au sud jusqu'à l'Himalaya au nord du pays, pour conserver

But protected area management is facing major new problems: an upsurge of poaching, rising human–wildlife conflict—and also human–human conflict. The armed insurgency, affecting the entire country including the conservation front, has been going on for about a decade now. Some of the insurgents' actions have been very brutal: we lost five staff from Parsa Wildlife Reserve in a landmine blast; 10 people including staff were killed in another blast in Suklaphanta Wildlife Reserve. These incidents have created terror among the staff. Such actions have not only created physical damage and mental torture but will also have a long-term effect on managing natural resources. Insurgency has led to illegal and indiscriminate exploitation of rare and valuable medicinal plants. Endangered species like the rhino have become more vulnerable to poaching; rhino poaching increased in 2001 and 2002.

Protected areas require constant surveillance through patrolling and stationing staff at different strategic points for effective protection and control. Infrastructural damage has occurred in all protected areas of the country, much of it to guard posts and office buildings.

With the continuance of conflict, the priority of security personnel deployed in the protected areas has changed to national security. It has reduced the occupancy of the existing guard posts to less than 50% and similarly movement within the protected areas has gone down significantly. Patrolling the interior of Royal Bardia National Park and Parsa Wildlife Reserve has become very risky, and virtually no wildlife monitoring has been done there for a long time because these areas are suspected as a transit route for insurgents. So it is almost impossible to know the current status of wildlife of the area, including that of the trans-located rhinos.

Even in such a situation, efforts have been made to increase surveillance in different protected areas by patrolling them and by forming community-based anti-poaching groups to gather intelligence. A reward system has been established to recognize the outstanding conservation work of the staff, army personnel and communities. The WWF Nepal Program has strengthened the communication network in the park by providing Motorola walkie talkie sets and just recently WWF–Nepal and Toyota have donated two four-wheel-drive jeeps to Royal Chitwan National Park.

Poaching is under control. We have learned that a committed and dedicated staff is vital to carry out

sa faune et ses paysages spectaculaires menacés et pour préserver sa riche culture, en harmonie avec son peuple. En tout, il y a 16 aires protégées de différentes catégories, avec des régimes de protection différents. L'histoire de la gestion de la conservation montre que l'approche de la gestion s'est faite par adaptation progressive. Par conséquent, le style de gestion des aires protégées va de la protection stricte à un système complètement communautaire avec partage des bénéfices, et de la conservation axée sur une seule espèce à la conservation holistique d'un écosystème.

Le Népal a réalisé avec succès la reprise de quelques espèces en danger, comme le rhino, le tigre et l'éléphant sauvage. Par exemple, la population de rhinos est passée de moins de 100 à la fin des années 1960 à 612 en 2000. Le Népal a aussi lancé un programme de translocation qui a montré la voie en Asie avec sa gestion proactive de la conservation des populations de rhinos. Des animaux qui sont, au départ, concentrés dans une région sont déplacés dans d'autres régions pour y instaurer des populations et les rendre viables – 82 rhinocéros ont été déplacés du Parc National Royal de Chitwan vers le Parc National Royal de Bardia et la Réserve de Faune de Suklaphanta.

Un programme de zones tampons a réellement motivé les populations et les a renforcées, en développant les institutions locales, en diversifiant les possibilités de générer des revenus et en réduisant la dépendance vis-à-vis des ressources du parc pour les besoins quotidiens. La conservation au niveau de l'écosystème a levé l'isolement des aires protégées, qui sont considérées comme des conservatoires de pools génétiques. La faune sauvage peut aussi évoluer en sécurité en dehors des aires protégées, ce qui aidera à l'avenir à maintenir des populations génétiquement solides.

Mais la gestion d'une aire protégée fait face à de nouveaux défis qu'elle doit relever pour rester à la hauteur des succès de la conservation. Les principaux problèmes sont dus à une hausse du braconnage, qui augmente les conflits hommes–faune sauvage et aussi hommes/hommes. La rébellion armée, qui touche tout le pays, dure depuis près d'une décennie maintenant, et elle a, directement ou indirectement, sérieusement touché tous les secteurs. Le front de la conservation ne fait pas exception. Certaines actions des insurgés ont été très brutales. Par exemple, nous avons perdu cinq hommes de la Réserve de Faune de Parsa dans l'explosion d'une mine. De même, dix personnes,

programmes in a conflict situation. We believe that support and collaborative efforts from conservation partner organizations is more essential in this difficult situation than in normal times for conserving the rhino and managing the natural resources of the country. More and more community empowerment will help support the conservation programme.

Preliminary census data for rhinos in Assam, India

Preliminary results of rhino counts in the main rhino areas in Assam have been announced. The official figures, after correction for double or incomplete counting, may give slightly different figures, but it is clear that the numbers are up again.

Kaziranga National Park has once again established itself as a conservation success story with an increase of over 300 in the population of the Indian rhinoceros (*Rhinoceros unicornis*) over the last seven years. The park director, N. K. Basu, stated, 'The rhino census has just been concluded and the minimum number of rhinos is projected to be 1855.' The population figure in the last census in 1999 was 1552. In 1966 the population was a mere 366; it jumped up to 658 in 1972, 939 in 1978, 946 in 1984, 1129 in 1991 and 1164 in 1993. In the same period about 450 rhinos died, but death due to poaching has been minimized to about five per year now.

The preliminary figures for Pabitora Wildlife Sanctuary are 81, and 68 for Orang National Park, bringing the total number of rhinos in Assam to about 2000. In 1999 only 46 rhinos were counted in Orang, and 20 rhino were poached since then.

One young rhinoceros that was swept away by floods in Kaziranga National Park but rescued has been relocated to Manas National Park. More rhinos will be moved later as part of the Vision 2020 programme.

dont des membres du personnel, ont été tuées dans une explosion dans la Réserve de Faune de Suklaphanta. Ces incidents ont semé la terreur parmi le personnel, et certains ont été forcés à quitter leur poste régulier. Ces actes n'ont pas seulement causé des dommages physiques et des tortures mentales, mais ils auront en plus un effet à long terme sur la gestion des ressources naturelles. La rébellion est ainsi devenue un des principaux facteurs de l'affaiblissement de la gestion des ressources naturelles. Elle a entraîné l'exploitation illégale et indiscriminée de plantes médicinales rares et précieuses, et des espèces en danger comme le rhinocéros sont plus qu'avant victimes du braconnage parce que leur mobilité est limitée et que la fusion des postes de gardes a laissé des espaces moins bien gardés par où il est possible d'accéder aux aires protégées. Pendant la rébellion, le braconnage des rhinos a été enregistré en hausse en 2001 et 2002. Ce braconnage alimente le commerce illégal de viande de brousse et de plantes aromatiques et médicinales.

Les aires protégées requièrent une surveillance constante, la protection et les contrôles efficaces étant assurés par des patrouilles et par du personnel posté à différents points stratégiques. Les infrastructures de toutes les aires protégées du pays ont subi des dommages, la plupart pour garder des postes et des immeubles.

Une grande partie de ces dommages ont touché les postes des gardes et les bureaux construits ces trente dernières années dans le cadre du développement du système des aires protégées. Il est certain que leur reconstruction coûtera beaucoup plus cher.

Avec la poursuite des conflits, la priorité du personnel de sécurité qui était déployé dans les aires protégées s'est reportée sur la sécurité nationale. L'occupation des postes de gardes existants s'est réduite de plus de 50% et parallèlement, les déplacements au sein des aires protégées ont diminué significativement. Patrouiller à l'intérieur du Parc National Royal de Bardia et de la Réserve de Faune de Parsa est devenu très dangereux, et on n'y a fait pratiquement plus aucun monitoring de la faune depuis longtemps parce que l'on suspecte que ce sont des voies de transit des insurgés. Il est donc presque impossible de connaître le statut actuel de la faune de la région, y compris celui des rhinos réintroduits.

Même dans cette situation, on a fait des efforts pour accroître la surveillance dans certaines aires protégées en y patrouillant et en formant des groupes

anti-braconnage communautaires pour réunir toutes les informations possibles. On a instauré un système de récompenses en reconnaissance du travail de conservation exceptionnel réalisé par le personnel, les militaires et les communautés. Le Programme WWF au Népal a consolidé le réseau de communication du parc en fournissant des walkies-talkies Motorola et, très récemment, le WWF-Népal et Toyota ont donné deux jeeps 4X4 au Parc National de Chitwan.

Grâce aux meilleures communications, à des moyens de transport améliorés et au travail ardu d'un personnel dévoué, de l'armée et des communautés qui vivent autour de l'habitat des rhinos, le braconnage est sous contrôle. Nous avons appris qu'un personnel engagé et dévoué est indispensable pour réaliser les programmes en cas de conflit. Nous croyons que le support et les efforts de collaboration des organisations partenaires dans la conservation sont plus essentiels encore dans cette situation difficile qu'en temps normal pour conserver les rhinos et gérer les ressources naturelles du pays. Le pouvoir accru confié aux communautés va aider à soutenir le programme de conservation.

Premières données du recensement des rhinos en Assam, Inde

Les premiers résultats des comptages dans les principales zones à rhinos d'Assam ont été annoncés.

Les chiffres officiels, après avoir reçu une correction pour comptages doubles ou incomplets, pourraient être légèrement différents mais il est clair qu'ils sont de nouveau en hausse.

Le Parc National de Kaziranga fait de nouveau figure de « success story », avec une augmentation de la population de plus de 300 rhinos d'Inde (*Rhinoceros unicornis*) au cours des sept dernières années. Le Directeur du parc, N. K. Basu a dit : « Le recensement des rhinos vient de se terminer, et le nombre minimum devrait être de 1855 ». Le recensement de la population en 1999 avait donné un chiffre de 1552. En 1966, la population ne comptait que 366 rhinos ; elle atteignait 658 en 1972, 939 en 1978, 946 en 1984, 1129 en 1991 et 1164 en 1994. Pendant cette même période, près de 450 rhinos sont morts, mais les morts dues au braconnage ont maintenant été ramenées à cinq par an environ.

Les chiffres préliminaires pour le Sanctuaire de Faune de Pabitora sont de 81, et de 68 pour le Parc National d'Orang, ce qui porte le total des rhinos en Assam à près de 2000. En 1999, on n'avait dénombré que 46 rhinos à Orang, et 20 ont été braconnés depuis.

Un jeune rhino qui avait été emporté par des inondations et puis sauvé dans le Parc national de Kaziranga a été placé dans le Parc de Manas. D'autres rhinos seront déplacés cette année dans le cadre du Programme Vision 2020.

RESEARCH

Effect of artificial water points on the movement and behaviour of desert-dwelling elephants of north-western Namibia

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Abstract

In November 2002, two artificial water points (AWPs) were drilled in the Hoanib River, north-western Namibia. This arid area (< 100 mm annual rainfall) seasonally supports a relatively large desert-dwelling elephant population. The range and the distribution of these elephants are determined by the distance that they need to forage from water. Before drilling the AWPs, female family units, hindered by their young, were limited in their movement, needing to stay close to natural permanent water sources. Free-ranging adult male elephants had larger ranges as they were less constrained in their drinking frequencies. However, the drilling of AWPs allowed family units to shift their ranges spatially beyond their normal foraging areas. Free-ranging males did not spatially shift their feeding areas but foraged closer to the AWPs. The seasonal movement of one family unit was disrupted by these AWPs, its members becoming more or less permanent residents along the river. AWPs have also changed the frequency and manner of drinking behaviour in this elephant population.

Résumé

En novembre 2002, deux points d'eau artificiels (PEA) ont été creusés dans la rivière Hoanib, au nord-ouest de la Namibie. Cette région aride (< 100 mm de chutes de pluie annuelles) accueille de façon saisonnière une population relativement importante d'éléphants du désert. La répartition et la distribution de ces éléphants sont déterminées par la distance qu'ils doivent parcourir entre l'eau et l'endroit où ils mangent. Avant de creuser les PEA, les unités familiales de femelles, ralenties par les jeunes, étaient limitées dans leurs déplacements puisqu'elles devaient rester à portée des points d'eau naturels. Les éléphants mâles adultes avaient une dispersion plus grande parce qu'ils avaient moins de contrainte en ce qui concerne la fréquence où ils devaient boire. Cependant, le creusement de PEA a permis aux unités familiales de déplacer leur dispersion au-delà de leurs aires de nourrissage habituelles. Les mâles n'ont pas changé spatialement leurs aires de nourrissage, mais ils se mirent à manger plus près des PEA. Le déplacement saisonnier d'une famille fut perturbé par ces PEA, et elle est devenue plus ou moins résidente permanente le long de la rivière. Les PEA ont aussi changé la fréquence et la manière de boire de cette population d'éléphants.

Introduction

Providing artificial water points (AWPs) in an arid or semi-arid area has been regarded as detrimental to the 'natural environment', as it gives permanent access for people and domestic stock to areas that were

traditionally available only seasonally (Perkins and Thomas 1993; Du Toit and Cumming 1999). The concentration of people and domestic stock around these AWPs has led to environmental degradation (Reid and Ellis 1995) and exclusion of wildlife from these areas (Verlinden et al. 1998). The greatest effect of AWPs

had been on vegetation, with dramatic changes in species composition and productivity occurring near the water point where intensive grazing forms distinctive zones or biospheres (Pickup 1994). Other authors have referred to the degraded area around AWP as a 'sacrifice zone' (Perkins and Thomas 1993). High densities of domestic stock have been reported to induce changes in infiltration rates, soil nutrient levels, and the resistance and resilience of ecosystems (Leggett et al. 2003a). However, the effect on bulk rangeland (more than a kilometre away from either AWP or human settlement) was reported to be rare (Leggett et al. 2003a,b). Leggett et al. (2003a) reported that wildlife and domestic stock had a similar effect on veld in an enclosed situation, which was a fenced area in a semi-arid environment.

Elephants vary in their home ranges from being almost sedentary (Douglas-Hamilton 1971; De Villiers and Kok 1997) to being semi-nomadic or seasonally dispersive (Viljoen 1989a; Lindeque and Lindeque 1991; Thouless 1995; Leggett 2006). The timing of seasonal movements and differential use of habitats has been linked to rainfall, forage preference and availability (Western and Lindsay 1984; White 1994; Thouless 1995; Babaasa 2000). Several authors (Viljoen 1987, 1988, 1989a,b; Lindeque and Lindeque 1991; Leggett et al. 2003c;) have described the movement, behaviour and ecology of elephants in the arid areas of north-western Namibia; however, most of these studies were undertaken before AWP were provided.

The ephemeral rivers of north-western Namibia and their associated springs, wetlands and vegetation form linear oases for wildlife and people in an otherwise barren landscape (Leggett et al. 2003c; 2004). The Hoanib River catchment, one of the 12 western-flowing ephemeral rivers of Namibia, has been extensively studied in recent years. Its geology, vegetation and seasonal distribution of resources have been well documented (Fennessy et al. 2001; Leggett et al. 2003a,b). Wildlife tend to concentrate around water sources during the dry season within relatively small home ranges and group sizes. These populations tend to disperse during the wet season but occasionally form large feeding aggregations to take advantage of seasonally available vegetation that is not necessarily located near water points (Leggett et al. 2004). Populations of domestic stock also tend to increase in the wet season, but they are concentrated around seasonally available water sources. During the dry season domestic stock is concentrated around permanent water sources (Leggett et al. 2004).

African elephants are known to dig holes in riverbeds to gain access to water during times of seasonal or sustained aridity (Dudley et al. 2001). In arid north-western Namibia, elephants routinely drink year round from shallow holes dug in the ephemeral riverbeds, called *ghorras* (a local Damara word meaning 'dug by hand').

Using a combination of observational and GPS satellite data of collared adult males and family units, in this paper I report changes in the feeding areas (spatial) and seasonal movements within established home ranges in response to the AWP. In addition, I report changes in drinking behaviour that occurred after the AWP were added.

Study area

The Hoanib River catchment is located in the Kunene Region of Namibia. The location of the study area, western wetlands, ghorras, rainfall isohyets and AWP is shown in figure 1.

In arid areas, rainfall is spatially and temporally variable. Seasonal rainfall is highly variable and the average rainfall of an area does not necessarily serve as a good indicator of the amount of rainfall that can be expected in any given season (Leggett et al. 2001a). The research reported in this paper was conducted on the desert-dwelling elephants in a zone with 0–100 mm average annual rainfall.

There are three recognizable seasons in north-western Namibia, functionally and broadly defined (after Viljoen 1988): wet season (January–May); cold dry season (June–September); and hot dry season (October–January). In practice these seasons are variable, for example, the 1999/2000 wet season commenced in October 1999, with the last rains falling in May 2000.

In the last 23 years, the number of days of flooding (flood is defined as any time there is surface water flowing in the river) in the Hoanib River varied from 4 in 1981 to 52 in 1983, with an average of 17.7 days (Leggett et al. 2001a). Before October 2002, the only water available to elephants in the western section of the Hoanib River outside of the flood periods was found in the permanent wetlands at Dubis and the seasonal wetlands near the dunes in the western section of the river. Elephants also drank from ghorras, which varied seasonally in their location but were always found close to the Dubis wetlands. During the cold dry and hot dry season, most ghorras were dug just to the west of Dubis.

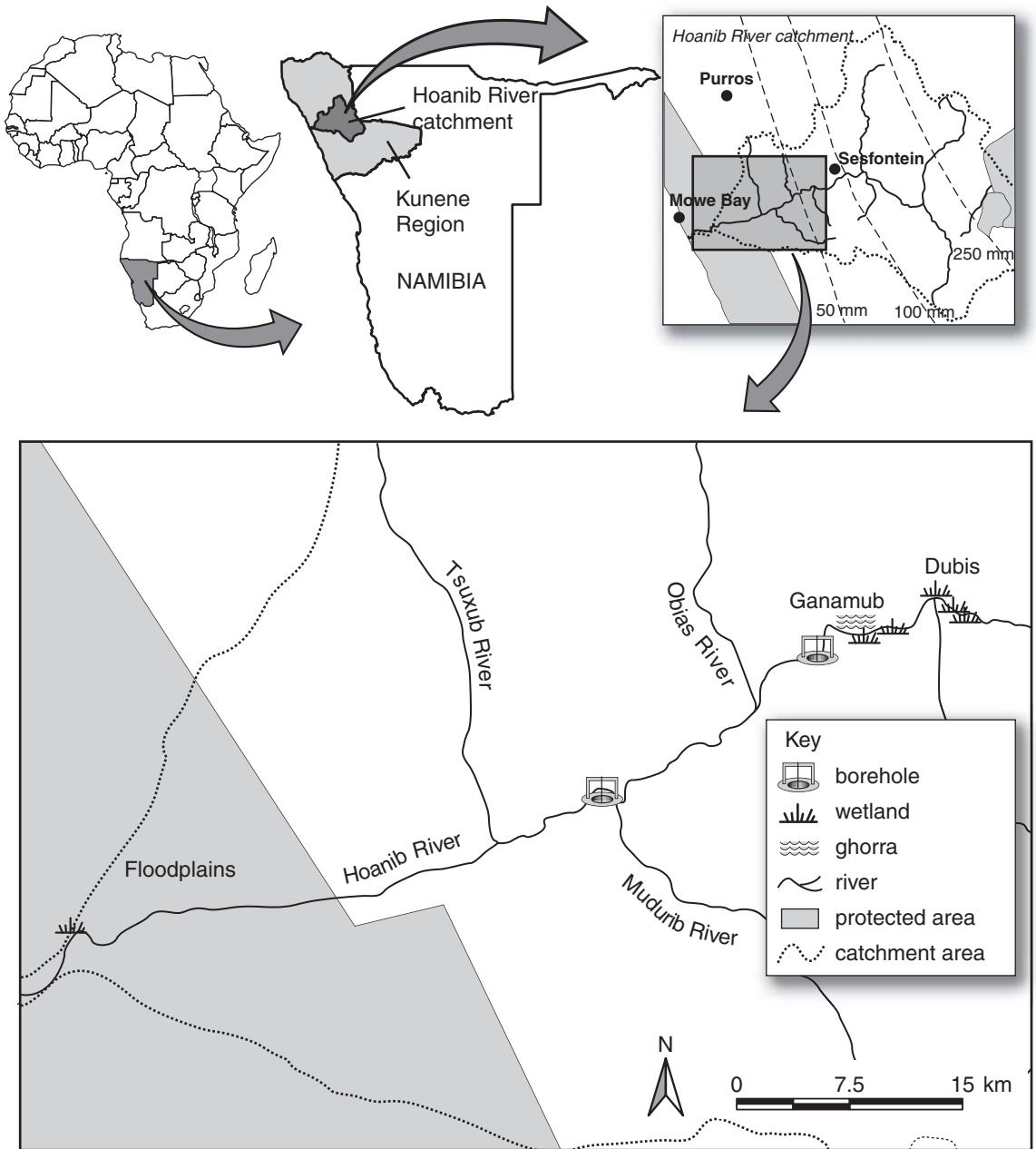


Figure 1. Location of wetlands, ghorras and artificial water points in the lower Hoanib River, north-west Namibia.

In late October 2002, two AWP were drilled in the western section of the Hoanib River: at Ganamub Poort and at the confluence of the Mudurib and the Hoanib Rivers. The government of Namibia provided these AWP to keep elephants away from the human settlements approximately 30 km to the east of Dubis.

Methods

The observations reported here were made between January 1998 and June 2004. From January 1998 until June 2001, transects were driven through the research area every two months and elephant identification,

location (coordinates obtained by GPS), numbers and drinking behaviour were recorded. (For a detailed description of the transect methods see Leggett et al. 2003c.) Since June 2001, I have spent a minimum of 10 days a month (weather and floods permitting) in the research area, observing elephants and recording detailed information on identification, location numbers, activities and behaviour.

Elephants were individually identified using a combination of photographs and identification sheets. The photographic techniques used were similar to techniques already described by Douglas-Hamilton and Douglas-Hamilton (1975) and Moss (1982).

For the purposes of this paper, a basic family unit is defined as a mother and offspring associated with her, a herd as a group of closely associated individuals who coordinate daily activities, and a clan as individuals who occupy the same seasonal range. While the Hoanib River catchment constitutes a small section of the total range of these elephants, it represents an important core area for elephants in the Kunene Region (Leggett 2006).

There are approximately 54 elephants in seven family units (between 3 and 9 individuals) plus 7 adult males at any one time in the western section of the research area. Only two family units and 4 free-ranging adult males moved between the Hoanib and Hoarusib Rivers. One of the family units (Western Kunene Female, WKF-18) and one free-ranging adult male (Western Kunene Male, WKM-10) were GPS collared in September 2002. Douglas-Hamilton (1998), Blake et al. (2001) and Leggett (2006) have previously described the use of

GPS collars for tracking elephants. Two other elephants were also GPS collared; their home ranges are presented in figure 2. The other family unit (Western Kunene Female, WKF-14) was closely observed and its locations recorded during the study period.

Elephant drinking behaviour was recorded for individual males and for family units over each study period (February 2002; February, May and September 2003). Elephants were located daily and followed during diurnal hours, and their behaviour was recorded. AWP's were checked morning and evening for spoor to determine whether elephants had drunk

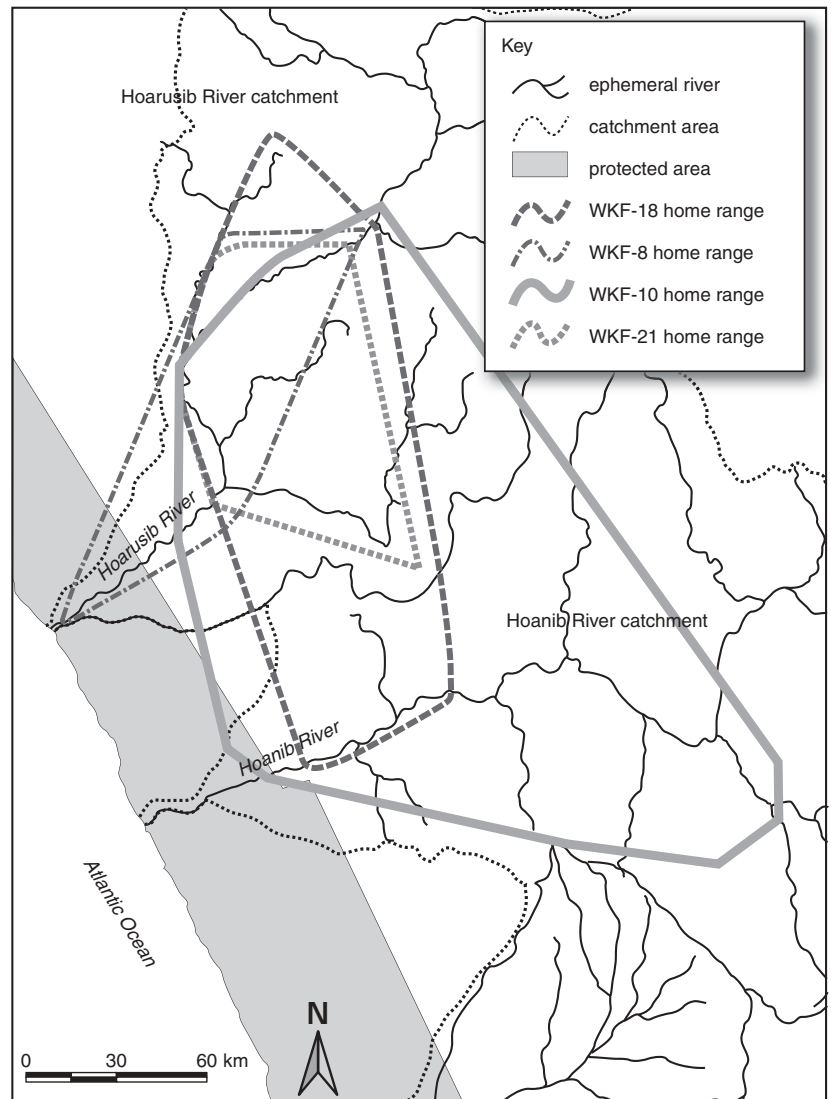


Figure 2. Home ranges of four GPS-collared elephants, north-west Namibia, 2003 and 2004.

there during my absence. Only data for elephants whose locations were known during the study period are presented.

Data analysis

All GPS readings were converted to a Schwarzek projection using MAPINFO, a geographical information system (GIS) (MapInfo Corporation 1998). Using overlays of GPS readings of the elephant locations and water-source information (both artificial and naturally occurring), the number and position of elephants within a 1-, 5- or 10-km radius of either the AWP or the wetlands was determined. The non-parametric Mann-Whitney *U*-test was used for all statistical analyses.

Results

Observational data on the density of elephants in the lower Hoanib River over the period 1998–2004 are presented schematically in figure 3. The densities of family units before AWP were provided (January 1998–November 2002) are presented in figure 3a, while figure 3b shows the density after AWP (December 2002–April 2003). Similarly, figures 3c and 3d show the density of male elephants before and after AWP were provided.

Average distance of elephants away from permanent natural water sources and AWP is presented in table 1. Additionally, this table contains the percentage of elephant observations within radii of 1, 5 and 10-km and a radius greater than 10 km of natural and artificial water sources.

Before AWP were provided, family units were observed 22% of the time within a 1-km radius of wetlands, 61% within a 5-km radius and 13% within a 10-km radius, with only 4% observed more than 10 km away from a wetland. The average distance of family units away from a wetland was 3.65 ± 3.54 km ($n = 23$). After AWP were added, however, only 2% of family unit observations occurred within a 10-km radius of a permanent natural water source, while 98% of observations located elephants at distances greater than 10 km away. The average distance of elephants away from permanent natural water sources was 17.90 ± 5.43 km ($n = 41$), which is significantly different from the pre-AWP situation ($U = 39$, $p < 0.001$).

Free-ranging adult males showed distribution different from the family units. Before AWP 40% of free-ranging adult male elephants were observed

within a 10-km radius of the natural permanent water sources, while 60% of observations were greater than 10 km away. The average distance males were observed from the wetlands and ghorras was 10.77 ± 8.66 km ($n = 52$). However, after the AWP were provided, observed free-ranging adult males showed a distribution ($U = 1187$, $p = 0.779$) similar to family units with 98% of observations being greater than 10 km away from the natural permanent water sources. Their average distance was 17.95 ± 6.45 km ($n = 60$), which was significantly different ($U = 839$, $p < 0.001$) from the pre-AWP distance.

Family units and free-ranging adult males showed similar distributions around the AWP with average observation distances of 3.97 ± 3.53 and 4.20 ± 2.92 respectively. There was no significant difference ($U = 791$, $p = 0.395$) between the distribution of family units and free-ranging adult males after AWP were provided.

Collared elephant movement

WKF-18 returned to her seasonal range in the Hoanib River on 3 October 2002 (fig. 4a). From October to November, she and her family unit occupied their traditional range around the wetlands, with occasional excursions down past the Obias and Mudurib Rivers. After the construction of AWP in November 2002, the female and her family unit gradually shifted their range until by the end of January, they occupied the area to the west of the Mudurib River almost exclusively (fig. 4b). The herd moved out of the Hoanib River on 29 January 2002. WKF-18 did not return to the Hoanib River during the 2003 hot dry season, remaining at the Hoarusib River instead.

WKM-10 returned to the Hoanib River on 29 October 2002 (figs. 4c and 4d). From October until December 2002 he occupied a range approximately 10 km to the west of permanent natural water sources. He then occupied a similar range for January, but in February and March 2003 he moved farther west and remained there until he moved out of the Hoanib River on 28 March 2003. He returned to the Hoanib River on 28 October 2003 and again occupied the western range area around the Mudurib AWP before leaving the river on 12 February 2004.

Seasonal movement

The seasonal movement of WKF-14 and her family unit, pre- and post- AWP, is presented in figure 5.

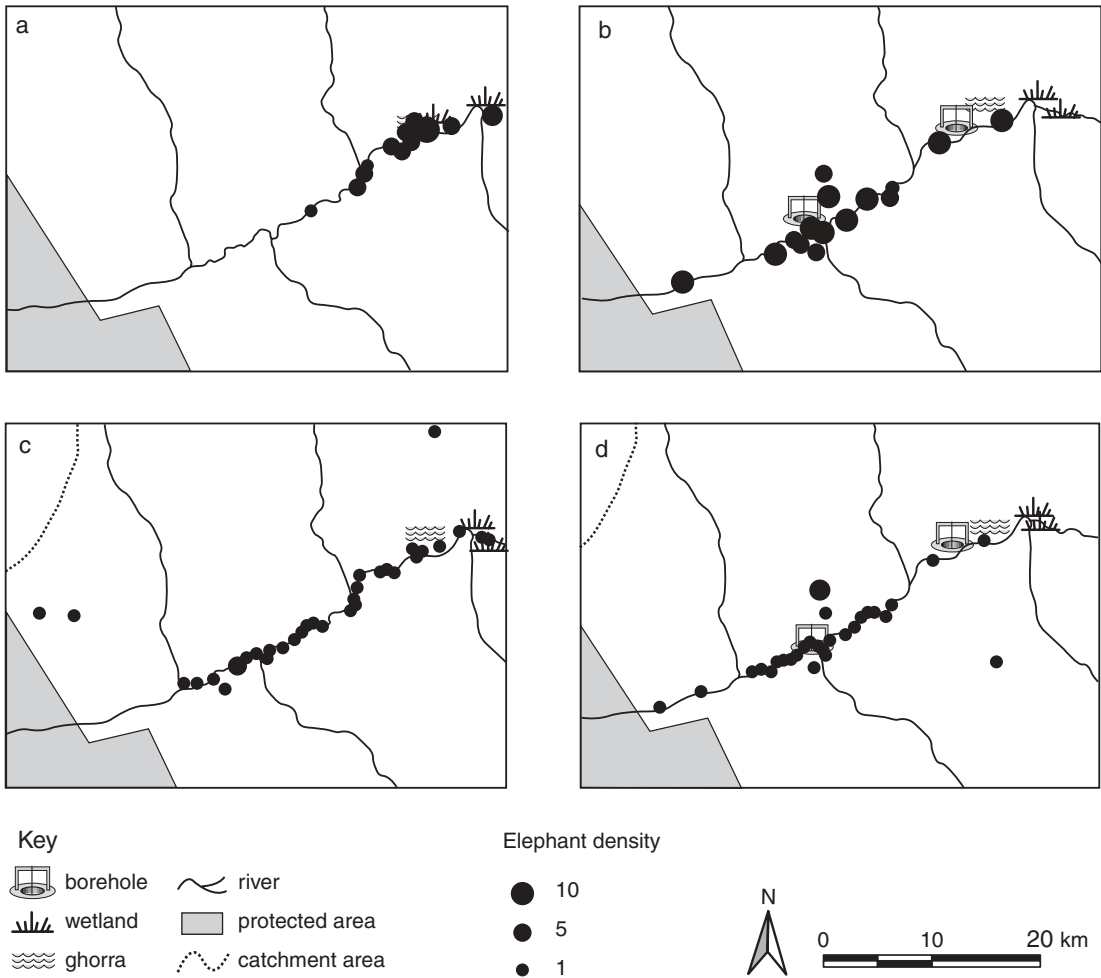


Figure 3. Elephant locations in the lower Hoanib River: female family units a) January 1998–November 2002, b) December 2002–June 2004; adult male elephants c) January 1998–November 2002, d) December 2002–June 2004.

Table 1. Average distance from, and the percentage of elephant sightings within 1-, 5-, 10- and > 10-km radii of water sources in the lower Hoanib River, north-west Namibia

	No.	Average distance (km)	Elephants within 1-km radius (%)	Elephants within 5-km radius (%)	Elephants within 10-km radius (%)	Elephants > 10-km radius (%)
Pre-artificial water points, in wetlands and ghorras						
Females	23	3.65 ± 3.55	22	61	13	4
Males	52	10.77 ± 8.66	16	24	12	48
Post-artificial water points, in wetlands and ghorras						
Females	41	17.90 ± 5.43	1	0	1	98
Males	60	17.95 ± 6.45	1	1	1	97
Artificial water points						
Females	35	3.97 ± 3.53	27	52	20	1
Males	57	4.20 ± 2.92	15	55	34	1

Before AWP were constructed, WKF-14 and her family unit moved (over the study period) at the end of the hot dry season from the Hoanib to the Hoarusib River, returning during the cold dry season. However, once AWP were built in the river, WKF-14 and her family unit did not move back to the Hoarusib River but stayed at the Hoanib River for all of 2003 until June 2004. There was also a spatial displacement of the location of this family unit toward the western section of the river, centring on the AWP at the Mudurib River.

Neither WKF-18 and her family unit nor WKM-10 disrupted their seasonal movement patterns after AWP were added.

Drinking frequency

During drinking studies carried out on two males and one family unit during February 2002, it was established that males drank every 3–5 days ($n = 3$) and female units every 2–3 days ($n = 3$). A similar study was undertaken in February, May and September 2003, when drinking frequencies for two males were observed to be 2–3 days ($n = 9$) and 2–3 days for one family unit ($n = 12$).

Flood events and ghorra use

Leggett et al. (2001a,b) and Leggett et al. (2005) described rainfall, flood events, water chemistry and sediment levels during flood events. The Hoanib River flooded twice during the 2003 wet season, with flood durations of four days and one day. During the 2004 wet season the Hoanib River flooded three times with flood durations of seven, three and four days (pers. obs.). Although elephants have been observed drinking from ghorras during all seasons, it was most common to observe them drinking during the cold dry and hot dry season ($n = 12$). After AWP were constructed elephants were no longer observed to drink from ghorras during the cold dry and hot dry seasons; however, they were observed to do so during the wet season ($n = 3$). The reason for the low number of observations is because the area becomes inaccessible when rivers flood or rains occur.

Discussion

Providing AWP in most areas of Namibia as elsewhere in Africa has led to permanent occupation by people and domestic stock, resulting in environmen-

tal degradation (Du Toit and Cumming 1999). This has not occurred in the western areas of the Hoanib River as local pastoralists have never used them extensively because they were too remote, access routes were poor and grazing erratic (Leggett et al. 2004). Large wildlife populations around AWP can have a similar effect on the environment as domestic stock (Leggett et al. 2003b); however, this effect is partially mitigated by the nature of the arid areas. Rainfall is not a certainty and neither is grazing. Grazers thus periodically migrate into and out of the area, effectively reducing pressure on the vegetation around AWP, allowing it to recover.

Historically, large herds of elephants were seasonally observed in the western section of the Hoanib River, particularly in the floodplains at the base of the dune field where seasonal water was available (Viljoen 1987). These aggregations were observed during the study period, with few elephants being observed in the western section of the research area. Before AWP, family units were restricted to areas close to natural permanent water sources around Dubis. However, AWP allowed elephant family units to shift their foraging range spatially approximately 22 km to the west, into areas they had previously visited only seasonally. They then maintained similar ranges around the AWP, with approximately 80% of sightings made within 10 km of the AWP. The main cause restricting range of the family units was the need for juvenile elephants to drink more often than adults (Moss 1982; Viljoen 1988). This concentrates the family units into areas within a distance from permanent water sources to which juvenile elephants can walk in one-and-a-half to two days. Elephant populations tend to stay more permanently in riverine areas, where their potential impact on the vegetation (particularly *Faidherbia albida* trees) is far greater. However, it is believed that these herds will again start their regular seasonal movements once the readily accessible vegetation has been removed.

Adult male elephants have been reported to have greater foraging range than family units in the western section of the Hoanib River (Viljoen 1988). Viljoen (1988) proposed that this greater foraging range resulted from the ability of free-ranging adult males to go for relatively long periods (3–5 days) without water. Both these observations were supported by this study. With AWP the free-ranging adult male's average foraging range decreased to a size similar to that of family units. In addition, the drinking frequency

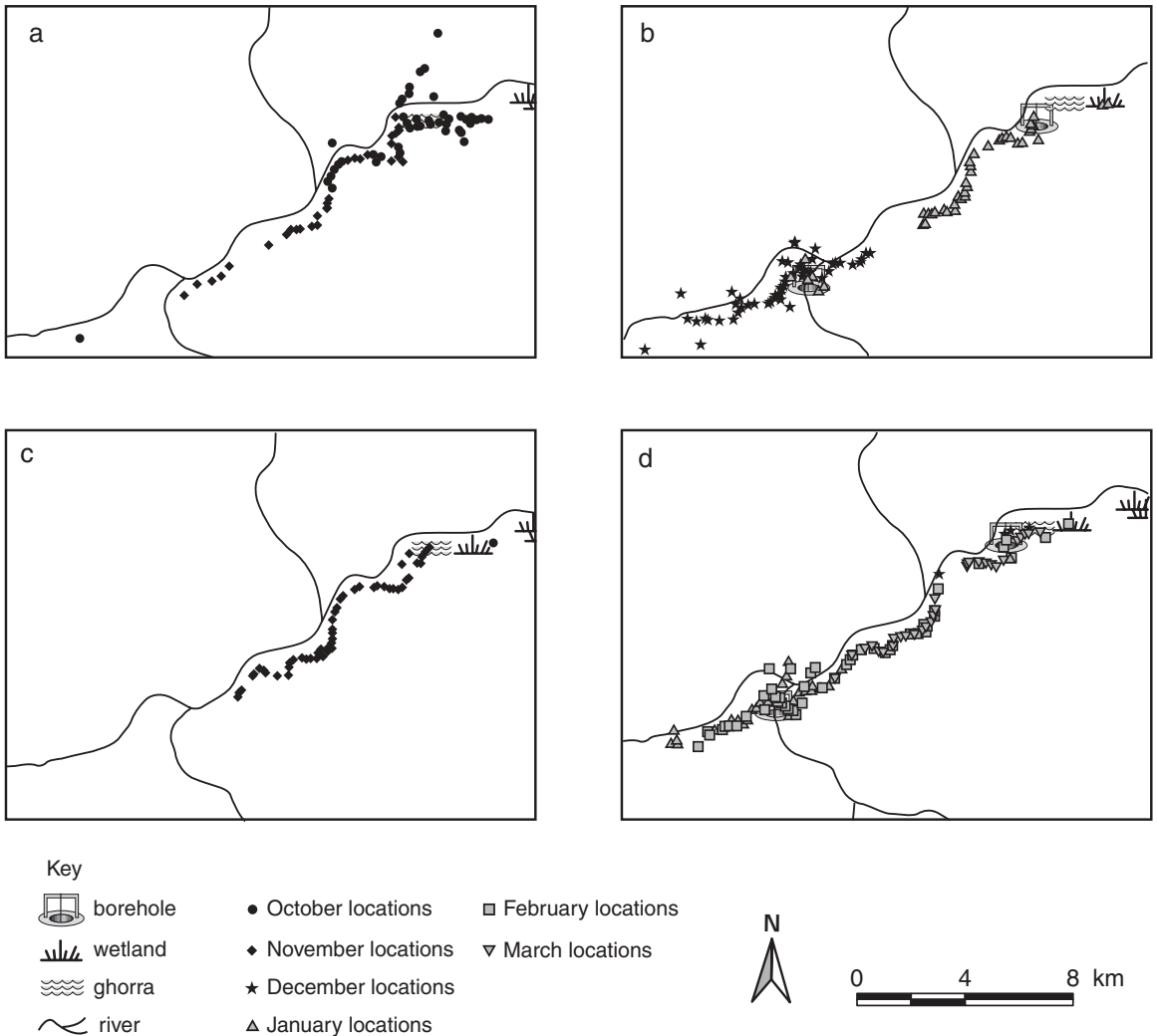


Figure 4. Movement of adult GPS-collared elephants in the Hoanib River: female WKF-18 a) October–November 2002, b) December 2002–January 2003; male WKM-10 c) October–November 2002, d) December 2002–March 2003.

increased to every second or third day. The spatial movement of elephants toward the western section of the Hoanib River was confirmed by GPS collar data from WKF-18 and WKM-10. Both elephants were observed to shift their foraging ranges once they discovered the western AWP. Verlinden et al. (1998) described similar spatial movements of domestic stock and wildlife in response to AWP in the Kalahari Desert.

Providing AWP has disrupted the seasonal movement of at least one family unit (WKF-14). Before AWP, WKF-14 and her family unit would move seasonally from Hoanib to Hoarusib Rivers. Throughout

2003 and until June 2004, however, WKF-14 and her family unit did not move away from the Hoanib River. The reason the family unit remained there most probably was linked to the easily accessible foraging areas close to the AWP. There was simply no need to move if forage and water both were readily available.

In other areas of Africa, providing AWP has resulted in a rise in reproductive rates of elephants (Weir 1971; Dudley et al. 2001). This would be unlikely in this elephant population as the elephant density is relatively small and their intercalving period is relatively large (Viljoen 1988).

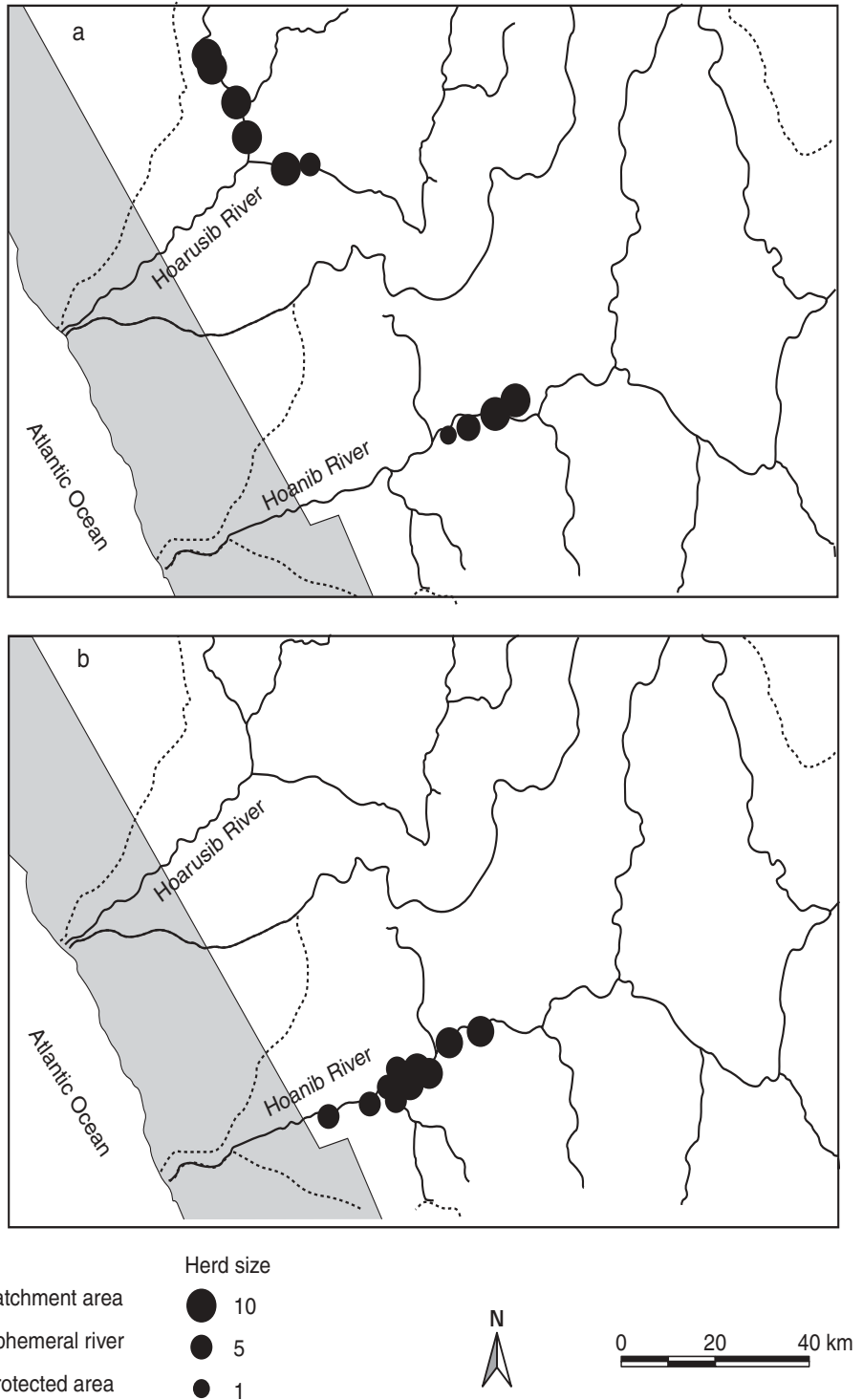


Figure 5. Observed locations of WKF-14 and her family unit in north-west Namibia, a) January 1998–November 2002, b) December 2002–June 2004.

In addition to changes in drinking behaviour and foraging ranges, other changes in water-foraging strategies have been observed. Before November 2002, the elephants routinely dug ghorras in the riverbed during all seasons, from which they obtained relatively clean water. During the cold dry and hot dry seasons, elephants would continue to dig ghorras to ensure good water quality. Digging and drinking of water from ghorras was a time-consuming process for elephants, taking up to one hour for an elephant to be sated (pers. obs.). With the addition of clean, readily available fresh water from AWP, elephants abandoned the practice of digging and drinking from ghorras during the cold dry and hot dry seasons. However, this practice continued during the wet season and with the arrival of the first floods. Floodwater quality is generally low, as it contains large amounts of suspended sediment (Leggett et al. 2005). As the ghorras filter most of the suspended sediment from the water, the quality of ghorra water was probably better than that of AWP during the wet season, due to a high water table in the rivers. During the cold dry and hot dry seasons as the water table falls in the rivers, ghorra water becomes more saline (Leggett et al. 2001b) and probably less palatable to elephants than the AWP water.

Conclusion

The addition of AWP to the western section of the Hoanib River has allowed spatial movement of elephants from their traditional drinking and foraging areas to areas that previously were visited only periodically. Family units in particular have benefited from AWP with a spatial shift in foraging range from 3.65 ± 3.55 km up to 17.90 ± 5.43 km from natural permanent water sources. Free-ranging adult males have also benefited by travelling shorter distances to drink. Both free-ranging adult males and family units were observed foraging within similar ranges around AWP, 3.97 ± 3.53 km and 4.20 ± 2.92 km respectively. Potential does exist for elephants to damage the riverine vegetation (particularly *Faidherbia albida* trees) in these extended foraging areas; however, it is believed that they will renew their seasonal movement patterns once the readily available vegetation has been removed.

AWP affected the seasonal movement of at least one family unit that remained in the Hoanib River, in preference to undertaking its normal seasonal move to the Hoarusib River. The seasonal movements of other

family units and free-ranging adult males appeared to be little affected. Free-ranging adult males also appeared to increase their drinking frequencies, preferring to drink every 2 to 3 days instead of every 3 to 5 days as they had before AWP were constructed. Drinking frequencies of family units remained unchanged. The practice of digging ghorras for water during the cold dry and hot dry seasons also appeared to cease, although elephants still dug ghorras during the wet season to obtain relatively clean drinking water.

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Distribution des éléphants autour d'une mare sahélienne en relation avec le cheptel domestique et la végétation ligneuse

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Résumé

Un indice du cumul d'occupation des éléphants a été mesuré autour de la mare de Benzéna dans le Gourma malien, en fin de saison sèche 2004. Un fort gradient d'utilisation d'espace des éléphants à partir de la mare a été enregistré. Les éléphants préféraient les endroits à haute diversité spécifique avec abondance de *Balanites aegyptiaca* et *Acacia* spp., mais évitaient les sols pauvres à *Leptadenia pyrotechnica*. Aucune évidence de compétition entre les éléphants et le cheptel domestique n'a été constatée.

Abstract

An accumulated count of elephant occupation was measured around Lake Banzena in Gourma in Mali, at the end of the 2004 dry season. There was a steep gradient of elephant use away from the lake. Elephants preferred areas with high species diversity and with abundant *Balanites aegyptiaca* and *Acacia* spp. but avoided poor soils with *Leptadenia pyrotechnica*. There was no evidence of competition between elephants and livestock.

Introduction

Les derniers éléphants (*Loxodonta africana*) du Sahel se trouvent dans la région du Gourma au Mali (Blake et al. 2003). L'écologie et les mouvements annuels de cette population ont été décrits par Olivier (1983), Jachmann (1991), Pringle and Diakité (1992), Maïga (1999) et Blake et al. (2003). Les mares constituent les principales ressources en eau en saison sèche, qui se rétrécissent par évaporation au fur et à mesure que la saison progresse. La plus importante est la mare de Benzéna située au nord ouest de la zone de distribution des éléphants. La mare de Benzéna est une ressource critique pour les éléphants du Gourma pendant la période de l'année où ils sont le plus susceptibles au stress. Cependant, la mare et les zones boisées voisines sont également utilisées par les grands troupeaux de bétail, de chèvres et de moutons ainsi que des dromadaires conduits par des pasteurs. Des signes d'intense pâturage autour de la mare ont été mis en évidence depuis des années (Blake et al.

2003). La dessiccation du climat sahélien, la végétation au cours des trois dernières décennies et l'accroissement de la population humaine ont engendré la crainte d'une exploitation non durable de l'habitat et la compétition entre les éléphants et le cheptel domestique pour le pâturage et l'eau (Maïga 1999). Nous avons observé que les éléphants semblaient éviter les fortes concentrations de chèvres et de boeufs au nord de la mare. D'autre part, les chèvres et éléphants étaient souvent observés en train de pâturer assez près l'un de l'autre : les chèvres consomment les gousses et branches tombées au sol par les éléphants.

Pendant que nous prospectons les environs de la mare à la recherche des éléphants, nous avons remarqué leur préférence pour les zones de végétation dense. De plus il nous a semblé que les éléphants évitaient les bandes de végétation dominées par *Leptadenia pyrotechnica*, une espèce qui couvre de vastes espaces du Gourma et qui s'étend progressivement autour de Benzéna. L'objectif de cet

inventaire était de décrire l'utilisation de l'espace par les éléphants en saison sèche autour de la mare en relation avec l'eau, l'abondance du cheptel domestique et la disponibilité du pâturage.

Description de l'aire d'étude

Le Gourma est la zone sahélienne située au sud et à l'ouest de la boucle du fleuve Niger, dans le sud-est du Mali. La saison sèche dure plus de huit mois, avec une pluviométrie annuelle moyenne de 300 mm au nord à 600 mm au sud. Les dunes couvrent environ 50% de la superficie de la zone, les plaines latéritiques environ 25% et les escarpements rocheux 16% (Maïga 1999). La mare de Benzéna (fig. 1) est située dans une dépression et entourées par un anneau de fourrées dominées par *Acacia nilotica*. Le nord est constitué d'un système de dune avec des arbustes clairsemés et des herbacées annuelles qui avaient disparus au moment de cet inventaire. Au sud existait d'avantage de dunes mais aussi de vastes plaines latéritiques dénudées. D'autres reliques de forêts sèches ont également été observées le long des ravins au sud et à l'ouest.

Les éléphants du Gourma suivent un cycle unique de migration annuelle et se regroupent habituellement à Benzéna de avril à juin puis se dispersent au début des pluies (Maïga 1999; Blake et al. 2003). La population était estimée à 350 par Blake et al. (2003).

Méthodes

Terrain

La température élevée, la brise constante et l'humidité faible provoquent l'assèchement rapide des déjections des herbivores ; les déjections déposées au sol représentent ainsi la distribution accumulée pendant la

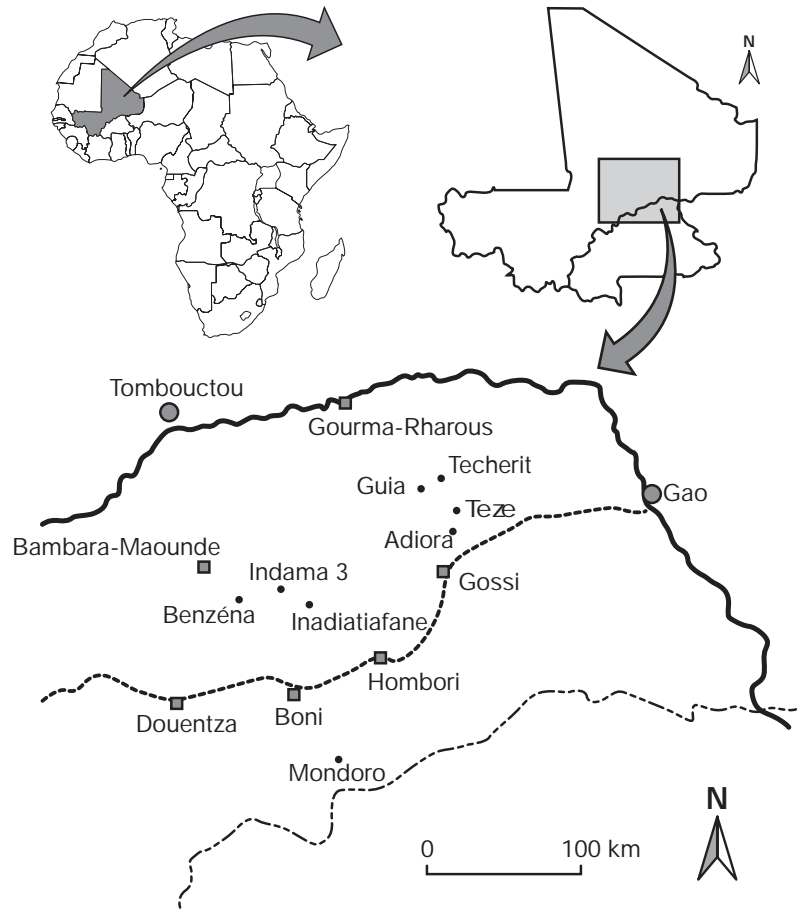


Figure 1. Carte du Gourma montrant la mare de Benzéna.

saison sèche. De ce fait, nous avons utilisé l'abondance des déjections animales comme un indice du cumul d'occupation pendant la saison sèche. Pour estimer la distribution des déjections, nous avons utilisé un modèle de transects systématiques avec un point de départ aléatoire. Après avoir sélectionné au hasard un point sur la berge de la mare, trois lignes parallèles orientées nord-sud à partir de la mare, ont été matérialisées sur la carte (fig. 2). L'intervalle entre les lignes a été fixé à 2 km. Sur chaque ligne, nous avons placé sept transects à des intervalles réguliers de 1 km, avec le premier transect centré à 500 m de la limite de la mare. Nous n'avons pas tenu compte des transects situés dans la forêt dense (ex : Tabarac-barac) à l'exception d'un seul, à cause du risque de rencontrer les éléphants.

Chaque transect mesurait 200 m de long. Au début et à la fin de chaque transect les déjections du cheptel domestique étaient comptées dans trois quadrats de 1 x 0.5 m, soit six quadrats par transect. La densité

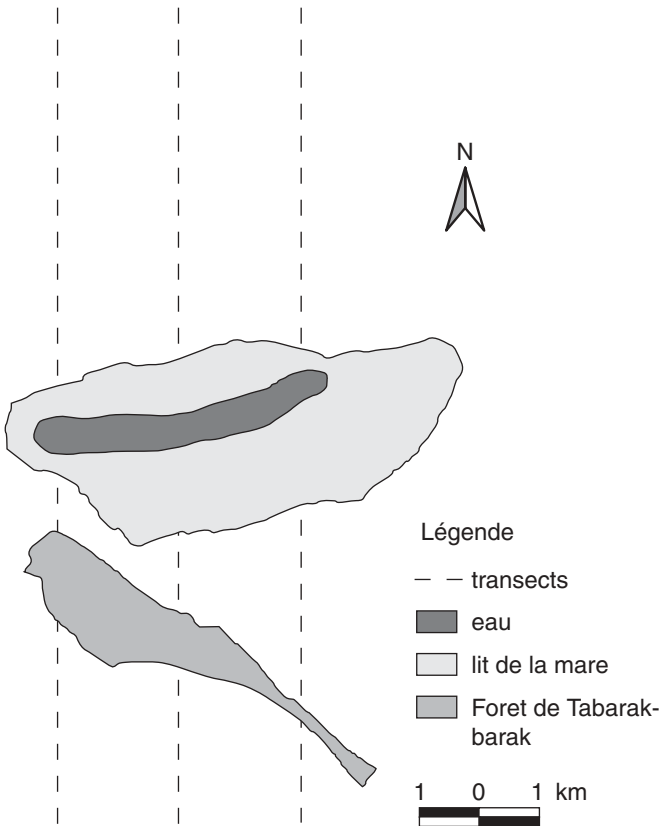


Figure 2. Carte montrant la position des transects autour de la mare de Benzéna.

moyenne de déjection était alors calculée pour chaque espèce d'animal domestique.

Les déjections d'éléphants ont été recensées en utilisant la méthode des transects en ligne : la distance perpendiculaire était mesurée pour chaque déjection observée à partir du centre de la ligne de transect (Buckland et al. 1993, 2001). La densité des déjections des éléphants (D) pour chaque transect a alors été calculée en utilisant la formule :

$$D = n.f(0) / 2L$$

où n représente le nombre de déjections observées, $f(0)$ l'inverse de la demi largeur effective de la bande et L la longueur du transect (Buckland et al. 1993, 2001). La valeur de $f(0)$ varie avec le type de végétation, ainsi les données pour tous les transects de chaque type de végétation ont été regroupées et une valeur globale de $f(0)$ calculée pour chaque type de végétation utilisant DISTANCE 4. La valeur de

$f(0)$ a ensuite été utilisée pour estimer la densité de déjection pour chaque transect dans chaque type de végétation. Les trois types de végétation étaient la végétation dense boisée adjacente à la mare (6 transects), la brousse claire (33 transects) et la forêt (1 transect).

Tous les arbres et arbustes situés dans une bande de 21 m du centre de la ligne de transect soit une largeur effective de 42 m, ont été identifiés et recensés. La densité de chaque espèce a été calculée.

Les transects ont été parcourus en fin de saison sèche, entre le 27 mai 2004 et le 1er juin; les pluies ont commencé le 5 juin 2004.

Analyses

Les applications de la loi de 'Taylor's power' (Southwood 1978: p 11) ont suggéré une transformation logarithmique pour les densités de déjections des éléphants, boeufs et chèvres, et une transformation de racine carrée pour les densités de déjections de moutons. Les densités de végétation ont aussi subi la transformation logarithmique ; toutes les transformations log étaient de la forme $\ln(1 + X)$. La diversité spécifique des plantes a été

mesurée par l'indice de Schannon-Weiner (Krebs 1989):

$$H = -\sum p_i \ln(p_i)$$

Où p_i était la proportion de la i ème espèce de l'échantillon.

Résultats

Déjection d'éléphant en relation avec l'eau

Un total de 652 déjections éléphants a été recensé sur 40 transects. La végétation boisée du côté de la mare était plus dense en déjection que la formation végétale claire, engendrant une différence significative de distribution de fréquence des distances perpendiculaires (Kolmogorov-Smirnov two-sample test $D_{\max} = 0.161$, $p < 0.001$), donc les transects près de la mare ont été traités séparément du reste. Les transects des forêts

ont aussi été traités séparément. Pour chaque groupe de transects, les modèles semi-normaux se sont révélés être les estimateurs les plus adéquats pour l'estimation de $f(0)$.

La distance de la mare était la variable qui expliquait mieux la distribution des déjections d'éléphant (fig. 3).

Déjection d'éléphant en relation avec la végétation

La densité de *Balanites aegyptiaca* avait aussi une forte influence sur la distribution des éléphants (tableau 1 et fig. 4), ainsi que la densité de toutes les espèces de *Acacia* (tableau 1 et fig. 5).

Acacia spp. et *B. aegyptiaca* montraient souvent des signes de broutage important, alors que *Boscia senegalensis* était rarement touché par les éléphants. Les éléphants étaient attirés par les zones de forte diversité spécifique (tableau 1 et fig. 6).

Le modèle qui expliquait mieux la distribution des déjections d'éléphants était :

$$\begin{aligned} \text{Ln}(1 + E) &= 2.61 - 0.41W + 0.60D - 0.20\text{Ln}(1 + L) \\ &\quad + 0.27\text{Ln}(1 + A) \\ r_{adj}^2 &= 0.596, F = 15.37, p < 0.0001 \end{aligned}$$

où E représente la densité de déjections d'éléphants exprimée en nombre de déjection par ha, W la distance de la mare (km), D l'indice de diversité

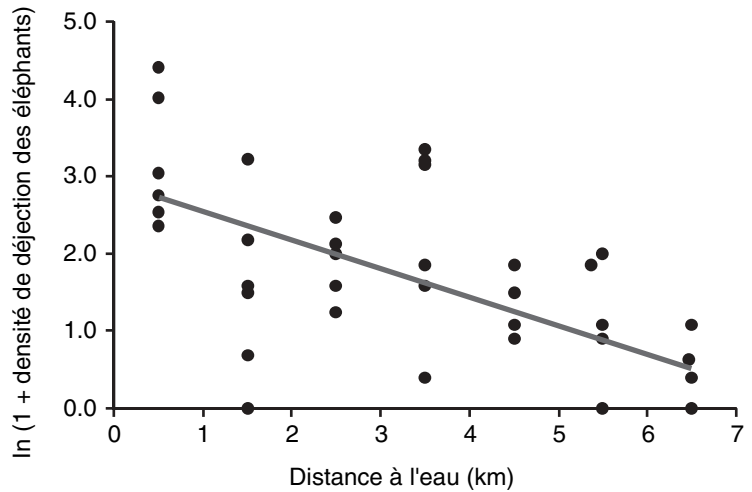


Figure 3. La relation entre la densité de déjection des éléphants et la distance de la mare. $\text{Ln}(1 + E) = 2.92 - 0.37W$, $r = -0.647$, $p < 0.0001$.

spécifique, L la densité de *Leptadenia* exprimée en nombre de pieds par ha et A la densité de *Acacia* spp. exprimée en nombre de pieds par ha.

Cheptel domestique

En contraste avec les éléphants, les déjections des boeufs ne montraient aucune corrélation avec la distance à l'eau ($r = -0.134$, NS). Il n'y avait aucune relation entre les boeufs et chacune des variables végétales (tableau 1).

Les chèvres étaient fortement corrélées avec *Balanites* et *Leptadenia* (tableau 1). Tout comme les éléphants, elles étaient plus fréquemment recensées près

Tableau 1. Corrélations entre les densités de déjection des herbivores et les variables de végétation. Toutes les densités sont exprimées en nombre de pieds ou de déjections par hectare

Variable de végétation	Ln(1 + densité de déjection d'éléphant)	Ln(1 + densité de déjection de boeuf)	Ln(1 + densité de déjection de chèvre)	$\sqrt{\text{Densité de déjection de mouton}}$
Nombre d'espèces ligneuses	0.195	-0.070	0.126	0.239
Diversité spécifique	0.360*	-0.062	0.141	0.414*
Ln(1 + densité de <i>Leptadenia</i>)	0.025	0.121	0.440**	0.094
Ln(1 + densité de toute les espèces ligneuses)	0.168	0.004	0.285	0.131
Ln(1 + densité de <i>Acacia</i> spp.)	0.422**	-0.160	0.107	0.219
Ln(1 + densité de <i>Balanites aegyptiaca</i>)	0.606**	0.045	0.554**	0.488**
Ln(1 + densité de <i>Boscia angustifolia</i>)	0.083	0.056	-0.206	-0.246

* $p < 0.05$; ** $p < 0.01$

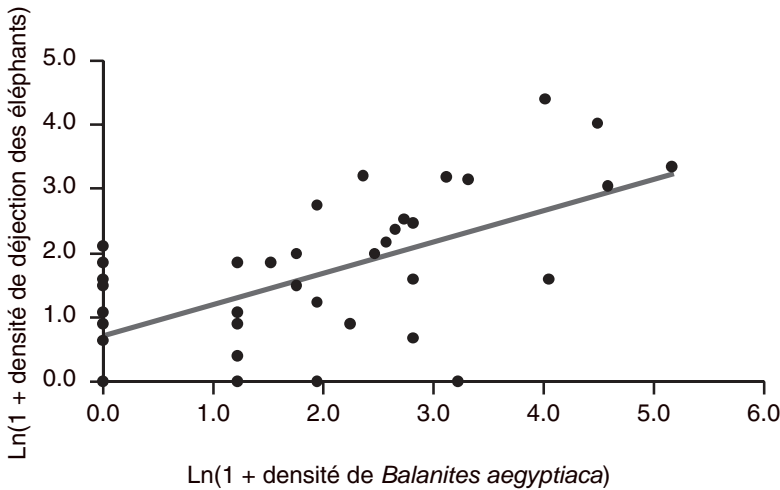


Figure 4. La relation entre la densité de déjection des éléphants et *Balanites aegyptiaca*.

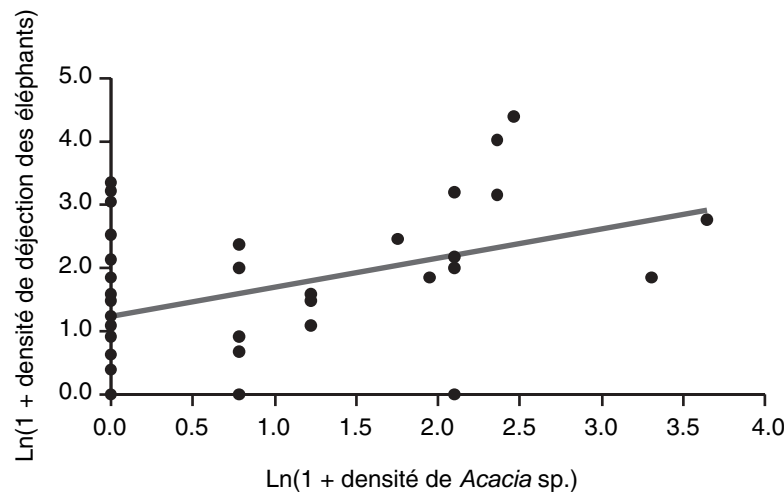


Figure 5. La relation entre la densité de déjection des éléphants et *Acacia* spp.

de l'eau ($r = -0.415, p < 0.01$). Les chèvres étaient plus communes au nord de la mare de Benzéna ($t = 2.333, df = 38, p < 0.05$). Le meilleur modèle pour les déjections de chèvre *G* était :

$$\text{Ln}(1 + G) = 8.79 + 0.41\text{Ln}(1 + B) + 0.24\text{Ln}(1 + L)$$

$$r_{adj}^2 = 0.366, F = 12.27, p < 0.0001$$

où *B* était *B. aegyptiaca*. Les moutons étaient aussi fortement corrélés avec *B. aegyptiaca* et avec la diversité spécifique (tableau 1) et seulement

faiblement corrélées avec la distance à l'eau ($r = -0.221, NS$). Les moutons étaient aussi communs au nord de la mare de Benzéna ($t = 2.607, df = 38, p < 0.05$). Le meilleur modèle pour les déjections de mouton *S* était :

$$\sqrt{S} = 0.12 + 0.17\text{Ln}(1 + B) + 0.67D + 0.56N$$

$r_{adj}^2 = 0.399, F = 9.65, p < 0.0001$ où *N* représente une variable indicatrice décrivant si le transect était au nord ($N = 1$) ou au sud ($N = 0$) de la mare de Benzéna.

Éléphants et cheptel domestique

Le cheptel domestique pourrait-il répondre à toutes les variations de densité de déjection d'éléphant non encore expliquées par les quatre variables de l'habitat ? Il y avait une corrélation légèrement positive avec les chèvres ($r = 0.279, NS$) et les moutons ($r = 0.275, NS$), mais aucune pour les boeufs ($r = 0.031, NS$). Chaque variable de cheptel domestique a été ajoutée par elle-même à l'équation de régression multiple de la densité de déjection d'éléphant. Les tests partiels *F-tests* (Neter et al. 1990) ont montré que chaque variable subit une réduction négligeable de la variance non

expliquée (tableau 2).

Discussion

La densité de déjection enregistrée à la fin de la saison sèche représente le cumul d'occupation de chaque espèce. En effet elle ne peut pas exprimer les changements d'utilisation de type de végétation qui pourraient advenir au fur et à mesure que la saison progresse, ni les changements de relations entre les espèces herbivores.

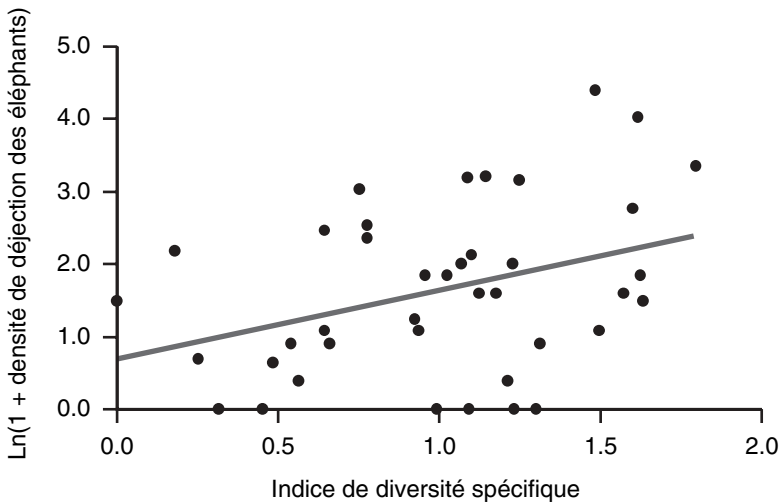


Figure 6. La relation entre la densité de déjection des éléphants et l'indice de diversité spécifique.

Tableau 2. Résultats des tests partiels *F*-tests pour déterminer si les variables du cheptel domestique contribuent de façon significative à l'équation de régression multiple qui explique l'abondance des éléphants

Espèces	F	P
Ln(1 + densité de déjection de boeuf)	0.053	NS
Ln(1 + densité de déjection de chèvre)	0.377	NS
Densité de déjection de mouton	0.253	NS

Quatre variables ont décrit la sélection d'habitat des éléphants autour de Benzéna : la distance à l'eau, la diversité spécifique, et les densités de *Leptadenia* et *Acacia* spp.

Il y avait un fort gradient de densité des éléphants au fur et à mesure que l'on s'éloigne de la mare (fig. 3). Il n'y avait aucun signe de pâturage éléphant au delà de 6 km dans les dunes au nord de la mare. Cependant il existait des axes de déplacements d'éléphants vers le Sud, avec plus de déjections le long des axes entre la mare de Benzéna et les forêts telle que Tabarak-barak où les éléphants s'abritent pendant la journée.

En calculant la capacité de charge écologique du Gourma pour les éléphants, Olivier (1983) et Jachmann (1991) ont tous les deux, supposé que les éléphants pâturent sur une vaste superficie. Nos résultats suggèrent que pendant la saison sèche, les éléphants utilisaient une fraction de paysage beaucoup

plus petite que l'on ne le pensait auparavant, compliquant d'avantage les questions générales de la capacité de charge (Macnab 1985).

Les éléphants préféraient les zones de forte diversité spécifique, ce qui conforte l'idée selon laquelle ils ont évolué comme des consommateurs généraux qui ont besoin de maintenir une alimentation variée (Olivier 1978). Leurs espèces préférées — telles que *B. aegyptiaca* et *Acacia* spp., et particulièrement *Acacia* — montraient des signes de broutage intensifs (Blake et al. 2003).

Le meilleur modèle pour les déjections éléphants montre qu'après que l'on ait pris en compte l'effet de l'eau (*W*), il y avait une relation négative avec *Leptadenia pyrotechnica*. C'est une espèce qui colonise les sols secs pauvres en nutriment et souvent elle couvre de vastes superficies du Gourma, parfois en forte densité ; bien que les dromadaires la consomment et que les chèvres prélèvent plutôt

les fleurs et les fruits, les éléphants ne la consomment pas du tout. La relation négative entre les éléphants et la densité de *Leptadenia* pourrait signifier que les éléphants évitent les zones de *Leptadenia*, ou qu'ils évitent les communautés de plantes sur les sols pauvres ; et *Leptadenia* est un indicateur de tels sols.

Il n'existait aucune évidence de compétition entre les éléphants et le cheptel domestique. Comme les éléphants, les chèvres et les moutons sélectionnaient les zones à forte densité de *Balanites* (tableau 1), mais ils n'étaient pas attirés par les zones à *Acacia* que les éléphants préféraient. Contrairement aux éléphants, les chèvres ont montré une forte corrélation avec *Leptadenia*. Des différences ont été mises en évidence entre les chèvres et les moutons : les moutons préféraient les zones à haute diversité spécifique alors que les chèvres montraient une préférence pour ce type d'habitat, et les moutons ne montraient aucune attraction pour *Leptadenia*.

Contrairement aux moutons et aux chèvres, les boeufs ne montraient aucune préférence pour aucun type de végétation.

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Elephant survey in the Bia Conservation Area, western Ghana

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Abstract

In February 2004, a dry-season elephant survey was conducted in the Bia Conservation Area in Western Region of Ghana to determine the distribution and abundance of elephants and the human and ecological variables that affect them. Fifty-two 1-kilometre transects were systematically distributed in three strata (high, medium and low density) based on elephant dung-pile density recorded in an initial reconnaissance. Two estimation models were used to estimate elephant numbers: a rainfall model gave an estimate of 115 (95% CI = [90, 148]) elephants while a steady-state assumption model provided 146 (95% CI = [107, 185]) elephants. Water availability explained a high proportion of the variance in elephant distribution and illegal activity. Other variables assessed, including raphia stand, secondary vegetation, gap length and fruiting trees, did not account significantly for the distribution of elephants.

Résumé

En février 2004, en saison sèche, on a réalisé une étude des éléphants dans l'Aire de Conservation de Bia, dans la Région occidentale du Ghana, pour déterminer la distribution et l'abondance des éléphants ainsi que les variables humaines et écologiques qui les affectent. Cinquante-deux transects d'un km de côté ont été déterminés systématiquement dans trois strates (haute, moyenne et basse) basées sur la densité de crottes d'éléphant relevée lors d'une reconnaissance préalable. Deux modèles d'estimation ont été utilisés pour évaluer le nombre d'éléphants : un modèle « chute de pluie » qui a donné une évaluation de 115 éléphants (IC 95% = [90, 148]), alors qu'un modèle « stationnaire » donnait 146 éléphants (IC 95% = [107, 185]). La disponibilité en eau expliquait en grande partie la variance de la distribution des éléphants et les activités illégales. D'autres variables évaluées, comme la présence de palmier raphia, de végétation secondaire, la longueur de le'space et les arbres en fruits, ne comptent pas significativement dans la distribution des éléphants.

Introduction

Around the turn of the 20th century, elephants were still widely distributed over the Upper Guinea forest zone and were little affected by human settlement (Roth and Douglas-Hamilton 1991) until the 1950s, when intensive development started. Currently, elephants in West Africa are fragmented into 84 separate populations, many of which are small and threatened (Blanc et al. 2003). Twelve of these can be found in Ghana, five of them, including the important Bia population, are forest populations.

The African Elephant Specialist Group through its Small Grants Programme funded by the European Union supported a preliminary investigation into the possibilities of linking this population to others in the Guinean rainforests of western Ghana. This paper is about two of the objectives of the extended study: 1) to determine the distribution and numbers of elephants in the Bia Conservation Area and 2) to investigate the relationship between elephant density and different levels of human activity and ecological factors.

The study also provided an opportunity to test and compare elephant population size estimates derived

from two estimation models, a steady-state assumption model (McClanahan 1986), and a rainfall model (Barnes et al. 1997; Barnes and Dunn 2002). The number of elephant dung piles lying on the forest floor is determined by the number of elephants present and the rainfall in the two preceding months (Barnes and Dunn 2002). Hence, the rainfall model uses rainfall data from previous months to estimate the numbers of dung piles that are likely to be on the ground when a survey is conducted and makes no such assumptions as steady states or normality. The steady-state assumption model on the other hand assumes steady state in the forest, such as a steady rate of dung decay. However, because rainfall varies from month to month, and in any one month is unevenly distributed across days, the steady-state assumption is often invalid (Barnes et al. 1997). Because of its appreciable elephant numbers the Bia Conservation Area (BCA) provides the opportunity to test and compare the two estimation techniques (Heffernan and Graham 1999; Sam 2000).

Study area

Located in western Ghana, the Bia Conservation Area (BCA), comprises Bia National Park (Bia NP) in the north and the adjacent Bia Resource Reserve (Bia RR) in the south (fig. 1). Both forests cover an area of 306 km² and were managed as a national park before their present classification. In early 1976, pressure from the timber industry compelled the government to downgrade part of the park into a resource reserve to allow controlled logging (PADP 2001). Logging was however stopped in 1997 and both forests classified as the BCA for ecosystem protection, research and recreation.

The BCA was originally part of a larger forest ecosystem for forest elephants known as the Bia Group of Forest Reserves, about 1500 km², most of which are non-existent. The Bia elephant range has contracted due to clearance for cocoa cultivation and is now an isolated population on an ecological island of forest with hard boundaries and no transitional zone to farmland (PADP 2001).

The vegetation comprises mainly *Celtis zenkeri* and *Triplochiton scleroxylon* moist semi-deciduous forest, which is transitional towards the more typical rainforest association of *Lophira alata* and *Triplochiton scleroxylon* found in the southern part of Bia RR (Taylor 1960; Hall and Swaine 1976). Rainfall is bimodal, peaking in June and October.

Methods

Reconnaissance survey

In a reconnaissance exercise undertaken in February 2004, the study area was divided into blocks and each block thoroughly searched for elephant dung using meandering transects in a predetermined compass bearing. The idea was to limit excessive cutting of vegetation, which would have had to be done had straight transects been used. Meandering transects also enabled teams to cover much of the forest within a short time.

Based on the dung-density estimates from the reconnaissance survey, the study area was divided into three strata of population density: high, medium and low (fig. 1). The southern half of Bia RR was designated high density; the remaining northern half of Bia RR, medium density; and the whole of Bia NP where no elephant activity was found, low density.

Main survey

The standard line transect method (Barnes 1996a; Buckland et al. 2001) was employed for counting dung piles (Barnes and Jensen 1987) within the study area in February–March 2004.

A grid consisting of squares, each one minute of latitude and longitude, was superimposed on the map of the study area. An initial square was randomly selected and an additional 51 squares were then systematically selected relative to it within the three strata according to the relative dung density found during the reconnaissance (Norton-Griffiths 1978). One-kilometre transects were placed in the middle of the selected grids and oriented northwards as a rule of thumb because of the unavailability of major streams within BCA. Thus 30 transects were distributed in the high-density stratum, 15 in the medium, and 7 in the low.

The perpendicular distance of the dung piles seen on transects was measured from the transect centre line using a tape measure. The distance along transects was measured with a hip chain. Age of dung was gauged using the criteria of Barnes and Jensen (1987).

Two survey teams of four persons each, led by a compass man (team leader) and a line cutter, were maintained throughout the counts to ensure consistency.

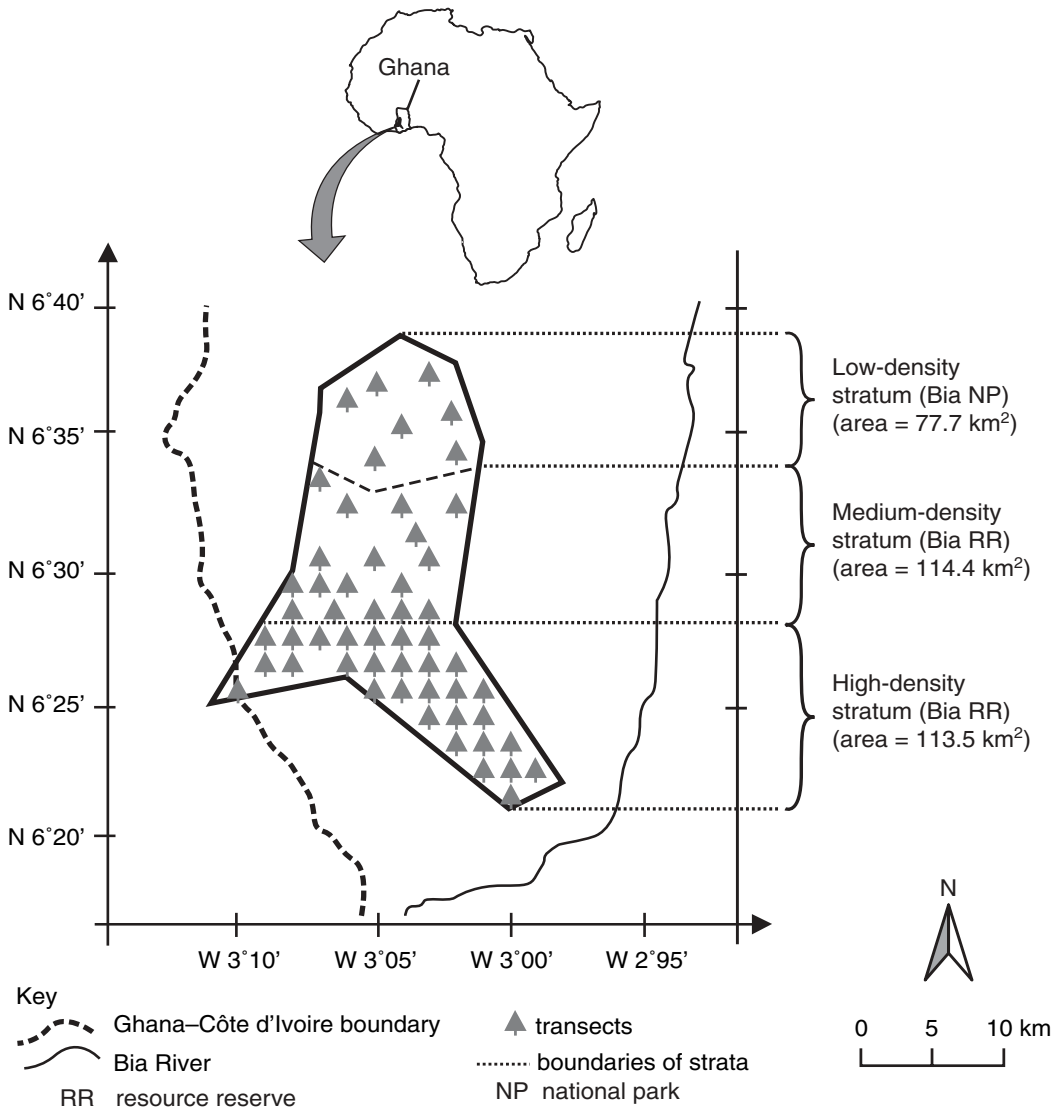


Figure 1. Bia Conservation Area showing transect distribution in the various strata.

Analysis

STEADY-STATE ASSUMPTION MODEL

Assuming a steady state in the forest, the density of elephants (E) can be calculated from three variables (McClanahan 1986; Barnes and Jensen 1987):

$$E = Yr / D \tag{1}$$

where Y is the density of dung piles, r is the decay rate and D is the defecation rate.

However, each of the variables (Y, r, D) is an estimate with its own variance, which will contribute to the variance of E (Barnes 1993):

$$\text{var}(E) = \text{var}(D) \times [(Yr)^2 / D^4] + [\text{var}(Yr) / D^2] \tag{2}$$

where

$$\text{var}(Yr) = \text{var}(Y) \cdot \text{var}(r) + Y^2 \cdot \text{var}(r) + r^2 \cdot \text{var}(Y) \tag{3}$$

The value of the decay rate, r , of elephant dung in the dry season was obtained from Barnes et al. (1994).

No estimate of defecation rate has been done in BCA; therefore Tchamba's (1992) defecation-rate estimate from Cameroon (D) was used. The value of dung-pile density, Y , was calculated using the DISTANCE program (Laake et al. 1993).

RAINFALL MODEL

Data on rainfall two months prior to the main line-transect dung survey was collected from four rain gauges mounted around BCA and the mean total rainfall value was calculated for each month. A model that relates dung density (Y_t) to rainfall two months preceding the survey was used to estimate density (Barnes et al. 1997). Thus,

$$Y_t = 1020.24 - 0.79RAIN_{t-1} - 0.46RAIN_{t-2} \quad (4)$$

where Y_t is dung density if there is one elephant per square kilometre and $RAIN_{t-1}$ is the total rainfall (mm) in the first month preceding the month of the survey and $RAIN_{t-2}$ rainfall preceding the second (Barnes and Dunn 2002).

Elephant density (E) is represented by

$$E = Y/Y_t \quad (5)$$

where Y is dung density from the survey.

The above analyses were done separately for each stratum, after which the separate estimates were merged (Norton-Griffiths 1978).

Factors affecting elephant distribution

On all transects, 10 sampling points were noted, each at every 100-m mark. When the observer arrived at the designated sample point, a GPS fix of the point was taken. The vegetation type (including secondary forest, raphia palm stand, riparian vegetation and other vegetation types, which would then be specified) was noted. Also the canopy condition (presence of gaps

in the canopy, length of gaps traversed by transect) was recorded.

Any human-built infrastructure or illegal human signs such as wire snares, empty cartridge cases, poaching camps, cane and wood cuttings encountered on the transects were also recorded. Other human influence such as the construction of trails or points associated with loading or hauling timber products was recorded as logging roads. All fruiting trees and water sources such as streams, rivers, ponds and swamps without raphia palm (may be dry as survey was conducted in the dry season) were also noted.

Regression analyses were used to investigate relationships between dung density and all human and geographical or other natural variables.

Results

Estimate of elephant numbers in the study area

A total of 210 dung piles was spotted: 183 in the high density (6.1 piles per km), 27 in the medium density (1.8 piles per km) and none in the low-density strata. Dung density was significantly higher in the high-density than in the medium-density strata (Mann-Whitney U test: $U = 41.5, p < 0.05$). The high-density stratum had a higher density of dung piles, and as expected gave a higher variance (suggesting a highly clumped elephant distribution) than the medium-density stratum (table 1). Using the rainfall model, the estimated number of elephants was 115 (90, 148 at 95% confidence level); with the steady-state assumption model the estimate was 146 (107, 185 at 95% confidence level). The rainfall model gives asymmetrical confidence limits (CLs).

Factors affecting elephant distribution

Most elephant activities were concentrated at the south and south-eastern sections of Bia RR and thinly

Table 1. Estimates of dung density per stratum in the Bia Conservation Area

Stratum	Area (km ²)	Dung-pile density (Y)*	Variance*	Number of transects
Low-density	77.7	0	0	7
Medium-density	114.4	305.28	7650	15
High-density	113.5	758.61	10562	30

* Hazard rate model

spread northwards through the central portions with no elephant activity in Bia NP.

Figure 2 indicates that elephant distribution was clumped and significantly influenced ($r^2 = 0.759, p < 0.05$) by the number of water sources (ponds and dams).

Elephants were reported hunted but the team could not ascertain the intensity. At Adjuofia, a community in north-eastern Bia NP, for instance, an elephant was reportedly killed less than three months into the study. Yet there was no direct correlation between illegal activity and elephant distribution ($r^2 = 0.413, NS$).

However, there is a threshold dung-pile density (approximately 5 dung piles per km) that affects illegal activity; no illegal activity was found beyond this threshold (fig. 3).

Similarly, no illegal activity was recorded on transects with more than approximately five water sources per kilometre (fig. 4).

Other variables assessed: raphia stand ($r^2 = 0.005$), secondary vegetation ($r^2 = 0.249$), gap length ($r^2 = 0.079$), and fruiting trees per kilometre ($r^2 = 0.009$) did not account significantly to the distribution of elephants.

Discussion

Estimate of elephant numbers in the study area

Dung counts relate elephant numbers to a count of dung piles detected along line transects, corrected for variables such as rainfall in the two months before the count, rate of deposition of dung piles, and rate of dung decay (Barnes et al. 1997; Barnes and Dunn 2002). The last factor is usually the most problematic (Laing et al. 2003), and many elephant surveyors have relied on data from other sites. A new alternative approach, referred to as the retrospective model (Laing et al. 2003), employs a more advantageous approach by estimating the mean time to decay of dung piles already present at the time of the survey. We could not use this method because it requires an added dung decay rate experiment, which is not fea-

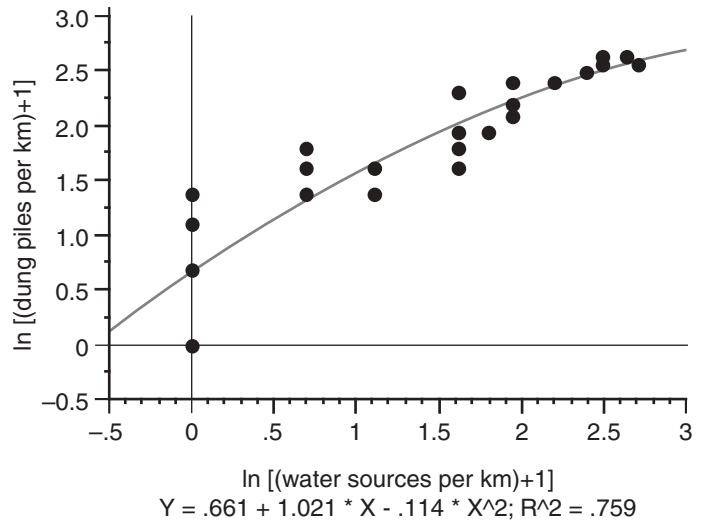


Figure 2. Relationship between water sources and dung-pile density.

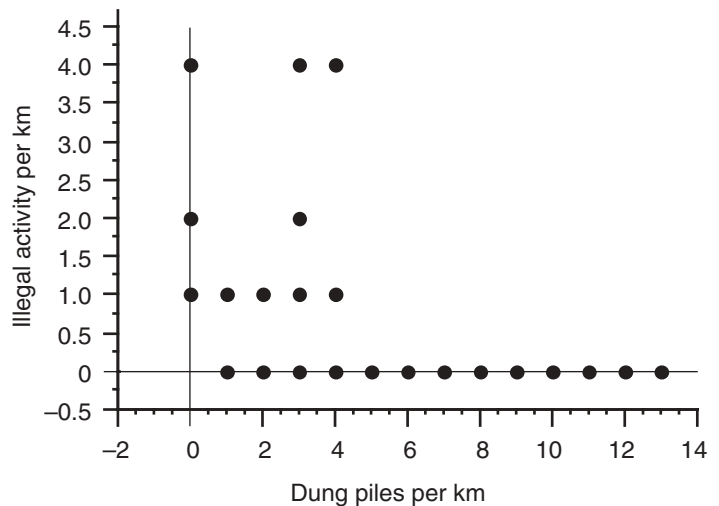


Figure 3. Scatterplot of illegal activity against dung piles per kilometre.

sible for relatively short-duration investigations like ours. Incidentally, the rainfall model also employs a retrospective approach—that is, it uses the rainfall data from previous months to estimate the numbers of dung piles that are likely to be on the ground when a survey is conducted while making no such assumptions as the steady states or normality. It is more accurate than the steady-state method, which employs a ‘prospective’ decay rate for analysing data on dung count and hence does not estimate the mean time to decay of dung piles that are present at the time of the

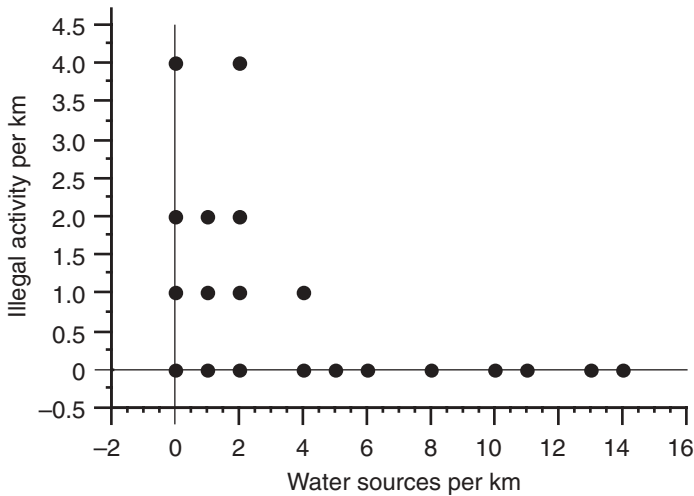


Figure 4. Scatterplot of illegal activity in relation to water sources per kilometre.

survey (Laing et al. 2003). Also, rainfall varies from month to month, and in any one month it is unevenly distributed across days. Thus the steady-state assumption is often invalid (Barnes et al. 1997). This is supported by the fact that the estimate provided by the steady-state assumption model was not conservative but rather higher (21%) than that given by the rainfall model. Conservative estimates of population sizes may be better than overestimates, especially if managers are faced with potentially damaging decisions, such as whether or not they should reduce the size of a population through culling (Eggert et al. 2003). We thus estimate the average density of elephants at BCA at 0.38 per km², based on the rainfall model.

In an earlier study based on track identification, Sikes (1975) estimated 52 to 82 elephants in BCA, giving a density of 0.25 per km². Martin (1982) followed with an estimate of between 200 to 250 for the Bia forest area, which was previously 1500 km² and included BCA, but currently is totally degraded leaving only BCA intact and with elephants. Based on his elephant densities, he provided an estimate of between 89 and 113 elephants (0.29–0.37 per km²) for BCA. This compared well with an estimated density of 0.33 per sq km (40 to 135 elephants) by Short (1983). More recently, Heffernan and Graham (1999) estimated 138 elephants, comparable to the estimate of 127 elephants provided by Sam (2000) with densities of 0.45 and 0.42 per km², respectively. Our present 2004 estimate of 115 elephants (0.38 elephants per km²) also lies well within the CLs of the preceding two estimates,

suggesting no evidence for any significant change between the years 2000 and 2004. The estimates up to 2000 suggest an increasing elephant density within BCA over the last quarter century. At the same time, the Bia elephant range has shrunk to about one-fourth of its original size (from 1500 km² to 366 km²), partly as a result of the Sikusuku Forest Reserve and the Bia Tawya Forest Reserve both being illegally and completely converted to farmland (Martin 1982). Hence the increasing elephant density may reflect the same number of elephants in a smaller area.

Factors affecting elephant distribution

Formerly elephants were found in both Bia NP and Bia RR (Short 1981; Martin 1982). Favourable conditions created by logging activities in Bia RR during the early 1980s (de Leede 1994), however, have caused elephants to migrate permanently into its southern portions (Short 1981; Martin 1982). Both Barnes (1996b and de Leede (1994), have also observed this pattern of distribution. However, in the current study, elephants were found to be more widespread than formerly observed. Indeed, there is a medium elephant-density stratum that extends above the more southern high density to the limits of Bia NP, suggesting that after the ban on logging in Bia RR in 1998 elephants have gradually been dispersing towards Bia NP.

Analysis of dung-pile distribution indicated that water sources accounted for a large proportion of this variation in BCA; elephants were spending more time around water sources. Barnes (1996b and Sam (2000) also reported a positive correlation between elephant abundance and number of water sources per kilometre. These pools or water sources, which were more abundant in the south and south-eastern sections of the reserve, were created as part of the logging activities of Mim Timber Company. Their construction of wide and extensive logging and hauling roads (PADP 1998) have blocked many streams, forming several pools and dams along the sides of sections of the roads. Apart from their swampy nature, the areas around these pools were surrounded by thick thorny vegetation, which is difficult to traverse and hence likely to be avoided by

hunters (Sam 2000). Therefore, while the pools provided water for the elephants, the vegetation at their banks also gave them protection. Barnes (1996b) further reported significant correlation between dung density and fruiting trees and Sam (2000) between dung density and illegal activity. This study found no such correlation.

Sam (2000) stresses that water availability in the reserve is not a problem because of many artificial pools in the reserve. However, elephants may be avoiding Bia NP due to lack of water in most elephant pools, especially in the dry season, when the present survey was conducted. Besides, the national park was last logged in the 1970s; that is, it has not been recently logged. Consequently, elephant movement and distribution in the dry season may be restricted by water availability more than any other single factor. A deeper understanding into this current movement towards the national park after a long period of absence is worth obtaining.

Mean illegal activity in BCA (0.74 activities per km) was comparable to other Ghanaian forests like the Kakum (0.67) and Ankassa (0.97) Conservation Areas (EBMP 2000; 2001). Similarly, illegal hunting for almost all species of animals occurs there including several killings of elephant (Sam 2000). Although elephants are fully protected in Ghana, the Bia elephant population, like others in the country, is still threatened. The last illegal elephant killing was just three months before this current study. It may be that as many elephants as are recruited are lost annually. Our information suggests that elephants may be killed for ivory rather than out of human–elephant conflict, although the resulting free meat is usually not wasted.

Different levels of illegal human activity within the park did not influence elephant density. The use of wire snares dominated the signs of illegal activity, although hunting with guns poses the greater threat to elephant populations. Poachers may be avoiding watering points, possibly because these areas had the highest concentration of elephants and they may fear encountering herds. These observations suggest that most of the illegal activities seen on the transects may be targeted at small game rather than elephants.

Importance of the Bia population for elephant conservation in West Africa

West African elephants may have diverted from the rest of Africa's elephants more than two million years

ago (Eggert et al. 2003) and may constitute a separate taxon. If this becomes confirmed through more extensive genetic sampling, the implications will make securing the long-term survival of the small and fragmented remaining populations of West African elephants challenging indeed (Blanc et al. 2003).

Such a possibility provides a basis for seriously considering the importance of the Bia elephant range for elephant conservation in the subregion. The relatively high elephant density estimate in the present study ranks it high in importance for elephant conservation and for ensuring its long-term survival in the subregion; BCA has the third highest forest elephant density and a relatively well-protected range (Sam 2004). Within Ghana, its importance cannot be over-emphasized, especially taking into consideration the number of forest populations available. Such a high concentration of elephants in a relatively small area also has management implications for tourism. Furthermore, the Bia population far exceeds the mean size of 40 elephants set as priority forest populations in West Africa (AfESG 1999). A population of just over 100 elephants is fairly large for today's fragmented forests but still is small, and is less than the viable population size estimated by Sukumar (1993). Hence, arguments for the possibilities of linking this population with the other elephant populations, especially the Goaso population and those in eastern Côte d'Ivoire, is crucial in ensuring the long-term survival of Ghana's elephant population and that of West Africa.

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Food plants of forest elephants and their availability in the Kakum Conservation Area, Ghana

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Abstract

The diet of elephants in the Kakum Conservation Area, Ghana, was studied from July 2001 to June 2002. Elephants ate fruits and other components of 34 plant species. An examination of elephant dung piles yielded fruit fragments representing 29 species, while data on fresh feeding signs showed an extra 5 plant species, either browsed upon or barked. The quantity and diversity of fruits eaten showed seasonal differences. Fruit availability in the park correlated to forest fruits consumed but was inversely correlated to cultivated crops consumed. Fruit was most available in October, least available in June. Barking activities were high in closed-canopy areas and browsing in open-canopy areas.

Résumé

Le régime alimentaire des éléphants de l'Aire de Conservation de Kakum, au Ghana, a été étudié de juillet 2001 à juin 2002. Les éléphants mangent des fruits et d'autres parties de 34 espèces végétales. L'examen des crottes a permis de récolter des morceaux de fruits de 29 espèces tandis que les données sur les signes d'aliments frais désignaient cinq espèces végétales supplémentaires, soit broutées soit écorcées. La quantité et la diversité des fruits consommés présentaient des différences saisonnières. La disponibilité des fruits dans le parc était en corrélation avec les fruits de forêt consommés et inversement proportionnelle aux plantes cultivées consommées. Les fruits étaient surtout abondants en octobre, et moins abondants en juin. L'écorçage était fréquent dans les endroits où la canopée est fermée et le broutage plutôt là où la canopée est ouverte.

Introduction

Few studies have been conducted on the diet of forest elephants in Ghana (Short 1981; Martin 1982; Liebermann et al. 1987; all in Bia National Park, Ghana) or elsewhere in West Africa (Alexandre 1978 in Tai National Park, Côte d'Ivoire; Merz 1981; Theuerkauf et al. 2000 in Bossematie Forest Reserve, Côte d'Ivoire).

It has been suggested that West African elephants are a separate species from other African elephants (Eggert et al. 2003) hence more information is needed on their foraging ecology to properly develop management strategies for their conservation. More research on the dependence of these elephants on seasonal fruit resources is also important for their

long-term conservation (Dudley et al. 1992). This is especially true since their protection is high on the conservation agenda in the subregion (AfESG 1999) and particularly in Ghana (Ghana WD 2000).

Study area

The Kakum Conservation Area (KCA) is made up of Kakum National Park and the adjacent Assin Attandanso Resource Reserve (fig. 1). It encompasses an irregular block of forest measuring 366 km², consisting mainly of *Celtis zenkeri* and *Triplochiton scleroxylon* moist semideciduous vegetation, which is transitional to the more typical rainforest *Lophira alata*-*Triplochiton scleroxylon* association in the southern part of Kakum Reserve (Dudley et al. 1992).

Materials and methods

To equalize sampling effort, KCA was classified into 10 blocks approximately 36 km² each: Adiembra, Aboabo, Ahomaho, Afiaso, Asomdwee, Antwikwaa, Briscoe I, Briscoe II, Mfuom and Park Headquarters (fig. 1).

Dung examination

In each block, elephant trails were followed to locate undisturbed and relatively new elephant dung piles in categories A to B (Barnes and Jensen 1987). Distance between selected dung piles was more than 5 m to ensure that samples taken were independent deposits (Yumoto and Maruhashi 1995).

Dung piles were examined in situ; 30 dung piles per month, 3 per block, were meticulously examined by carefully sifting the piles and recording the number and type of seeds, fruit and leaf fragments, and seedlings (Short 1981; White et al. 1993; Muoria et al. 2001; Blake 2002). The frequency of occurrence of forest fruits and cultivated crop fragments in dung piles was also estimated for each month. Unidentified seeds, seedlings, fruit and leaf fragments were sent to the University of Cape Coast Herbarium for identification.

Dung components were broadly classified as seeds, fibre, leaf fragments and unidentified remains. Their abundance was quantified on a 4-point scale of relative abundance: up to 25% abundance of a particular component was considered 'rare' and given 1 point; 25–50%, 'few', 2 points; 50–75%, 'common', 3 points; more than 75%, 'abundant', a full 4 points (White et al. 1993). Monthly averages

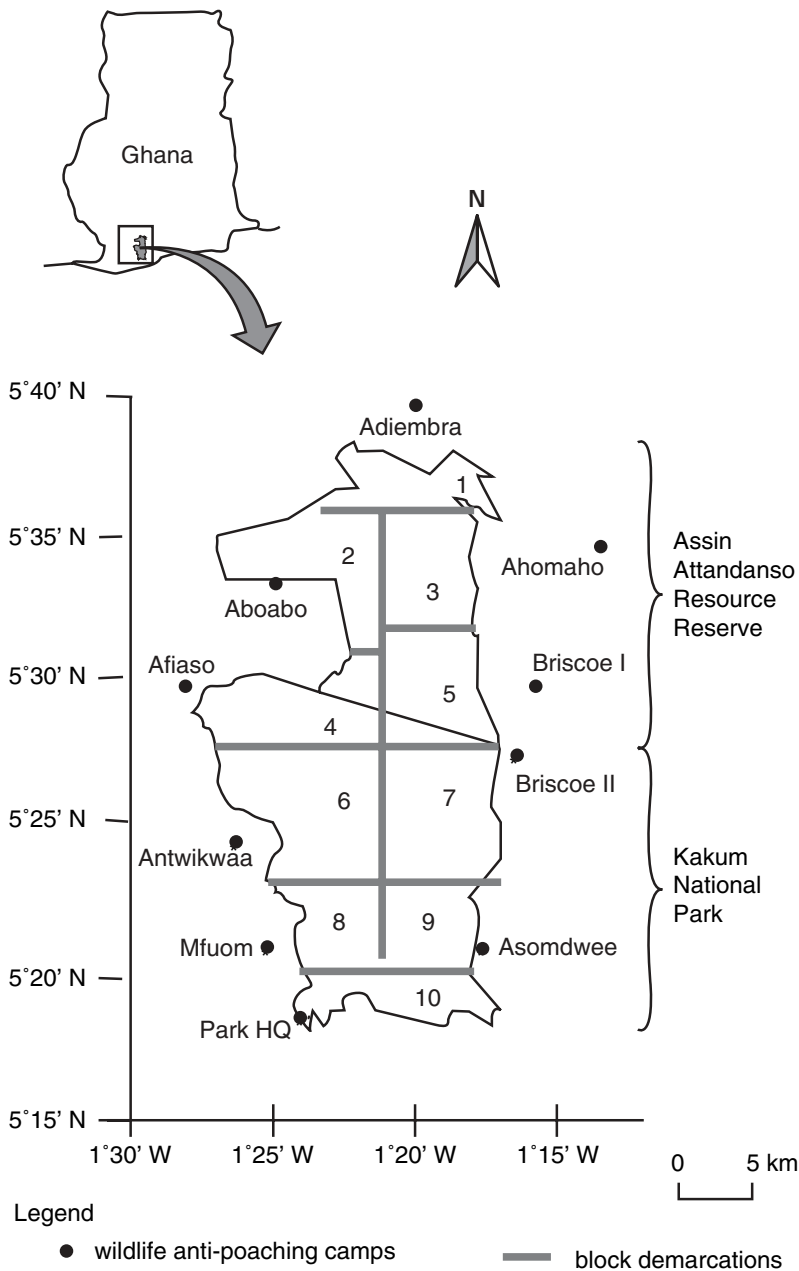


Figure 1. The Kakum Conservation Area showing the 10 classified blocks.

The rainfall pattern is bimodal: two rainfall seasons separated by a short dry spell in August. The major season is between March and July with a peak in June, and the minor season between September and November with a peak in October. There is also a main dry season from December to February or March, when many water-courses dry up.

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(nearest whole number) per dung component were computed by dividing the total points per component by number of dung piles each month.

An existing record (Nyame 1999) on the average seed content per fruit of each species was used to estimate fruit consumption per dung pile. Data were compiled for a large sample of fruits of the species (> 50 fruits), noting the average number of seeds per fruit per species.

Examination of feeding signs

Four blocks—Park Headquarters, Antwikwaa, Briscoe II and Ahomaho—were randomly selected out of the 10, based on a numbered system, and a strip transect for viewing elephant feeding signs was constructed in each. To increase the likelihood of observing elephant feeding signs and minimize vegetation damage when cutting new transects, viewing transects were constructed by linking up elephant trails. Thus were established four non-linear strip transects approximately 3.4 km long and 10 m wide.

Fresh feeding signs that could be attributed with certainty to elephants (directly by sight or indirectly by association with footprints or dung) were inspected monthly on transects, and species and parts consumed noted (White et al. 1993; Blake 2002). Vegetation type was classified as open or closed forest canopy based on the presence or absence of canopy gaps (> 5 m) within a 5-m radius from where the feeding activity was observed. Feeding was classified as leaf stripping, removing terminal twigs, or barking (Short 1981).

Fruit availability

Trees with diameter at breast height (dbh) greater than 0.01 m whose fruits are important elephant food sources (Merz 1981; Short 1981; White et al. 1993; Theuerkauf et al. 2000) were marked as encountered along and within 5 m of each side of the strip transects.

Fruit availability of marked species was monitored every two weeks by counting and recording the number of fresh fallen fruits within and along the strip transects (White et al. 1993; Chapman et al. 1994). Fruit availability was expressed as number of fruits per square kilometre.

Results

Dung examination

Three hundred and sixty elephant dung piles were examined yielding seeds and seedlings, fruits, and leaf fragments representing 29 species of which 26 were forest fruit trees (table 1) and three cultivated crops (*Carica*, *Dioscorea* and *Citrus* species)

There was a distinct seasonal difference in the quantity (Kruskal-Wallis one-way analysis of variance $H = 8.344$, $df = 3$, $p < 0.05$) and number of species ($H = 8.698$, $df = 3$, $p < 0.05$) that elephants consumed. The highest quantity (1688) and number of species (21) consumed occurred in the minor wet season, while these variables were least (quantity 60; number of fruit species 8) during the short dry period in August. Similarly, fruit density per dung pile was highest (18.8) in the minor wet season and least (2.0) during the short dry period (table 1). *Panda* was the most abundantly eaten species. *Desplatsia* and *Strychnos* species were eaten throughout the year while species of *Aningeria*, *Antiaris*, *Ficus*, *Milicia*, *Strombosia* and *Treculia* were eaten seasonally.

Elephant food contained more fibre during the major wet season (March to July) and a high proportion of seeds from minor wet season to early dry season (September to January). There were unidentified dung components in June (table 2).

Feeding signs

Thirteen species of plants were recorded either browsed or barked with eight previously registered during dung examination (table 3). Thus only five new species were added. Leaf and twig stripping (browsing) accounted for 58% of the feeding signs whereas barking formed 42%.

Apart from *Antrocaryon micraster*, all browsed tree species were saplings (dbh < 0.03 m). However, with the exception of *Musanga cecropioides*, barking activities occurred on bigger trees (dbh > 3 m). The stem of *Combretum oyemense*, a liana, was frequently chewed entirely. Elephants selectively browsed (95%) in open canopy forests (G -test of independence $G = 12.566$, $df = 1$, $p < 0.05$) and barked (87%) in closed canopy forests ($G = 8.014$, $df = 1$, $p < 0.05$). To sum up, elephants ate fruits and other components of 34 plant species including *Carica*, *Dioscorea* and *Citrus* species. Trees represented 85%, climbers 9%, and shrubs 6%.

Table 1. Type and quantity of forest fruit species (mean number of fruits per dung pile) found in dung piles in each season. Scientific names following Hutchison and Dalziel (1954–1972)

Family	Fruit species	Season				Total fruit consumed/ (percentage)
		Long wet (Mar–Jul)	Short dry (August)	Short wet (Sep–Nov)	Major dry (Dec–Feb)	
Anacardiaceae	<i>Antrocaryon micrastr</i>	0	0	94 (1.0)	24 (0.3)	118 (3.7)
Chrysobalanaceae	<i>Parinari excelsa</i>	0	0	20 (0.2)	122 (1.4)	142 (4.5)
Euphorbiaceae	<i>Riciodendron heudelotii</i>	20 (0.1)	19 (0.6)	230 (2.6)	0	269 (8.4)
Euphorbiaceae	<i>Uapaca guineensis</i>	6 (0.04)	4 (0.1)	32 (0.4)	19 (0.2)	61 (1.9)
Guttiferae	<i>Mammea africana</i>	0	0	59 (0.7)	16 (0.2)	75 (2.4)
Irvingiaceae	<i>Irvingia gabonensis</i>	0	0	21 (0.2)	26 (0.3)	47 (1.5)
Irvingiaceae	<i>Klainedoxa gabonensis</i>	0	0	153 (1.7)	40 (0.4)	193 (6.1)
Loganiaceae	<i>Strychnos aculeata</i>	100 (0.7)	6 (0.2)	48 (0.5)	15 (0.2)	169 (5.3)
Mimosoideae	<i>Tetrapleura tetraptera</i>	7 (0.05)	4 (0.1)	41 (0.5)	39 (0.4)	91 (2.9)
Moraceae	<i>Aningeria robusta</i>	0	0	43 (0.5)	0	43 (1.3)
Moraceae	<i>Antiaris africana</i>	0	0	0	41 (0.5)	41 (1.3)
Moraceae	<i>Ficus capensis</i>	123 (0.8)	0	0	0	123 (3.9)
Moraceae	<i>Microdesmis puberula</i>	0	0	36 (0.4)	62 (0.7)	98 (3.1)
Moraceae	<i>Milicia excelsa</i>	186 (1.2)	0	0	0	186 (5.8)
Moraceae	<i>Musanga cecropioides</i>	8 (0.05)	0	4 (0.04)	0	12 (0.4)
Moraceae	<i>Myrianthus arboreus</i>	0	0	100 (1.1)	16 (0.2)	116 (3.6)
Moraceae	<i>Treculia africana</i>	25 (0.2)	0	0	0	25 (1.0)
Myristicaceae	<i>Pycnanthus angolensis</i>	4 (0.03)	2 (0.1)	34 (0.4)	12 (0.1)	52 (1.6)
Ochnaceae	<i>Strombosia glaucescens</i>	0	0	40 (0.4)	0	40 (1.3)
Olaceae	<i>Ongokea gore</i>	0	0	203 (2.3)	64 (0.7)	267 (8.4)
Palmae	<i>Raphia</i> sp.	89 (0.6)	13 (0.4)	50 (0.6)	24 (0.3)	176 (5.5)
Pandaceae	<i>Panda oleosa</i>	62 (0.4)	0	269 (3.0)	57 (0.6)	388 (12.2)
Sapotaceae	<i>Omphalocarpum ahia</i>	22 (0.1)	2 (0.1)	2 (0.02)	3 (0.03)	29 (1.0)
Sapotaceae	<i>Tieghemella heckelii</i>	0	0	47 (0.5)	114 (1.3)	161 (5.0)
Tiliaceae	<i>Desplatsia dewevrei</i>	47 (0.3)	10 (0.3)	162 (1.8)	11 (0.1)	230 (7.2)
Zygophyllaceae	<i>Balanites wilsoniana</i>	26 (0.2)	0	0	11 (0.1)	37 (1.2)
	Total	725 (4.8)	60 (2.0)	1688 (18.8)	716 (8.0)	(100)

Table 2. Average abundance of seeds of forest fruit species, fibre, leaf fragments and unidentified remains in elephant dung piles in each month

Dung component	Month												Total points	Overall percentage
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun		
Seeds	1	1	2	3	3	3	3	2	1	1	1	1	22	32
Fibre	4	4	3	1	2	2	2	3	3	3	4	4	35	52
Leaf fragments	1	1	0	0	0	0	1	1	1	1	2	2	10	15
Unidentified remains	0	0	0	0	0	0	0	0	0	0	0	1	1	1

Fruit availability

Overall fruit availability showed a highly significant relationship with fruit consumption ($r^2 = 0.711, p < 0.05$) (fig. 2). Individually, *Panda* ($n = 7, r = 0.921, p < 0.005$), *Parinari* ($n = 4, r = 0.991, p < 0.01$) and *Tieghemella* ($n = 4, r = 0.984, p < 0.05$) species displayed significant correlations with the remaining fruit species being insignificant.

The forest fruits or cultivated crop species that elephants ate varied with fruit availability across

months (fig. 3). The highest fruit availability levels of the late minor wet season to the early dry season (October to January) resulted in the highest intake of forest fruits and reduced the consumption of cultivated crops. In contrast, in the major wet season (peak in June) consumption of cultivated crop species was highest and availability and consumption of fruit the least. Fruit availability correlated ($r = 0.908, p < 0.01$) to the presence of forest fruits in the dung piles but was inversely correlated ($r = -0.583, p < 0.05$) to the consumption of cultivated crops.

Table 3. Plant species browsed or barked by elephants. Fruits of species marked with asterisk (*) are also eaten. Scientific names following Hutchison and Dalziel (1954–1972)

Family	Tree species	Life form	Mean		Forest type	Activity observed	
			Dbh (m)	Feeding height (m)		Browsing	Barking
Anacardiaceae	<i>Antrocaryon micraster</i> *	tree	3.200	2.4	closed	1	2
Combretaceae	<i>Combretum oyemense</i>	liana	0.021	1.2	closed	–	6
Euphorbiaceae	<i>Uapaca guineensis</i> *	shrub	0.009	1.0	open	2	–
Loganiaceae	<i>Strychnos aculeata</i> *	liana	0.025	1.0	open	2	–
Meliaceae	<i>Entandophragma angolense</i>	tree	3.200	3.0	closed	–	2
Meliaceae	<i>Trichilia prieureana</i>	shrub	0.022	1.0	open	1	–
Mimosoideae	<i>Albizia zygia</i>	tree	0.021	1.0	open	1	–
Moraceae	<i>Aningeria robusta</i> *	tree	0.026	1.5	open	3	–
Moraceae	<i>Ficus capensis</i> *	tree	0.022	1.2	open	2	–
Moraceae	<i>Musanga cecropioides</i> *	tree	0.028	1.5	open	5	2
Moraceae	<i>Myrianthus arboreus</i> *	tree	0.012	2.0	open	2	–
Papilionoideae	<i>Baphia afzelia</i>	shrub	0.019	1.0	open	2	–
Sapotaceae	<i>Tieghemella heckelii</i> *	tree	3.600	2.6	closed	–	3

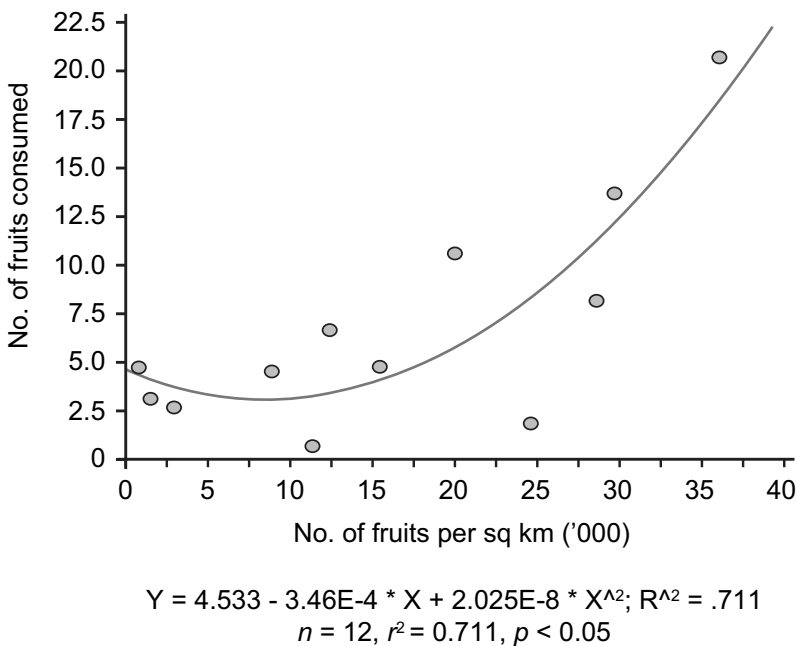


Figure 2. Relationship between fruit availability and elephant fruit consumption in the Kakum Conservation Area.

Discussion

Dung examination and fruit availability

The study enumerated 34 plant species in the diet of elephants at KCA. The bulk of the diet in number of

species and quantities eaten came from fruits, leaves, twigs and bark. Trees represented 85% of the species that elephants fed on in KCA. Similarly, White et al. (1993) reported that trees were 73.5% of consumption in Lopé Reserve, Gabon. Our sample of 360 dung piles in KCA is similar to the 311 dung piles that White et al. (1993) inspected at Lopé Reserve. However, soil and fungi, which elephants in Lopé Reserve were reported to have eaten, were not observed in the diet of elephants in KCA.

Differences in digestibility make difficult any detailed discussion of the relative quantities of plant parts that were ingested. However, the presence of seeds in all dung piles

shows the importance of fruits in elephant diet (Wing and Buss 1970; Short 1981; White et al. 1993 (in 82% of dung piles); White 1994; Muoria et al. 2001 (in 64.5% of dung piles)) and their significance as seed-dispersal agents (Alexandre 1978; Short 1981; Lieberman et al. 1987; White et al. 1993; Muoria et al.

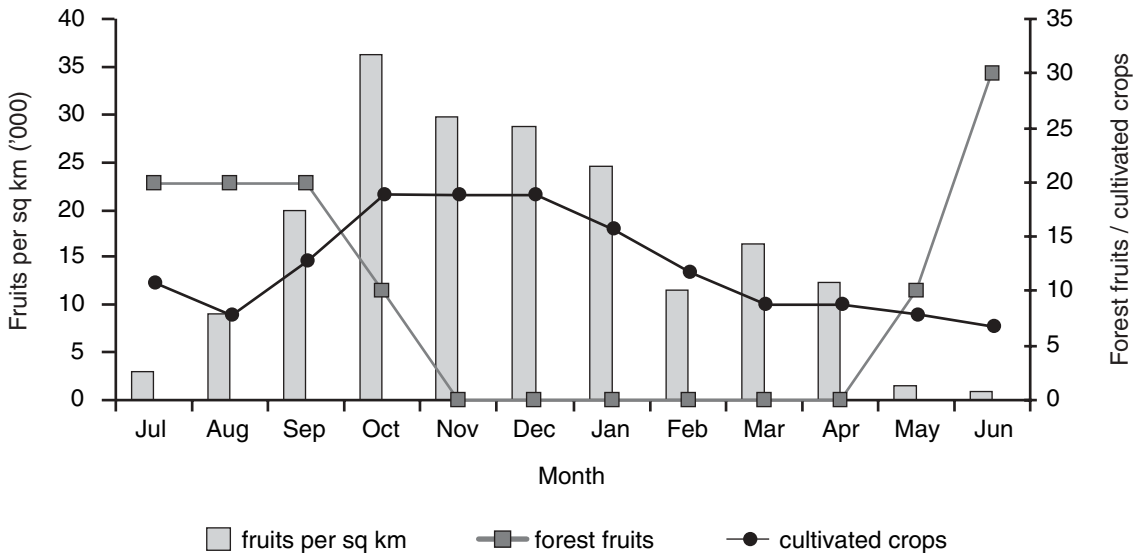


Figure 3. Frequency per dung pile of forest fruits and cultivated crop fragments in relation to fruit availability each month.

2001; Waithaka 2001; Blake 2002). In KCA elephants disseminated seeds of at least 29 species of forest trees in their dung piles. Other animal groups like birds, rodents, monkeys, duikers and antelopes also disperse many of these species; hence it may be that only a few tree species really depend directly on elephants for their survival (Hawthorne and Parren 2000). Possibly large mammals such as elephants may better disperse seeds by conveying them over a wider area than other animals (Yumoto and Maruhashi 1995). Also, plants with large seeds such as *Tieghemella* sp., *Panda* sp. and *Parinari* sp., which usually would not be swallowed by other animal groups, stand a better chance of avoiding 'seed shadow' by being dispersed at suitable places by elephants. Hawthorne and Parren (2000) also reported improved regeneration rates of *Panda* and *Balanites* species with passage through elephant gut.

Generally, elephants are known to feed on a wide variety of plant species (Barnes 1982; Yumoto and Maruhashi 1995; Dudley 1999). Research on forest elephant feeding ecology in Nouabalé-Ndoki National Park in northern Congo has shown that elephants have a general diet comprising more than 350 species (Blake 2002). At Lopé, the diet of elephants was also diverse and constituted 230 plant species with 73.5% from trees (White et al. 1993). Furthermore, the Lopé elephants barked trees from a wide range of 87 plant species (White et al. 1993). At KCA, however, elephants

had a rather narrow diet of 34 plant species with 85% from trees; they barked only 4 tree species. This may seem unusual considering the extent of plant diversity that occurs in tropical forests. However, elephants may be restricted in the range of foods they consume in KCA because the number of preferred species is limited (Short 1981).

There is a distinct difference in the quantity and number of fruit species (diversity) eaten seasonally (White et al. 1993). In KCA, the threshold fruit density (approximately 15,000 fruits/km²) influences elephant feeding behaviour. As fruit density increases beyond the threshold (from minor wet to early dry season), elephants consume the available fruits with increasing rapidity. During this period, they are probably less attracted to other sources of food and hence the absence of cultivated crops in their diet. Large quantities of seeds are present in the dung piles, which are low in fibre and leaf fragments. When fruit density falls below the threshold, elephants possibly use a different feeding strategy to compensate for the lack of fruit and tend to depend much more on supplementary food, including foliage and bark. Reduced consumption of fruits and increased consumption of supplementary foods is responsible for the decreased seed content but increased fibre and leaf fragment content of dung piles for the period. An increased level of cultivated crop fragments (suggesting an increase in crop-raiding activity) and the presence of uniden-

tified components in elephant dung piles all indicate a shift in elephant feeding behaviour (Danquah 2003).

Dudley et al. (1992) speculated that a reduction in the number of fruiting trees (due to logging) in KCA, has stimulated elephants to sometimes go outside the forest to raid crops, but they provided no evidence. Barnes et al. (1995) suggested that if the hypothesis were true, it would mean that yesterday's loggers are partly responsible for today's crop-raiding problems in KCA. Recently Danquah (2003) reported that due to logging there has been a significant reduction in tree densities of large timber species whose fruits elephants eat. Hence fewer trees than previously are likely to result in poor fruit availability, especially in minor fruiting seasons. There is an inverse correlation between fruit availability in the forest and consumption of cultivated crops, which provides the evidence to support Dudley et al. (1992). Elephants ate fewer cultivated crops outside the forest when fruit availability in the forest was high, and elephant crop-raiding activity increased during the major wet season with reduced fruit availability. It is likely that other factors act together with insufficient quantity of fruit to encourage elephants to raid farm crops. Seasonal migration of forest elephants (Short 1983) and changes in their use of habitat (Blake 2002) in response to fruit availability have been intimated as reasons for crop raiding.

Dudley et al. (1992) did not record elephants eating citrus, yet this study found citrus seeds in elephant dung piles. Recently established citrus plantations close to the south-eastern edge of KCA might have influenced this elephant adaptation. Barnes et al. (2003) reported strong correlation between distance from the boundary of KCA to maize farms and frequency of elephant crop raids, yet this study did not record maize seeds in dung, possibly due to their high digestibility. Farmers also complained of emerging cases of elephants eating cocoa fruits, but no cocoa seeds were found in the dung sampled. It is also possible that elephants involved in this act are few and that the study missed their dung piles. Nonetheless, the large-scale expansion of cocoa farms around almost all sides of the park suggests the potential of elephants adapting to cocoa fruits growing in close proximity to the park. This is a serious signal to park management to discourage farming and destruction of forest close to the conservation area to avert the problem of elephants adapting to new sources of food outside protected areas.

Seeds of *Strychnos aculeata* and *Desplatsia dewevrei* were found regularly in dung piles throughout the study period. Short (1981) also found *Strychnos aculeata* in dung throughout the year. Apart from longer fruiting periods, these fruits possess extra hard outer coats and are able to persist on the forest floor for a long time without decaying. Such characteristics enable them to serve as a source of fruit for a long time, even when their fruiting season is long past. Nevertheless, elephants relied heaviest on *Panda oleosa*, *Parinari excelsa* and *Tieghemella heckelli*. Such species fruit for only short periods and deteriorate rapidly and thus are available only briefly. Therefore, consumers with relatively small home ranges such as small primates may experience reduced fruit resources, unlike elephants, which have large home ranges and will move within them to find these fruits.

Feeding signs

Entandophragma and *Tieghemella* species found barked by Short (1981) in Bia National Park, Ghana, were also barked in KCA. *Antrocaryon micraster*, which occurs in both locations, was barked only in KCA. Barking of trees is likely to have a very severe effect on tree species that occur in low densities since barking formed a significant proportion of feeding activity. This aspect of elephant feeding behaviour, which is targeted at bigger trees, should be of great concern to park management. Short (1981) reported that *Guibourlia ehia* became vulnerable to termite attack after being barked. Struhsaker et al. (1996) observed that elephant damage to larger trees in the form of bark damage exposes the wood to attack by beetles and fungi. Elephants, however, browsed much more on saplings than on bigger trees (Struhsaker et al. 1996). Barnes (1982) argued that the anatomy of the elephant's digestive system makes it more sensitive than a ruminant to toxic secondary plant compounds; hence, elephants avoid eating larger, more mature plants. Elephants perpetuate clearings and secondary forests by continuously browsing and trampling on immature plant communities (Struhsaker et al. 1996).

Generally it is accepted that forest elephants prefer secondary forests that follow logging to primary parts of rainforests (Barnes et al. 1991; Struhsaker et al. 1996) because of the abundance of palatable browse species. Barnes et al. (1991) also found elephants in Gabon abundant in secondary forests if there was no hunting. Theuerkauf et al. (2000), however, argued that the

assumption that forest elephants prefer secondary forest might not be valid under certain habitat conditions. According to Theuerkauf et al. (2001), in heavily exploited forests that were too degraded to offer optimal conditions for elephants, such as in the Bossematie Forest Reserve, elephants rather preferred parts of the forest with high canopy cover, obtaining fruits from the remaining mature trees. Dudley et al. (1992) also stated that the fruiting trees on which forest elephants depend for both fruits and bark are more abundant in primary forest and therefore elephants prefer such habitats. However, this study found no evidence to reject either claim. Our results indicate that elephants tend to bark more trees and browse plants in closed-canopy primary forests than in open-canopy secondary forests (Short 1981). Similarly, White et al. (1993) and Merz (1981) indicated that resources in secondary forests combined with resources of the primary forest offer the forest elephant the best possible living conditions. Barnes (1982) noted that because elephants lack a rumen they do not benefit from the synthesis of amino acids and vitamins by rumen bacteria. Hence one can assume that in KCA, elephants eat both vegetation types to provide the necessary range of nutrients and achieve good nutrition.

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Elephant numbers and distribution in the Tsavo–Amboseli ecosystem, south-western Kenya

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Abstract

We assessed how elephants use two Maasai group ranches—Kimana and Kuku—that straddle Tsavo West, Chyulu Hills and Amboseli National Parks in south-western Kenya, and investigated their relative distribution, numbers and ranging patterns. Elephant sightings, fresh elephant dung counts and questionnaire interviews with local people revealed that elephants were widely distributed. Kimana Community Wildlife Sanctuary was reported as the place elephants were most likely to be found within the two communal areas. *Acacia xanthophloea* riverine woodland and *Acacia tortilis* woodlands were the habitats highly associated with elephants during the dry season. Bull elephant groups were dominant in the wet and dry seasons. Elephant movement from Kuku Group Ranch into Kimana Group Ranch was restricted by an electric fence and other human activity into two narrow strips, 1.66 km and 0.45 km wide, to the north and south of Kimana fence. We believe that the future of Kuku and Kimana Group Ranches as an elephant dispersal area depends on how fast initiatives are made to halt the continuing loss and fragmentation of the critical elephant habitat in the area. Immediate interventions need to explore options that enlist landowners' support in conserving these habitats within the ecosystem.

Additional key words: elephant movement, dispersal areas

Résumé

Nous avons évalué comment les éléphants utilisent deux groupes de ranches masai (GR) – Kimana et Kuku – qui se trouvent dans les Parcs Nationaux de Tsavo-ouest, Chyulu Hills et Amboseli, au sud-ouest du Kenya, et étudié leur distribution relative, leur nombre et les patterns de répartition. Les observations d'éléphants, les comptages de crottes fraîches et l'interview de la population locale ont révélé que les éléphants sont largement distribués. Le sanctuaire communautaire de la Faune de Kimana s'avéra être, des deux sites étudiés, l'endroit où il était le plus probable de trouver des éléphants. La forêt riveraine à *Acacia xanthophloea* et les zones boisées à *Acacia tortilis* étaient des habitats fortement associés à la présence d'éléphants pendant la saison sèche. Les groupes de mâles étaient dominants pendant la saison des pluies et la saison sèche. Les déplacements des éléphants du Groupe de ranches de Kuku vers le Groupe de ranches de Kimana étaient limités à deux bandes étroites de 1,66 km et 0,45 km de large, au nord et au sud de la clôture de Kimana, par des clôtures électriques et par d'autres activités humaines. Nous croyons que l'avenir des deux groupes de ranches, Kuku et Kimana, en tant qu'aires de dispersion des éléphants, dépendra de la rapidité des initiatives qui mettront fin à la perte et à la fragmentation continues de l'habitat critique pour les éléphants dans la région. Lors d'une intervention qui doit être immédiate, il faudra explorer les options qui font le compte des propriétaires qui s'engagent à supporter la conservation de ces habitats, au sein de l'écosystème.

Mots clés supplémentaires : déplacements d'éléphants, aires de dispersion

Introduction

Two Maasai group ranches, Kimana and Kuku, straddling Amboseli, Tsavo West and Chyulu Hills National

Parks (NP) are used by elephants from these protected areas. Studies in parts of the Tsavo–Amboseli ecosystem indicate that forage quality (Western and Lindsay 1984) and water distribution (Western 1975; Western

and Lindsay 1984), human settlement and actual presence of humans (Kangwana 1993) influence elephant use of the ecosystem. Elephants select habitats with abundant forage and their mean group size varied within habitats (Western and Lindsay 1984).

The Amboseli elephants known to frequently use Amboseli NP are a discrete population that probably overlaps with elephants from Tsavo West and Chyulu Hills NPs in the Kimana Community Wildlife Sanctuary (Kimana Sanctuary) (Moss 2001). Elephants from Amboseli NP also use the lower Kilimanjaro slopes (Poole and Reuling 1997). The demographics and behavioural aspects of the Amboseli elephant population have been documented through long-term studies by the Amboseli Elephant Research Programme (AERP). There were 1087 elephants in 1999 comprising 52 families and 183 adult males (Moss 2001). Their population today is estimated to be 1300 elephants (S. Sayialel, pers. comm. 2005).

Elephant dung count is the most common indirect method of counting elephants (Barnes 1996). This method was used to determine elephant occupancy levels on Maasai settlements in the Amboseli area (Kangwana 1993) and in different habitats in the Athi–Kapiti plains (Gichohi 1996). Recently, periodical aerial elephant counts that covered Kuku and Kimana Group Ranches (GR) were undertaken (Omondi et al. 2002). The counts do not adequately show the fluid nature of elephant use of the Kuku–Kimana area as can be captured by regularly recording elephant signs such as dung and tracks. Elephant distribution within community land can be evaluated through existing local knowledge. For instance, the Maasai people, ancestral inhabitants of this area, have historically interacted with elephants on a daily basis and possess a wealth of knowledge on elephant use of the area.

Further understanding of how elephants use the private land among the Amboseli, Chyulu and Tsavo West NPs is critical considering the evolving changes in land use and a growing human population that may negatively affect elephant use of the area. The Maasai have, for instance, shifted their lifestyle from pastoralism to a much more diverse and sedentary economy that includes crop farming (Kioko 2005). This coupled with increased crop farming by immigrants from Tanzania and other parts of Kenya has led to accelerated encroachment into the wetlands and subsequent displacement of elephants (Kioko 2005). We give the scope of elephant use of Kuku and Kimana GR, the most important range for dispersal of Amboseli

elephant into the Tsavo–Amboseli ecosystem, and investigate their relative distribution, numbers and ranging patterns.

Study area

Kuku (1310 km²) and Kimana (251 km²) Group Ranches are in Oloitokitok Division in Kajiado District, south-western Kenya. The two, together with neighbouring group ranches (Olgulului, Imbirikani and Rombo) and individually owned land on the lower slopes of Mt Kilimanjaro, are a dispersal area for elephants and other wildlife (fig. 1). The semi-pastoral Maasai are the predominant inhabitants although in the recent past there has been an influx of immigrant farming communities from other parts of Kenya and Tanzania (Berger 1993). In 1996, Kimana Sanctuary, a 30-km² block in Kimana GR, was established to generate wildlife-based tourism income for its members (Kioko 2005). Group ranches, introduced in 1968 under the Group Ranch Act, were a way to settle the Maasai (Graham 1989). In 1981 group ranch members preferred to own individual parcels of land so subdivided the ranches among themselves. In 2004 Kimana GR was subdivided among the 843 registered members. Kuku GR remains communally owned; the swamps have, however, been allocated to the group ranch members who either farm or lease them.

Mt Kilimanjaro, 5895 m high, and the Chyulu Hills Range, 2300 m high, have a dominant influence on the climate and water distribution in the Amboseli ecosystem. Rainfall is highly variable and poorly distributed. It occurs in two seasons (Pratt and Gwynne 1978) and ranges from 300 mm within the group ranches to 900 mm on the eastern slopes of Mt Kilimanjaro (Berger 1993). The ‘short’ rains occur between November and December and ‘long’ rains from March to May. The short rains are more critical with most droughts associated with their failure (Musembi 1986). The permeable nature of volcanic rocks forms regionally distributed aquifers from Mt Kilimanjaro that are important sources of water (Omenga and Okello 1992) in an area that has only two permanent rivers (fig. 1). Dominant species are the yellow fever tree (*Acacia xanthophloea*), riverine and umbrella thorn (*Acacia tortilis*) woodland, wait-a-bit thorn (*Acacia mellifera*) and mixed *Commiphora* bushland (Kioko 2005). The area is famous for its wildlife and abundance of bird species (Berger 1993).

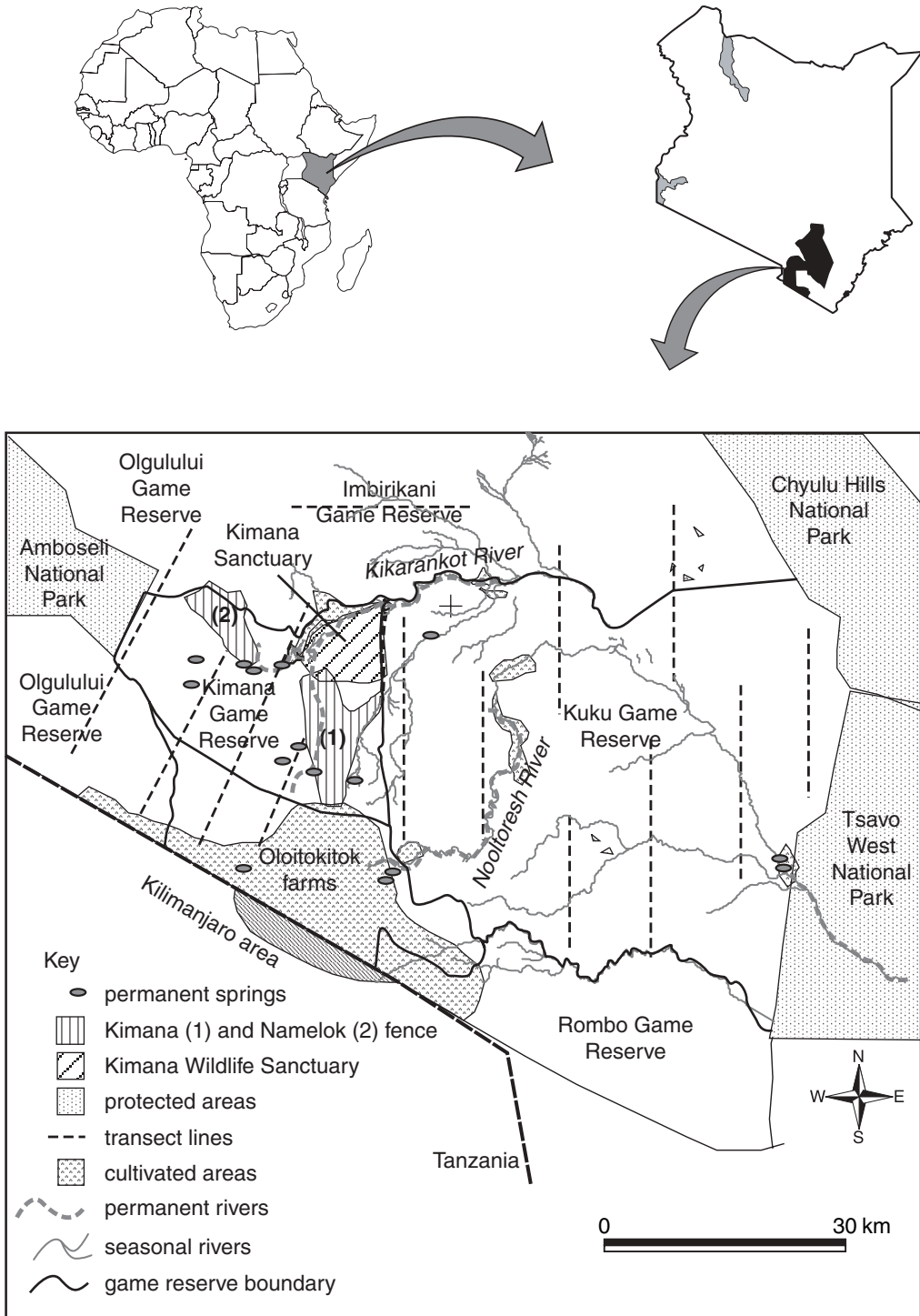


Figure 1. Location of Kuku and Kimana Group Ranches in relation to Amboseli, Chyulu Hills and Tsavo National Parks.

Methods

Elephant numbers and relative distribution

To determine elephant distribution in different habitats, data on fresh elephant dung and elephant sightings were collected along predetermined transects. Transects of 0.5 km to 2 km were established in the different vegetation types. In each transect, an assistant walked and counted fresh elephant dung piles sighted within 10 m on each side of their walking line. In the springs, fresh elephant dung was sampled at a 100-m radius from the middle of the spring. When elephants were sighted, information on the season, number, group type, habitat type and GPS location of the group was recorded. An elephant group was defined, following McKnight (2004), as 'members feeding, resting or moving as a coordinated unit' and classified as either bulls or mixed groups (bull and female with offspring). The sampling was carried out in the dry (July–October) and wet seasons (November–January) at intervals of one month.

In Kimana Sanctuary, a focal point of this study, elephants were counted twice each month. It is relatively easy to conduct vehicle counts in the sanctuary as there are established roads and the area is relatively open. Considering that the Maasai people have historically interacted with elephants in the area (Kangwana 1993), we interviewed the local Maasai using a structured questionnaire to gather information on elephant movement patterns within the group ranches and adjacent areas. The reported movement was verified by walking the identified routes and taking GPS points along the trails.

Elephant herd dynamics

Elephant monitoring sites were established in different habitats in Kuku and Kimana GR. In each site, a research assistant trained to recognize elephant groups monitored elephants daily during both wet and dry months. Once an elephant group or individual was sighted, information on group size and members was recorded. AERP personnel were occasionally consulted to help identify elephant groups and individuals to determine if they belonged to the Amboseli or the Tsavo elephant population. AERP has kept long-term records of Amboseli elephants and individual elephants can be identified from photographs.

Data analysis

Analysis of variance (Ritchie et al. 2000) was used to compare the mean elephant fresh dung-pile densities for different habitat types in each season. If there were any significant differences in dung-pile densities ($p < 0.05$), the Turkey test (Ritchie et al. 2000) was used to establish which means differed. Elephant habitat relationships in the wet and dry season were established using the chi-square goodness of fit. A correlation coefficient was computed to illustrate the magnitude of the spatial relationship between fresh elephant dung-pile densities and increasing distance from water points. An independent *t*-test was used to compare means for elephant group sizes and mean distances from water points for wet and dry season. ArcView-based GIS (geographic information system) maps were made to show spatially the reported elephant movement patterns, trails and main access points.

Table 1. Number of elephants sighted and mean elephant group size in Kimana and Kuku Group Ranches, January 2003–February 2004

Location	Area (km ²)	Number of elephants	Elephant density ± SE (no/km ²)
Kimana and Kuku Group Ranches area	1561	390	0.25 ± 0.1
Kimana Sanctuary	30	59	1.95 ± 0.96
Kimana Group Ranch (excluding Kimana Sanctuary)	251	45	0.18 ± 0.08
Kuku Group Ranch	1310	39	0.03 ± 0.014
Location	Group type	Dry season	Wet season
Kimana and Kuku Group Ranches (excluding Kimana Sanctuary)	mixed	4.47 ± 0.71	9.30 ± 1.55
Kimana Community Wildlife Sanctuary	mixed	17.75 ± 3.83	5.05 ± 0.81
Kimana Community Wildlife Sanctuary	bull	3.36 ± 0.42	3.27 ± 0.37
Kimana and Kuku Group Ranches (excluding Kimana Sanctuary)	bull	3.53 ± 1.20	4.96 ± 0.56

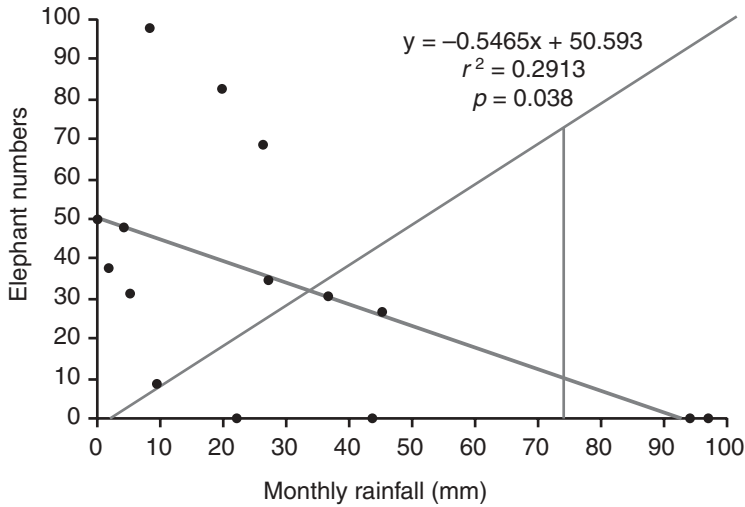


Figure 2. The relationship between rainfall (mm) and mean monthly elephant numbers in Kimana Community Wildlife Sanctuary.

Results

Elephant numbers and relative distribution

Elephant density was significantly higher in Kimana Sanctuary compared with other parts of the group ranches (table 1). The monthly mean number of elephants in the sanctuary was 34 ± 6.49 SE for the period January 2003–February 2004. Elephant numbers in the sanctuary increased during the dry season and at times there were no elephants there during the rainy season (fig. 2). The total number of elephants observed in different habitats varied between wet

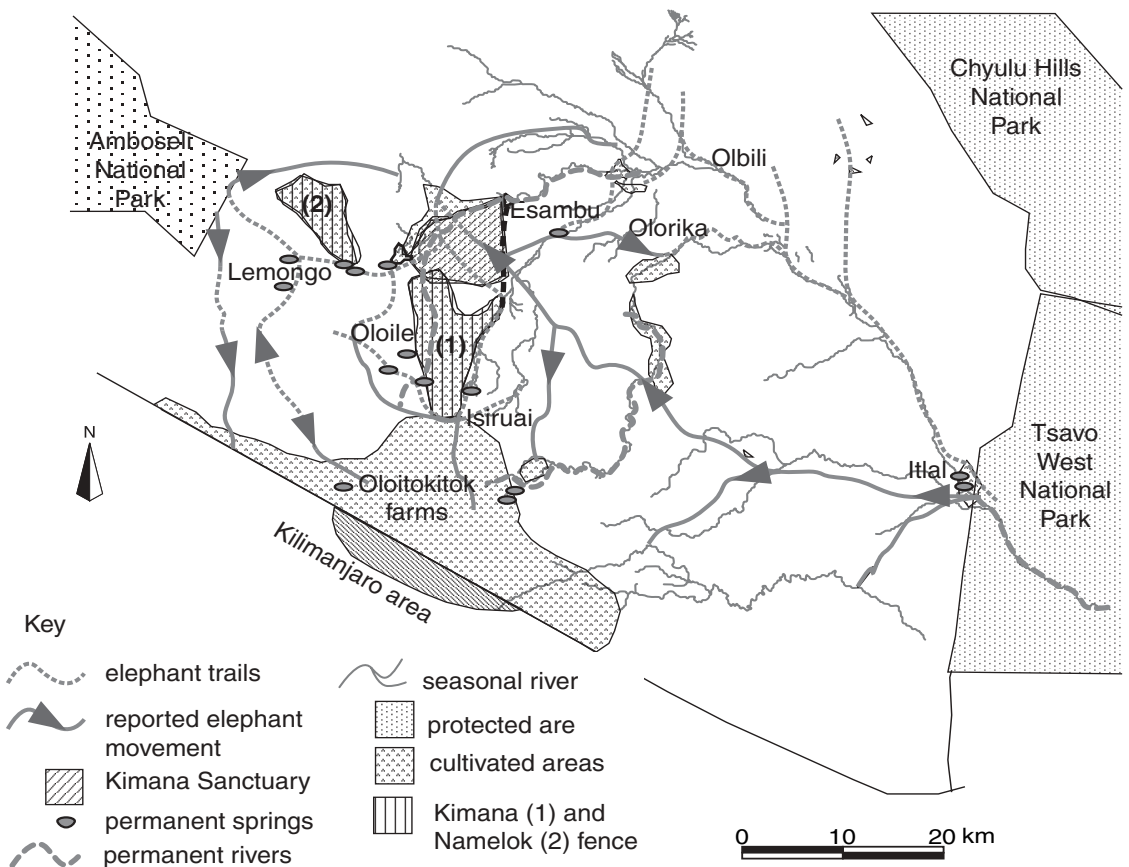


Figure 3. Elephant movement within Kuku and Kimana Group Ranches in relation to Amboseli, Chyulu Hills and Tsavo West National Parks.

and dry seasons ($\chi^2 = 26.50$, $df = 5$, $p < 0.01$). *Acacia xanthophloea* riverine woodlands had the highest elephant numbers: 97 (74.04%) during the wet season and 461 (80.17%) during the dry.

In the entire area (Kuku and Kimana GR), fresh dung-pile densities varied in the different habitats (Kruskal-Wallis $H = 8.79$, $df = 3$, $p = 0.02$). In the dry season, *Acacia xanthophloea* woodland had the highest density of 98 ± 32 SE, while *Acacia mellifera* bushland had the lowest: 17.20 ± 9.40 SE. In the wet season, the highest density of fresh elephant dung piles (12.1 ± 5.70 SE) was in *Acacia mellifera* bushland; *Acacia xanthophloea* woodland had 12.1 ± 5.7 SE and *Acacia tortilis* woodland 10.80 ± 9.7 SE dung piles. When each habitat type was compared in the wet and dry seasons (fig. 3), only *Acacia tortilis* woodland ($t = 3.54$, $p < 0.001$) and *Acacia xanthophloea* woodland ($t = 3.14$, $p < 0.001$) had significant differences in mean fresh dung-pile densities.

Elephant relative use of wetlands

There was significant difference in fresh elephant dung-pile densities in the wet and dry seasons within wetlands ($t = 3.26$, $p = 0.0015$): 10.73 ± 30.2 SE fresh elephant dung piles in the dry season and 7.70 ± 4.11 SE in the wet. Elephants were close to wetlands in the dry season ($t = 2.45$, $p = 0.016$). The mean distance (in kilometres) was 4.79 ± 0.88 SE from the springs and 8.2 ± 1.11 SE from permanent rivers. In the wet season, there was no significant difference in the mean distance elephants were sighted from wetlands ($t = 0.50$, $p = 0.61$). The mean distance from springs was 6.9 ± 13 SE and 7.8 ± 1.1 SE from rivers.

In the dry season there was a weak and insignificant positive relationship between fresh dung-pile density and increasing distance from permanent rivers ($r^2 = -0.021$, $p = 0.884$), and an insignificant negative relationship between fresh dung-pile density and increasing distance from springs ($r^2 = 0.054$, $p = 0.059$). In the wet season, there was a weak positive relationship

between fresh dung-pile density and increasing distance from springs ($r^2 = 0.015$, $p = 0.166$) and from permanent rivers ($r^2 = 0.019$, $p = 0.113$).

Elephant herd dynamics

Table 1 shows mean elephants sighted within Kuku and Kimana GR. When data for Kimana Sanctuary were not considered, there was no significant difference in mean elephant group size for the wet season ($t = 0.2281$, $p = 0.820$). In the dry season mean elephant group size was higher in the sanctuary compared with other parts of the group ranches ($t = 2.89$, $p = 0.004$). In the wet period, elephant group size was higher outside the sanctuary ($t = 2.46$, $p = 0.01$).

The mean bull group size was not significantly different in wet or dry season in Kimana Sanctuary ($t = 0.143$, $p = 0.88$); however, bull group size differed significantly between the sanctuary and other areas in Kuku and Kimana GR in the wet season ($t = 2.19$, $p = 0.03$). The number of bull groups ($n = 84$, 73.68%) in the sanctuary was higher than in mixed groups ($\chi^2 = 25.57$, $p < 0.001$).

In the dry season, the number of bull groups ($n = 19$, 57.57%) was not significantly different from the number of mixed groups ($\chi^2 = 0.758$, $p = 0.384$) in the sanctuary. In the wet season, the number of bull

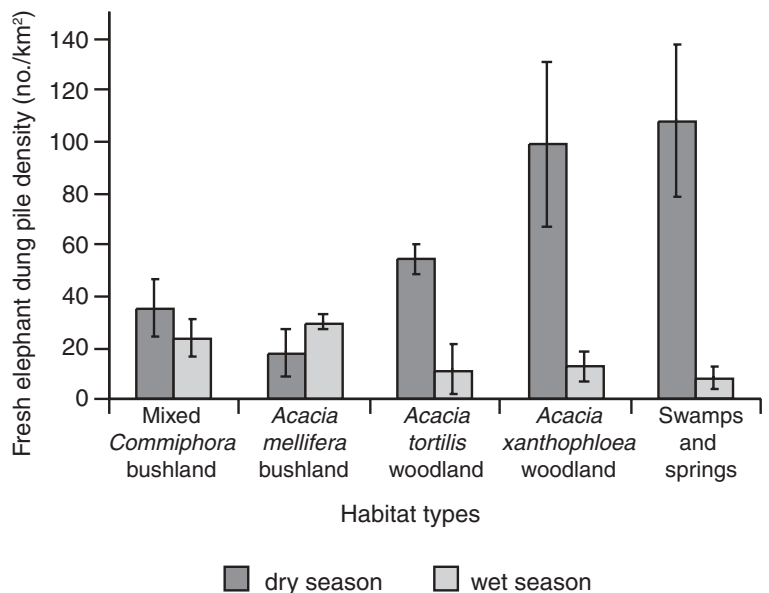


Figure 4. Mean fresh elephant dung piles for different habitat types in the Kuku-Kimana area in wet and dry seasons.

groups ($n = 65$, 81.3%) in the sanctuary was higher than mixed groups ($\chi^2 = 31.25$, $p < 0.001$). There were more bull groups ($n = 51$, 81%) than mixed groups ($n = 12$, 17%) in the wet season ($\chi^2 = 24.14$, $p = 0.001$) and more bull groups ($n = 60$, 80.0%) than mixed groups ($n = 15$, 20%) during the dry season outside the sanctuary ($\chi^2 = 27$, $p < 0.001$).

Elephant movement

Elephant trails were clearly defined in the dry season and led into and out of the wetlands (fig. 4). Elephant movement between Kimana and Kuku GR was constricted into two access points. Elephants from Kimana GR entered the neighbouring Kuku GR through a 1.66-km strip in Isinet and a 0.45-km strip in Impiron. The Impiron point is between Kimana fence and Impiron farmlands on the southern end of Kimana fence. The Isinet access point is to the northern end of Kuku and Kimana GR and falls between Kimana fence and Isinet farms.

Elephants were widely reported within the group ranches; only 7.8% ($n = 61$) of the residents did not see elephants in their home area. Most of the inhabitants ($n = 255$, 78.5%) knew in which areas elephants were 'commonly' found within the group ranches. In Kimana GR, Kimana Sanctuary ($n = 174$, 46.63%), Oloile ($n = 39$, 10.46%) and Lemongo ($n = 25$, 6.7%) were reported as the areas in which one was most likely to see elephants. In Kuku GR, Itlal ($n = 54$, 25.96%), Isiruai ($n = 18$, 8.65%) and Olorika ($n = 17$, 8.17%) were reported as the most likely places. Most of the places reported in Kuku GR were in the area adjacent to Tsavo West NP and in the area north-west of Chyulu Hills NP. Mbirikani GR, neighbour to Kuku GR, Kimana swamp ($n = 60$, 25.32%), Olbili ($n = 47$, 19.83%) and Esambu ($n = 21$, 8.86%) were reported as the areas where elephants were most likely seen.

Discussion and conclusions

Elephants widely use Kuku and Kimana GR. The use pattern is characterized by peak concentration in the wetlands in the dry season. Kimana Sanctuary, partially a wetland, is an important elephant range in the two group ranches. The flood plain on the edges of the sanctuary and a wetland-associated riverine habitat in the sanctuary produce forage that sustains elephants and other wildlife during the dry season. The sanctuary may have become increasingly impor-

tant after loss and fragmentation of wetlands in the group ranches by crop cultivation and human settlement.

While elephants relatively associated with permanent water points in the dry season, the weak relationship suggests that a multitude of factors influence elephant use of Kuku and Kimana GR. Elephants use water points at night to avoid conflict with people fetching water or watering their livestock. Increased human activity within the group ranches is likely to limit elephant use of them. This will negatively affect the eco-tourism enterprises that depend on big game species such as elephants.

The lack of seasonal change in the mean group size for both male and mixed groups in Kimana Sanctuary and other parts of the group ranch may imply that specific individuals and groups use the area seasonally. The area is mainly associated with male elephants. Males move further from water points in the dry season than groups with young (Stokke and Du Toit 2002). The presence of lactating calves may limit how far the group can move from water, quality forage and shade. The groups with young in Kimana Sanctuary remained in the riverine *Acacia xanthophloea* woodland during the day; they were observed to leave the sanctuary in the afternoon and return early morning.

While there existed defined elephant cluster areas, their daily movement pattern was triggered by the need to have access to water and a wider feeding area. There was a sudden shift in elephant movement within wetlands, with elephants suddenly leaving areas once the temporary source of water dried. Mpanduji et al. (2003) observed that permanent river systems influenced elephant movement in the Selous–Niassa wildlife corridor in Tanzania. In the group ranches, the riverine-associated *Acacia xanthophloea* woodland was the habitat most likely to have reliable shade, forage, escape cover, and a nearby drinking and wallowing site for elephants.

Elephants avoided human disturbance by staying in core areas such as Kimana Sanctuary during the day and moving out at night. At night they are able to exploit a wider range with potentially diverse food resources and with little disturbance from humans. The continuing disappearance of elephant corridors in Kimana and Kuku GR is a major threat to elephant dispersion into the wider Amboseli–Tsavo ecosystem. Movement of Amboseli elephants from Kimana GR into Kimana Sanctuary and Kuku GR has been confined by

farming and human settlement into two narrow strips on both extremes of Kimana fence, and even these strips are increasingly becoming fragmented.

The distribution of elephants across landscapes is influenced by rainfall, presence of permanent water points, human presence and habitat characteristics. It is likely that destruction of elephant range through farming and human settlement led to the high concentration of elephants in areas such as Kimana Sanctuary in the dry season. Such an elephant nucleus faces isolation and its future is at stake. Since these elephants are a focus for community-based tourism, a key economic base for the local people is likely to be lost. We urge that measures be put in place urgently to safeguard elephant pathways into the wider Amboseli ecosystem. This will require an elephant management strategy that seeks to solicit landowners' support through initiating elephant conservation education programs and implementing economic incentives to landowners that are viable, within critical elephant habitats such as corridors and wetlands. In the long term an integrated land-use policy is essential to make it possible for both humans and wildlife to use the Amboseli ecosystem.

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Caught in the crossfire: the forest elephant and law enforcement in a region of political instability, eastern Democratic Republic of Congo

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Abstract

Although much research has been conducted that has generated a wealth of information on basic elephant biology, information on law enforcement and illegal killing has not yet been systematically collected over sufficient time in most areas of Africa, including in Kahuzi-Biega National Park. Attempts are now under way under the auspices of the Monitoring of Illegal Killing of Elephants (MIKE) programme to address this gap by training law-enforcement personnel in how to better collect data at selected sites across Africa and accordingly by gathering and consolidating law-enforcement data. This paper reports on law-enforcement efforts in Kahuzi-Biega National Park and its adjacent hinterlands and provides current information on an endangered elephant population. It also suggests possible conservation strategies to protect the species from further slaughter.

Résumé

Bon nombre de travaux ont déjà été effectués sur la biologie de l'éléphant alors que la collecte systématique de l'information sur le monitoring de l'application de la loi et sur les activités illégales fait encore défaut dans la plupart d'Afrique, y compris le Parc National de Kahuzi-Biega. Sous les auspices du programme MIKE (*Monitoring of Illegal Killing of Elephants*), quelques initiatives sont présentement en cours à dessein de former le personnel dans la collecte et la consolidation des données en rapport avec le monitoring de l'application de la loi. Ce document livre l'information sur l'effort de protection versus les activités humaines au Parc National de Kahuzi-Biega et dans son hinterland en période de conflits armés, ainsi que sur la population d'éléphant en danger. Bien plus, il suggère une stratégie de conservation de l'éléphant pour mieux protéger l'espèce.

Introduction

Ivory poaching has been a serious problem for African forest elephant (*Loxodonta africana cyclotis*) populations. Reliable records of elephants killed and ivory harvested within range states are generally unavailable, particularly where parks have been run on a hand-to-mouth basis. In the Democratic Republic of Congo (DRC), unreliable data on resources allocated for law enforcement and on levels of illegal activity often result in limited information to guide law-

enforcement operations. This is particularly the case in Kahuzi-Biega National Park (KBNP).

Although much research has been conducted on elephants, information on law enforcement and illegal killing has not yet been systematically collected over sufficient time in most areas of Africa (Dublin and Jachmann 1992; Barnes et al. 1999; MIKE 1999). Attempts are now under way under the auspices of the Monitoring of Illegal Killing of Elephants (MIKE) programme to address this gap by training law-enforcement personnel at selected sites across Africa in

how to collect data. Indeed, given that around 90% of the staff of African wildlife authorities are employed in the field as law-enforcement staff, particularly to protect large and economically important species like the elephant (Cumming et al. 1984), wildlife managers must place high priority on monitoring them. This paper reports on law-enforcement efforts in KBNP and its adjacent hinterlands. It provides current information on an endangered elephant population, and suggests possible conservation strategies to protect it.

Study area

Kahuzi-Biega National Park was gazetted in 1970 to conserve the eastern lowland gorilla (*Gorilla beringei graueri*). It covers an area of 6000 km² and protects a mountain forest in the heavily populated Kivu region (fig. 1). Open cultivated areas dominated by banana (*Musa parasidiaca* or *Musa sapientum*) plantations, bean, irish potato and cabbage surround the eastern side of the park. The area is predominantly montane forest with a low canopy and abundant herbaceous vegetation with large areas of bamboo (*Arundinaria alpina*) forest, primary forest, secondary forest, *Cyperus latifolius* swamps, and mountain transition forest (Steinhauer-Burkhart et al. 1995). The upland sector has two dry seasons (January–February and June–August) and two wet seasons (March–May and September–December) (Bultot and Griffiths 1972). The annual precipitation at Tshivanga, the park headquarters, is 1200 ± 1300 mm; however, precipitation increases with altitude, reaching a peak of 3000 mm (Bultot and Griffiths 1972).

KBNP lies between 1°36'–2°37' S and 27°33'–28°46' E. Two extinct volcanoes, Kahuzi (3308 m) and Biega (2790 m), have given the national park its name. The ecosystem is divided into two zones that are connected by a narrow corridor (ICCN/PNKB 2000). On one side is mountain forest covering 600 km² with altitudes between 1800 m and 3308 m and on the other side covering 5400 km² is tropical forest with altitudes between 600 m and 1200 m. The rich biodiversity of this region situated in the Albertine Rift makes it a hotspot of the biological and geographical history of eastern DRC, a natural crossroad where a dense human population and wildlife have lived in harmony for years, making it one of the most important tropical moist forest areas within the Albertine Rift region and a centre of endemism in

Africa (Mittermeier et al. 1998). Much of the region supports densities of over 300 inhabitants per square kilometre (Hall et al. 1998), and overall it experienced a 4% rate of growth between 1950 and 1984 (Wils et al. 1976; Institut National de la Statistique 1984).

It is indeed because of its extraordinary natural beauty that this park was declared a UNESCO World Heritage Site in 1980. Unfortunately, however, escalating wars have laid waste to it, and it with others in the eastern part of the country are now World Heritage Sites in Danger.

Methods

The two main elements of law enforcement are patrols and investigations. Scouts supported by carriers carried out the patrols; investigations were carried out primarily in Bukavu town and in villages outside the conservation area (fig. 1), following up information concerning illegal activity back to its source. By their nature, investigations are non-standard and unpredictable, which makes them easier to quantify than patrols.

An initial one-week training session on law-enforcement monitoring (LEM), both theoretical and in the field, sponsored by a United Nations Foundation/UNESCO fund in 2002 was held at park headquarters in Tshivanga. This course was reinforced with an additional week of actual fieldwork and debriefing exercises in plenary sessions. Field trials with compass, tape measure and GPS (global positioning system) were undertaken to equip the guards to handle the fieldwork later at different patrol posts. The principle applied throughout this programme was to train trainers—supervisors would train team leaders—who in turn would train rangers, guides and trackers. This training was further enhanced with a Wildlife Conservation Society/PNKB programme in collecting and managing data using GPS, compass and maps.

A patrol was usually issued with a *bulletin de service*, patrol forms, a map of the area to be covered, a patrol summary, various ancillary recording sheets, simple instruction guidelines, and a notebook and pen. The basics were recorded on patrol but more detailed records were completed from notes on return; they were verified, corrected or enriched during the debriefing as necessary. On return from patrol, the patrol leader and the patrol secretary scout who kept records were debriefed to ensure that the patrol route was correctly defined and that all necessary information

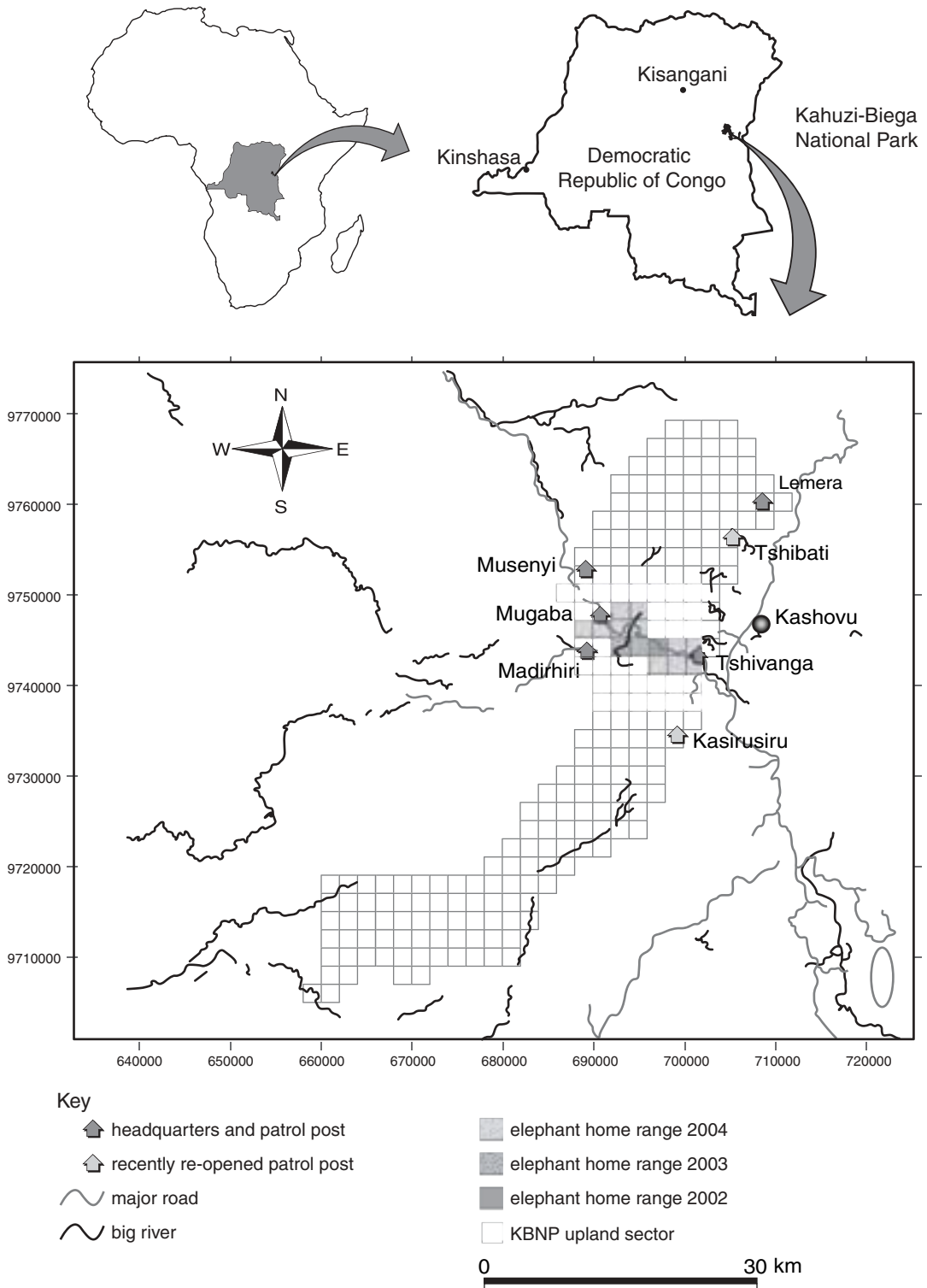


Figure 1. The study area and elephant home range in Kahuzi-Biega National Park, 2002–2004.



Figure 2. The patrol leader and patrol secretary scouts are debriefed at Epulu headquarters in the Okapi Faunal Reserve.

was entered in the report, which would give a 'big picture' of the controlled sector. The debriefing interview was conducted with the wildlife officer responsible for the surveillance unit and the MIKE site officer and the information incorporated in the monthly report (fig. 2).

Trained scouts and guides used two daily data sheets (fig. 3). The standardized patrol data sheet listed the main observations on human activity, key species activity and phenological events; the gorilla data sheet detailed visits made to habituated gorilla groups.

Data on law enforcement and illegal activity were collected from various sources including from exist-

ing reports and by assessing the extent of illegal activity. The number of operating patrol posts varied between six and eight, depending on the security situation. Each scout patrol team produced monthly reports that included details of their patrol routes and patrol efforts, law-enforcement activities, sighting or signs of both small and large mammals, and any problems encountered. All available monthly scout reports were carefully read, from all operating scout patrol posts, for the period 2002–2004. From these,

data were collated on poaching incidents, sightings of elephant signs or carcasses, and patrol efforts. Out of an expected 4420 original handwritten scout reports, 3924 were on file. Each patrol had a leader and a secretary.

Indicators were rounded to the nearest decimal and multiplied by 100 to facilitate interpretation of the data, thus providing encounter rates of illegal activity per 100 effective patrol days (Jachmann 1998). The effective time spent by each staff member on foot patrol measured the commitment of anti-poaching units (Bell 1986). Patrol lengths were counted as the number of days that scouts were patrolling on foot in the forest. The patrol effort and score for each class of each illegal activity was then compiled by surveyed area (grid of 2 x 2 km), and by time (month or year). The catch per unit effort index (C/E index), derived from the data, measured the encounter rate of a particular type of illegal activity per unit of law enforcement.

All these LEM data were compiled on standard data sheets and entered into a computerized database for analysis. The information collected was of immediate use in the field to examine trends in wildlife distribution and illegal activity through averaging the catch per unit effort indices. However, for the formal analysis used for this paper a complex statistical analysis was necessary using StatView software, all the more so because the data on the index of sightings contained many zeros and were therefore termed skewed. Accordingly, corrections needed to



Figure 3. To replicate and compare the results generated by the law enforcement monitoring programme, a structured data collection system that makes it possible to compare results from various sites is essential.

be made for patrols of different lengths and in different seasons (Leader-Williams et al. 1990).

At the monitoring unit office in Bukavu, patrol distances and encounters with illegal activity, together with the grid coordinates, were computerized to visualize patrol intensity and illegal wildlife use for each grid square in PNKB. The user-friendly ESRI ArcView 3.2a was used to better understand spatial relationship in law-enforcement monitoring data related to the distribution of elephant and human activities, as taken from the sample patrols. Areas of elephant occurrence and those of high human impact were modelled using a GIS overlay (figs. 1, 4 and 5).

Results and discussion

Background on population status, trends and current human threats

Originally considered 'fairly common to common' over much of their range, the number of KBNP elephants has fluctuated dramatically over the last decades, principally as a result of their being hunted for meat and ivory. These elephants occupied both low-altitude and mountainous forests. In 1995, their more-or-less straight travel routes could be seen on steep slopes. As elephants contributed to the rejuvenation of the forest, they were important landscape architects. The gaps they created were usually occupied by light-loving plants, which cannot grow in the gloom of the forest. In this way, elephant browsing helped to increase plant diversity. But beginning in 1996, a wave of poaching swept KBNP, and elephant distribution was determined by the intensity of poaching, the distribution of roads and settlements, and the distribution of secondary forest. Population figures varied extensively, from 1350–3600 animals (Hart and Hall 1996) to 3720 in 1997 (Hall et al. 1997), and then went down to 771 three years later (Inogwabini et al. 2000), and further to respectively only 25 and 10 elephants in the upland sector (Blanc et al. 2003). Figures in the lowland sector were still estimated to vary between 1900 elephants (Hall et al. 1997) and 1125 (Blanc et al. 2003); recent explorations in 2001 showed no elephant sign in the lowland sector (ICCN/PNKB 2002). The report is extremely disturbing and suggests that both pongid and elephant species are at severe risk if conservation efforts are not intensified. Density per square kilometer in 1994–1995 was estimated at 0.40 in the upland sector and 0.24 in the

hinterland. Given the drastic decrease in elephant numbers, many donors assumed that under war-torn circumstances it would be impossible for such a large and vulnerable mammal to survive. The challenge now is to link protection of the remaining elephants with conservation of the entire park.

Over the past several years, the wildlife populations in eastern DRC (Garamba National Park, KBNP, Okapi Wildlife Reserve) have been severely depleted through poaching by refugees, guerillas and army forces in the ongoing civil war in the region (Plumptre et al. 2000). In December 1997, six elephants were killed and the poachers arrested. Between April and June 1999, two infamous poachers alone, both from Kashovu village, killed 17 elephants (ICCN/PNKB 1999). A new word, 'ecocide', has been added to our vocabulary to define destruction of the environment for military purposes (McNeely 2003).

Assessment of law-enforcement efforts

The objective of law enforcement is to reduce illegal offtake or at least keep it at a low level. In PNKB the acceptable C/E level is set at 0.0012 encounters per 100 effective patrol days or 1 encounter per 8.33 effective days (table 1, figs. 6–7). The least amount of elephant lifetime range (Jewell 1966; Osborn 2004), calculated by ArcView version 3.2a software using X Tool extension was estimated at 100 km² to over 6000 km², can explain this given the small portion of the vast forest of KBNP that has been patrolled. However, the small elephant lifetime range varied from 28 km² in 2002 up to 24 km² in 2003 and then 48 km² during six months in 2004 (fig. 4). This trend towards larger range should not be explained as an increase in elephant movement but rather as the result of extensive deployment of scout teams over a larger area after three patrol posts were reopened: Lemera, Musenyi and Kasirusiru (figs. 1 and 5). Elephant signs were concentrated around Musisi Swamp in an elephant landscape 'haven' controlled by Tshivanga, Mugaba and Madirhiri sectors (fig. 4). In fact, the overall rate of decline in numbers of elephants was 99.73% between 1995 and 2000, following rapid increases in human pressure and incursions into the park. This decline clearly arose from illegal activity, as is evidenced by 150 skulls recovered and stored in the aptly named Elephant Museum at Tshivanga.

Only a small portion of the vast forest of KBNP has been patrolled (fig. 1) and the LEM data are in too pre-

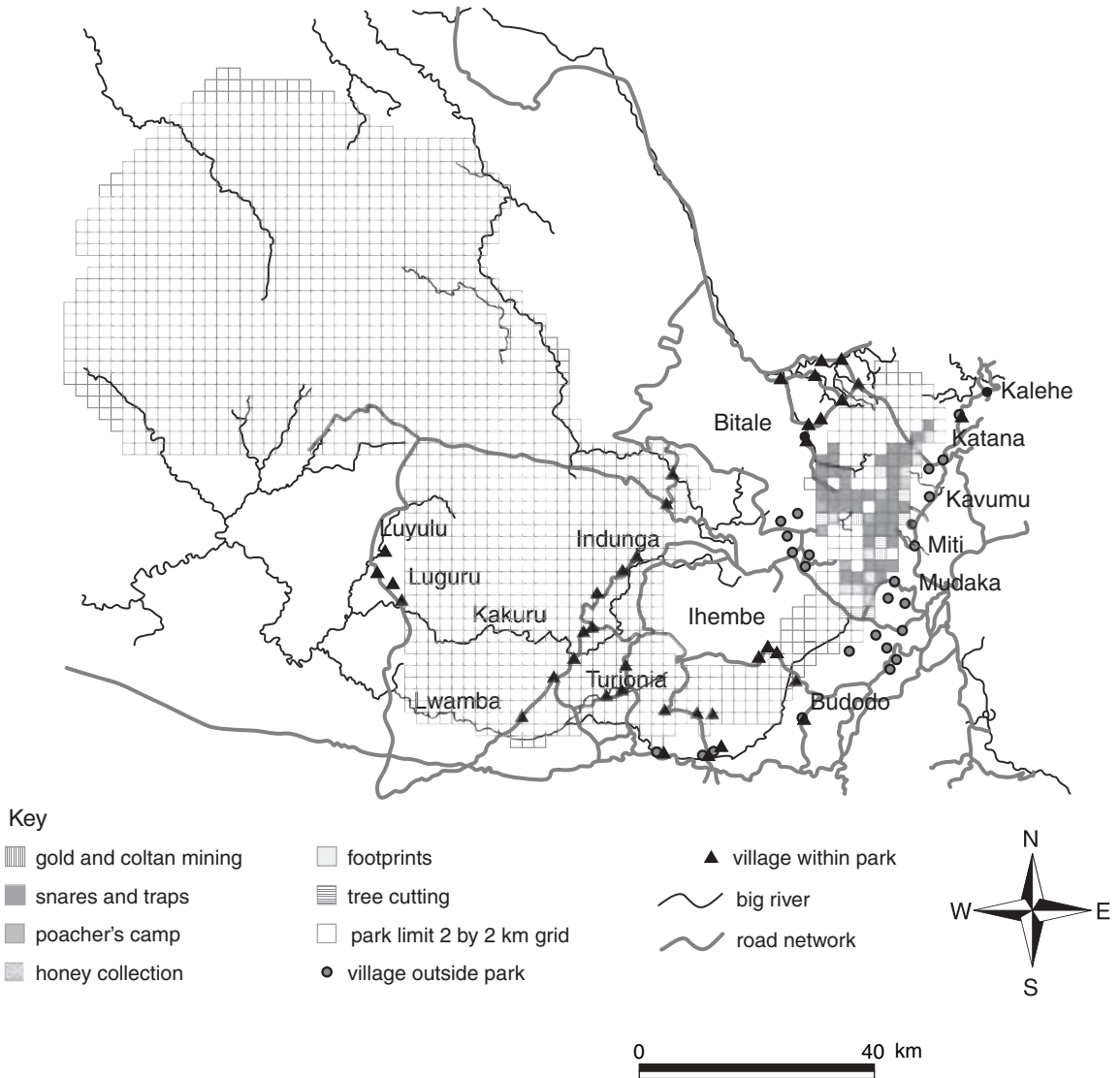


Figure 4. Illegal activity in Kahuzi-Biega National Park, 2004.

liminary a state to be useful in designing an effective elephant management programme (table 2). However, from 2000 to 2004 the number of effective man-patrol days markedly increased as park management initiated a major recovery programme of the lowland sector with 30 new scouts being recruited and trained. The recovered park extension area provides ideal conditions in which elephant populations can recover, should their security continue to be guaranteed. Over 15,000 people were estimated to be moving inside the park itself, associated with over 90 colombo-tantalite (coltan) and gold-mining camps. They were living off the land and no

traces of elephants and very few of other species could be found (ICCN/PNKB 2001).

Indicators for arrests on patrol showed a steady decline from 4.19 encounters per 100 effective man-days in 2000 to 0.76 in 2001 and 0.04 in 2002, a decline of 18.13% in 2001 and 1% in 2002. The upland sector of the park was occupied from June to December 2002 by two competing factions—the Rwandan-backed Congolese Rally Gathering for Democracy rebel army, and the Mai Mai militia. It was therefore difficult for park scouts to control all sectors through overnight patrols, especially those identified with the

highest rate of illegal incidents. The indicator for confiscated snares, firearms recovered and footprints followed a similar pattern, with a steady decline from 9.23 for the snare in 2000 to 0.09 in 2003.

Most staff in anti-poaching units spent about half of each month patrolling on foot under difficult conditions. They covered 376 km² in 2002, 316 km² in 2003, and 304 km² in the first half of 2004 (fig. 1). Signs of illegal activity, such as poachers' footprints and camps, snares, and coltan artisanal mining were encountered throughout the year. Encounters of illegal activity generally showed consistent trends within different areas, but most trends showed complex changes over time.

Poachers and camps tended to be seen less often in more heavily patrolled areas even though these held the remaining elephants. The detection of illicit activities within the upland sector generally increased as patrol units contained a greater number of staff as well as spent much more time on the ground (figs. 8 and 9). The staff density for KBNP was clearly insufficient to protect a large area (Leader-Williams et al. 1990). Indeed, the minimum KBNP number of 0.014 guards per square kilometre does not begin to measure up to the IUCN recommendation of 1 guard per 40 km² in an area with human population density exceeding 350 inhabitants per square kilometre (Hall et al. 1998). The average guard density in the central and eastern sectors of Virunga National Park was one guard per 10 km² (Mubalama 2000; Mubalama and

Mushenzi 2004). Following staff shortfall, wildlife authorities need to direct manpower into a more effective intelligence network outside protected areas (Bell 1986; Leader-Williams et al. 1990), all the more so since the likelihood of detection is a better deterrent than a severe penalty, especially in a region with poor law enforcement and a declining economy.

Leader-Williams et al. (1990) demonstrated the relative efficiency of investigation operations over conventional patrols, in terms of ivory and ammunition recovered. For PNKB in 2001, the encounter rates of ivory recovered on investigation operations varied between 1 and 248 times that of patrols, while it varied between 1 and 65 times that of patrols for the recovery of ammunition (figs. 6 and 7). Building upon recorded intelligence data in KBNP and as things stand now, the investigation approach does not seem to be effectively operating as it did the previous four years, due to underfunding and inadequate security. In the future, investigations should be more effective and more efficient than is possible with conventional field patrols.

Law enforcement operational budget

The total annual budget allotted to PNKB for the years 2000 to 2003 varied substantially from one year to another. In 2000, park management used USD 51,028. This means USD 8.50 per km². The amount in 2002 was USD 41,560 with USD 6.93 per km² and in 2003 USD 55,832 or USD 9.30 per km². When considering that during the same period the average staff density of guards per square kilometre was 0.011 in 2000 and 2001, 0.013 in 2002, and 0.014 in 2003, it becomes apparent that the severe lack of workforce can be linked to an insufficient operational budget. This budget for law enforcement contrasts with USD 46.50 per km² a year (Jachmann 1998) allocated to elephant protection for the Luangwa Integrated Resource Development Project in Zambia and is slightly less than the USD 11 per km² (Yirmed Demeke 2003) for Omo National Park in Ethiopia.

Table 1. The catch per unit effort (C/E) index of encounter rates of serious and minor offences per 100 effective patrol days, and serious offences encountered per 100 effective investigation days, 2001–2004

Event or item	2000	2001	2002	2003	2004
Serious offences (patrol)					
Elephants killed	< 0.01	0.49	< 0.01	< 0.01	< 0.01
Arrests	4.19	0.76	0.04	0.05	< 0.01
Poachers encountered	< 0.01	0.35	0.05	0.01	0.23
Firearms	0.21	< 0.01	0.01	0.01	0.01
Ammunitions	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Serious offences (investigation)					
Ivory	< 0.01	2.48	< 0.01	< 0.01	< 0.01
Other animals confiscated	< 0.01	< 0.01	0.04	< 0.01	< 0.01
Ammunition	< 0.01	0.65	< 0.01	< 0.01	< 0.01
Minor offences (patrol)					
Snares recovered	9.23	2.28	1.84	0.09	4.72
Camps found	< 0.01	< 0.01	0.02	0.01	< 0.01
Footprints sited	< 0.01	0.98	0.02	0.04	< 0.01

Table 2. Law-enforcement effort and illegal activity

Event	2000 ^a	2001 ^a	2002 ^a	2003	2004 ^b
Elephants killed by poachers	0	150	0	0	0
Ivory recovered	0	5	0	0	0
Ammunition captured	0	197	6	163	0
Firearms captured	15	0	6	13	0
Effective man-patrol days	18,960	30,090	53,641	198,660	115,584
Estimated coverage (km)	11,250	13,210	36,555	41,015	39,772
Total patrol days	1,299	1,224	679	2,365	1,376
Total arrests	289	76	34	92	42

^a Only the original sector of the park under park management control

^b From January to June 2004

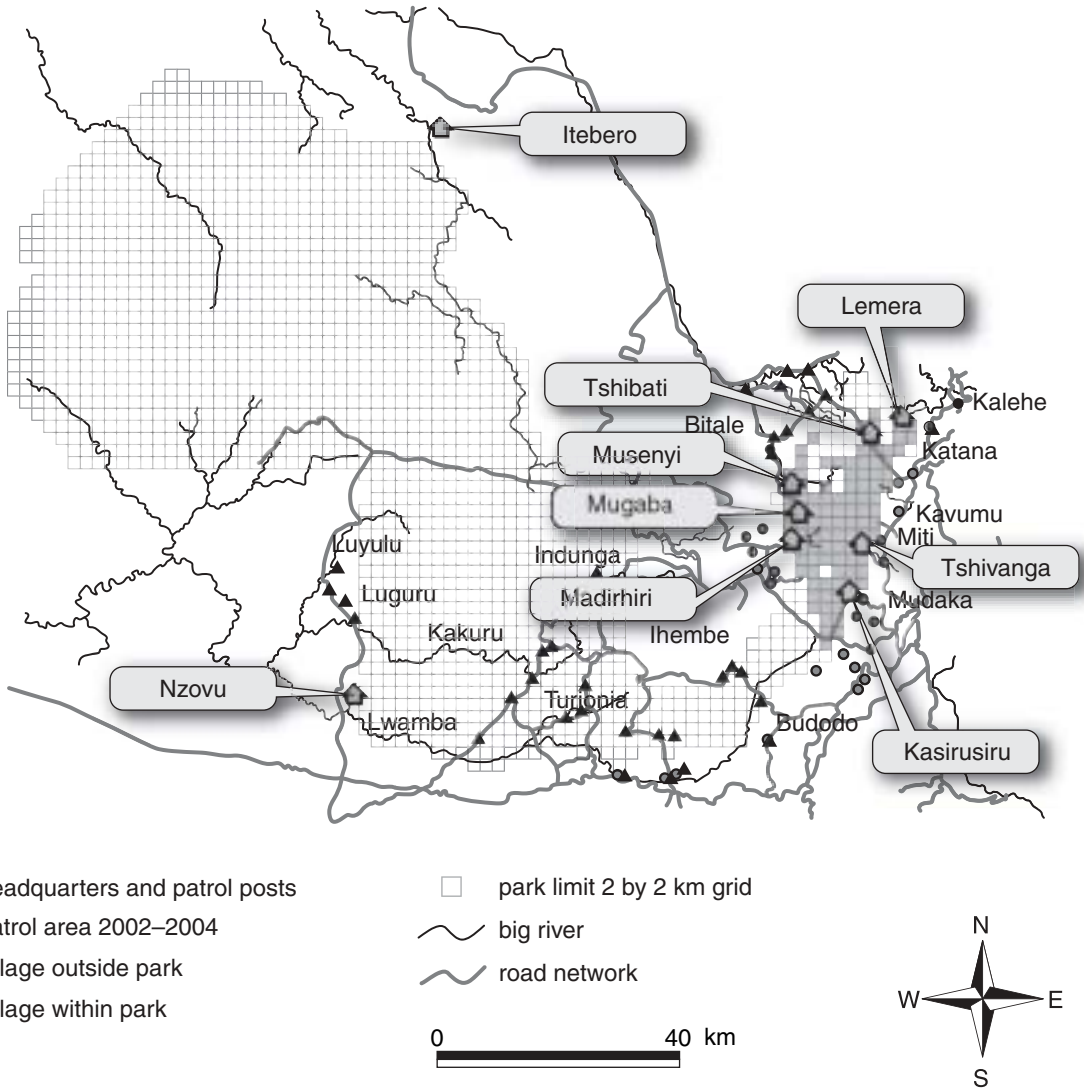


Figure 5. Protection effort in the upland sector of Kahuzi-Biega National Park.

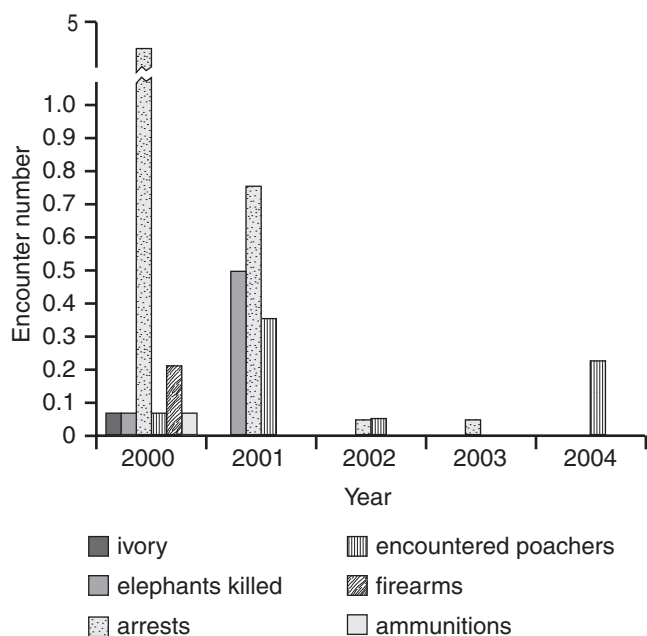


Figure 6. Encounter rate of illegal activity: serious offences per 1000 effective patrol days, 2000–2004.

We suggest that law-enforcement staff should have been deployed at an effective density of at least one man per 40 km² of protected area to have prevented the decline of elephants. If we are to avoid further mass slaughter of wildlife and a drastic reduction in elephant population in PNKB and surrounding areas, we recommend that an annual operational budget of USD 300,000 be allocated for PNKB. This means an average of USD 50 per km².

Conclusion and recommendations

Elephants in KBNP are facing a severe, unprecedented crisis. We conclude that the available workforce for law enforcement was reasonably effective in capturing minor offences in a very limited protected area but was too small to provide effective protection to the large populations of elephants over such a vast and challenging area as KBNP. This situation calls for immediate action to find and control the causes to save some of the local wildlife populations from extinction. Today, the law-enforcement budget to protect wildlife has plummeted and sophisticated weapons in wrong hands

have escalated elephant poaching. Evidence of such poaching was encountered throughout the patrolled areas, suggesting that small populations of elephant continue to be at severe risk of being killed for both ivory and meat.

The future of the African elephant involves much more than maintaining an international moratorium on ivory trade for the foreseeable future. We are convinced, however, that any resumption of legal trade will threaten the elephant throughout its range and the ban should continue to be enforced. Uncovering and checking new information on the movement of poachers and smugglers should be the highest priority of the anti-poaching intelligence unit, as receiving advance information on poacher and smuggler activities is extremely important for apprehending criminals engaging in such nefarious activities. A strong site-based conservation program is needed to sustain long-term conservation efforts in a region under civil war. Dedicated national staff should receive regular hands-

on training, developing them professionally to manage their natural resources. Greater emphasis should be placed on developing methods to ensure proper documentation of informant sources and the information they provide.

Enduring peace remains elusive for DRC national parks, including KBNP. Racketeers, mercenaries and *interahamwe* continue to terrorize the local human

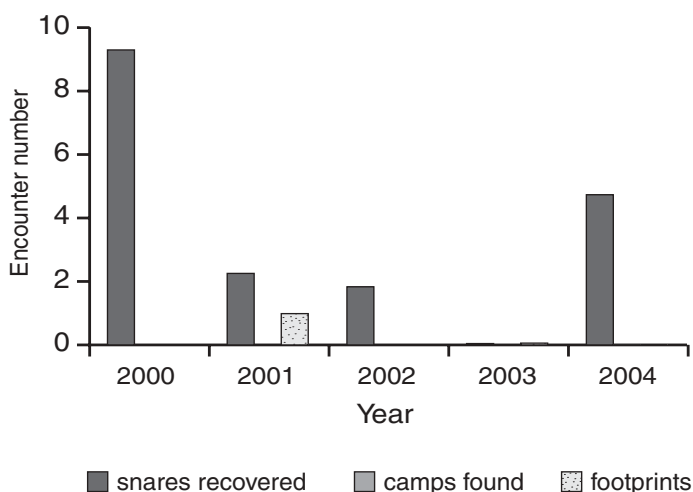


Figure 7. Encounter rate of illegal activity: minor offences per 1000 effective patrol days, 2000–2004.

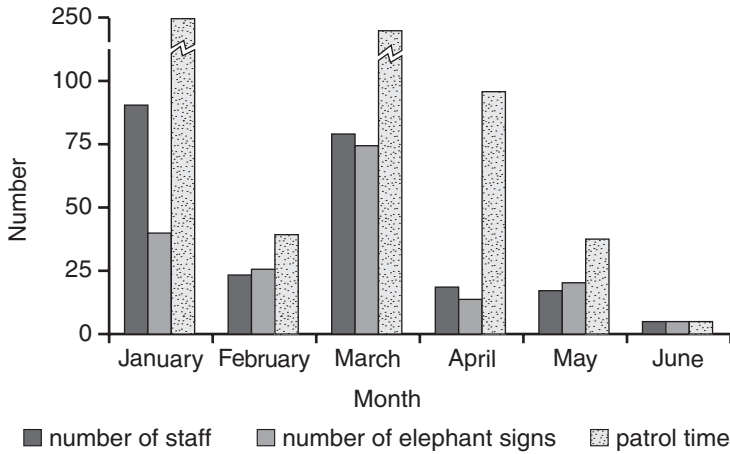


Figure 8. Detection of elephant signs related to number of field staff and amount of patrol time, January–June 2004.

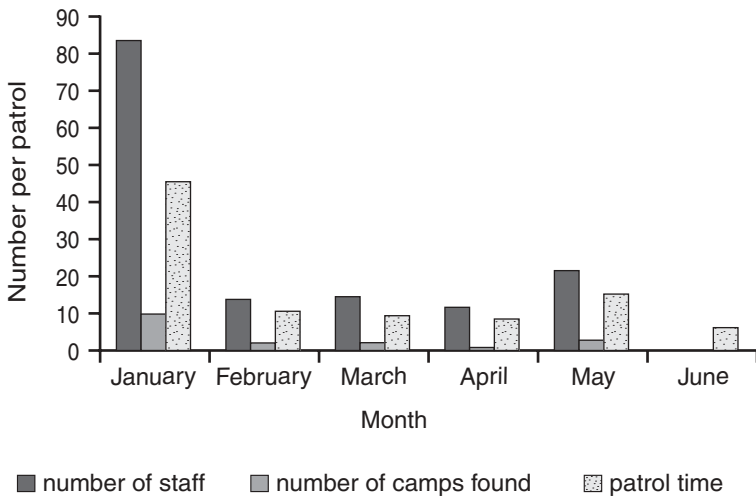


Figure 9. Detection of poacher camps related to number of field staff and amount of patrol time, January–June 2004.

population and plunder wildlife, minerals and forests. But we can still draw hope for these war-torn protected areas by looking at Uganda. Throughout the 1970s and much of the 1980s, the Ugandan government completely lost control of its parks and wildlife with highly placed government officials and security officers sponsoring elephant and rhino poaching in the parks. When peace came, much of Uganda’s wildlife and natural environment recovered, and the national government now publicly endorses conservation and promotes collaborative forest management with local communities.

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We take this opportunity to express our sorrow over the deaths of dedicated staff who died on duty in KBNP, including Méthode Ruboneka, Chimanka Baganda, Misarhi Mastaki, Masumbuko Musharamina, Kasigwa Kaboyi and recently Busasa Byanjira. Their sacrifice will not be in vain.

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The peaks and troughs of Macau's ivory trade

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Abstract

Macau, now a small, special administrative region of China, has a long history in dealing in ivory. During the early centuries of Portuguese rule, ivory items—especially religious sculptures—were traded in Macau, and some of these items could have been carved there. The boom years for Macau's ivory industry were in the mid-1980s. Astute Chinese Hong Kong businessmen took advantage of a legal loophole. Macau's officials, unlike those in Hong Kong, did not implement CITES controls on raw ivory until 1986. So these businessmen set up ivory factories in Macau to exploit this loophole with the result that in 1985 almost 100 tonnes of tusks were imported legally into Macau to be processed into various items, especially beaded necklaces for the Hong Kong market. When Macau finally conformed to CITES regulations, the ivory industry declined significantly. By late 2004 there was not a single ivory factory left and only one full-time carver. In my survey carried out in late 2004 only 21 retail outlets displaying 1718 ivory items were recorded in Macau. The retail business was slow as the main tourists to Macau, who are mainland Chinese and Hong Kong people, are more interested in gambling than buying ivory. Thus Macau is now a minor player in the world's ivory commerce.

Résumé

Macao, qui est aujourd'hui une petite région administrative spéciale de Chine, a un long passé de commerce d'ivoire. Au cours des premiers siècles passés sous la législation portugaise, les objets en ivoire, et spécialement les sculptures religieuses, étaient commercialisés à Macao, et il se pourrait que certains aient même été sculptés là. Les années glorieuses de l'industrie de l'ivoire à Macao se situent vers le milieu des années 1980. Des businessmen chinois de Hong-Kong ont en effet profité d'un vide juridique. Les officiels de Macao, contrairement à ceux de Hong-Kong, n'ont pratiqué aucun contrôle CITES de l'ivoire brut avant 1986. Donc, les businessmen ont installé des fabriques d'objets en ivoire à Macao pour exploiter cette possibilité avec comme résultat qu'en 1985, près de 100 tonnes d'ivoire ont été importées légalement à Macao pour y être transformées en objets divers, spécialement des colliers de perles destinés au marché de Hong-Kong. Lorsque Macao s'est finalement conformé aux réglementations de la CITES, l'industrie de l'ivoire a décliné de façon significative. Fin 2004, il ne restait aucune fabrique d'objets en ivoire, et il n'y avait plus qu'un seul sculpteur à temps plein. Dans l'étude que j'ai menée fin 2004 à Macao, je n'ai relevé que 21 points de vente de détail, qui proposaient 1718 objets en ivoire. Le commerce de détail était modeste dans la mesure où les principaux touristes qui visitent Macao sont des Chinois du continent et de Hong-Kong, qui sont plus intéressés par le jeu que par l'achat d'ivoire. Macao est donc devenu un acteur mineur dans le commerce mondial de l'ivoire.

History of ivory carving in Macau to 1970

Macau was an insignificant fishing village on the south coast of China until 1557 when the Portuguese were permitted by the Chinese authorities to reside there permanently (Gunn 1996). The Portuguese needed a base on the Chinese coast from which to trade. Within only 20 years of settlement, the Portu-

guese and Chinese had built 1000 houses in Macau. The main commerce consisted of gold, musk, porcelain and silk imported from Canton (Guangzhou). These goods were then sent from Macau by ship to Japan. On the return journey, silver was brought back to Macau (Gunn 1996).

In the early 17th century Macau's ships went also to Manila, especially after the collapse of Japanese trade in 1639. During this time some ivory items,

particularly religious statues, may have been brought back to Macau to decorate churches, but such early pieces no longer exist. It is doubtful that any ivory carving was done in Macau at that time.

With the end of trade to Japan, Macau's fortunes declined. But in the mid-18th century, the economy strengthened with many foreigners in Macau trading with China. The earliest ivory statues found in Macau today were made in this century. These include five statues in St Dominic's church museum such as Our Lady of the Rosary and the Lady of Dores. These and nine other ivory religious statues in this church museum that date from the 19th or early 20th centuries are thought to have been made in Macau. Others in the church museum from the 19th and early 20th century are thought to have been crafted in Goa, Manila and Portugal.

The Museum of Macau has on display three 19th-century religious ivory statues and a crucifix reportedly carved in Macau. The bishop's house has two magnificent wooden female religious statues with the hands and faces delicately carved out of ivory. The silver on them would have come from Japan.

There is controversy, however, as to whether Macau's ivory statues were actually carved in Macau. The historian Manuel Texeira, who lived for many decades in Macau, thought that most, if not all, were carved in Manila (pers. comm. 1982). The former bishop of Macau, Domingos Lam, who renovated the bishop's house in 1992 and is knowledgeable about religious statues, stated that parts of some of the statues in St Dominic's church museum were carved in Macau, as was the case with some in the bishop's house (pers. comm. 2004). According to SKS Roy, a conservator and restorer at the Museum of Macau, a Portuguese professor called Fernando Antonio Baptista Pereira had identified Macau as the country of origin of the statues in St Dominic's church museum, based on the style of carving, and he had labelled them as such (pers. comm. 2004). The head of the Museology, Conservation and Restoration Section at the Museum of Macau, Grace Lei Lai Kio, thinks that the four sculptures in her museum—two of St Francis Xavier, one of St Francis Paul and a crucifix—were made in Macau (pers. comm. 2004).

Whether or not ivory carvers were practising in Macau in the 18th and 19th centuries, and I believe they probably were, Macau's overall importance as a trading centre declined from the early 19th century, especially with the rise of Hong Kong from

the 1840s. By the turn of the 20th century, one writer described Macau as 'little more than an impoverished backwater' (Fallon 2004). Macau's economy was largely then based on opium and gambling monopolies and the production of fireworks.

During World War II Macau, which was officially neutral, was besieged by Chinese refugees from the mainland. At the end of the war, Macau's economy was strained, with most basic services in ruins and with the government having difficulties in making sure there was enough food for the greatly expanded population of almost 600,000 (Gunn 1996).

Beginning in the 1950s the economy of Macau changed. It became based on the manufacture of goods, with industrialists in Macau and from Hong Kong investing in electronics, imitation flowers, garments, plastics, textiles and toys.

Esmond Martin



Macau maintains a unique Portuguese atmosphere that attracts large numbers of visitors, the main buyers of ivory.



Esmond Martin

This religious statue in the bishop's house is over a metre tall with ivory hands and face, and silver imported from Japan.

Macau's ivory industry, 1979 to 1990

Ivory items were made in Macau in the 20th century, but it is not known exactly when Macau's modern industry started. The owner of the Min Heng Ivory Factory in Macau, who started working there in 1970, claimed that his uncle had started the factory just before World War II. He believed it was the first modern ivory factory there (Ho Fook Shing, pers. comm. 1986).

When I first visited Macau in 1979, I went to the Min Heng Ivory Factory. The workers were all born in Macau, and some had been trained by Hong Kong craftsmen who came to Macau temporarily and solely for that purpose. In 1979 there were seven workers using electric drills to make a great variety of ivory objects, such as animal and human figurines, ban-

gles, chopsticks, jewellery and name seals. None received a salary but were paid for what they produced. The most successful earned 2000 patacas (USD 385) per month while trainees earned 800 patacas (USD 154) per month. In 1982 I returned to this factory and interviewed another employee, who gave me more details. There were five permanent workers at that time. One craftsman said he had been crafting ivory in Macau since 1952. Workers earned on average 1000 patacas (USD 162) per month and the tusks all came from Hong Kong. The artisans made the same types of objects as they had in 1979 for tourists in Macau, although some items such as name seals were also exported to Japan and Taiwan. The factory sold the leftover chips and powder from the ivory carving to local people to cure indigestion (it was mixed with boiling water and drunk by people who had eaten too much spicy food, especially in the hot season). Residents did not buy them for fertilizer, a practice in Japan, as they disliked the smell.

The ivory business prospered in Macau during the 1970s and early 1980s because ivory wholesale and retail prices were lower than in Hong Kong as labour and rents were cheaper. The carving was more often of lower quality, however, than in Hong Kong and mainland China.

In the early 1980s Hong Kong and other member states tightened controls on raw ivory trading to conform with the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Although Portugal became a Party to CITES in 1981 and Macau was a Portuguese colony until 1999, the Portuguese government did not officially require Macau to implement CITES procedures until February 1986. Therefore, a small group of Hong Kong ivory traders made use of this loophole. They looked for places from where they could import tusks into Macau, such as non-CITES Parties or exporting countries with improper documentation, as it was now illegal to take these dubious tusks into Hong Kong. The tusks were processed in Macau into items such as jewellery, name seals and figurines. Then the ivory could be legally taken as worked ivory to Hong Kong. Macau was thus the perfect place as an entrepot for carving activities because it was close to Hong Kong (one of the largest ivory markets in the world), possessed skilled cheap labour, and most importantly, tusks were cheaper and could be imported without CITES documentation, unlike in Hong Kong. These cunning Hong Kong ivory traders thus took advan-

tage of Macau's laxity in conforming to CITES by not only importing tusks from dubious sources but by also setting up new ivory factories from about 1983 and expanding the existing ones (Woodrow 1988).

As a result, Macau became a huge importer of tusks in the mid-1980s. Imports of tusks rose from only 294 kg in 1981 to 23,200 kg in 1983, 42,103 kg in 1984, 97,275 kg in 1985 and 71,005 kg in 1986. Most big consignments came in from Dubai via Hong Kong (in transit) to Macau (Parker 1989). Of course, many of these tusks were from poached elephants, especially from the Democratic Republic of Congo and Tanzania. Often they were shipped from Burundi via Dubai to Macau. Exports of worked ivory from Macau to Hong Kong rose considerably from 1981 to 1986. In 1981 the export value was only USD 95,035, but by 1985 it was USD 664,486. In 1986, the peak year, it rose to USD 1,830,813. Afterwards, with the implementation of CITES in Macau starting in 1986, the official export value declined. By 1988 the figure was down to USD 827,979 (Milliken and Melville 1989).

During this ivory boom, a new factory, Un Heng Ivory, was set up in early 1985 by a Hong Kong businessman, Chou Wing Hung. At the time of my visit in January 1986 there were five full-time carvers, all from Macau; the manager, Chun Chun Cheong, was

from Hong Kong. Several of the owner's relatives also worked part time on carvings in the factory. According to the manager, the owner established his factory in Macau because of cheaper tusks—HKD 400–550/kg compared with HKD 500–650/kg in Hong Kong—and cheaper labour—HKD 50/day compared with HKD 70/day in Hong Kong for ivory craftsmen. The exchange rate at the time was HKD 7.8 to USD 1. The factory used about 4 tonnes of ivory in 1985 with most being used for making beads for necklaces. All these necklaces went to Hong Kong; none were sold locally (Chun Chun Cheong, pers. comm. 1986). The manager admitted that about 10 ivory factories (Woodrow 1988), mostly small ones with perhaps 100 craftsmen, had opened in Macau by the mid-1980s (TH Poon, Tat Hing Ivory Wares Factory, Hong Kong, pers. comm. 1986).

Another new ivory factory, the Song Heng Cong Ngai, was opened in 1983 by the Poon family, well-known Hong Kong ivory traders. During my January 1986 visit, there were 13 artisans making mostly ivory beads for necklaces. In this factory, the artisans put small pieces of ivory into a vice and lowered an electric machine with a rotating head onto the vice to make the ivory pieces spherical. They then put the rough beads into a tumbler with ivory powder and water to



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Some of Macau's oldest ivory sculptures are exhibited in St Dominic's church museum.

improve the finish. Next they put wax on a cloth that was spun across the beads to make them shiny. If the beads were brownish, the artisans used hydrogen peroxide to bleach them. Most beads were made from 'white' or soft ivory (from the savanna elephant) because it was cheaper than 'yellow' or hard ivory (from the forest elephant). The craftsmen also made bracelets and earrings. All the items were exported to Hong Kong (Ching Cheong, supervisor, Song Heng Cong Ngai, pers. comm. 1986).

I returned to the Min Heng Ivory Factory in early 1986, my third visit to this factory, and business had picked up considerably since its earlier slump in 1982. There were now 7 full-time craftsmen, but when business was good the manager hired up to 20 more artisans. Salaries had gone up from 1982 to 1986 by 50%, and the artisans were earning around USD 256 a month, further illustrating that ivory carving was booming in the mid-1980s. They were paid a salary rather than paid per item as this allowed them to produce higher quality items rather than rush their work.

In January 1986 the largest factory in Macau was the Luen Fat Ivory Factory, which had been established in 1979 by another Hong Kong businessman. The factory started with 3 or 4 workers, but beginning in the middle of 1981 business greatly expanded, until by early 1986 there were 35 artisans. Men carved netsukes and Japanese-style figurines (90% of the output) while women smoothed and polished the items. They received a monthly salary; experienced carvers could get HKD 1800 (USD 225) a month. The owner preferred to buy 3-kg tusks (USD 45/kg) for making figurines, but he sometimes bought 7–8-kg tusks for bracelets and 12–13-kg tusks for chopsticks (Lo Sun Vo, supervisor, Luen Fat Ivory Factory, pers. comm. 1986).

The Van Heng Silverware and Ivory Company was set up in 1985 in Macau by a man from Hong Kong (where he also was involved in a business called the Yan Kee Ivory Company). This company imported tusks for carving and also imported ivory items for retail sale that had been made on the China mainland. The manager stated that they imported tusks into Macau from African countries that had no CITES permits, especially from the Democratic Republic of Congo, and also tusks that had CITES permits from Hong Kong. Tusks with no CITES permits were bought by the company for 10–15% less. The company sold these tusks wholesale for USD 40/kg for 1-kg tusks, USD 58/kg for 3–5-kg tusks, and USD 100/kg for 10–30-kg tusks. The manager admitted that

business was prospering in Macau now that Hong Kong could only import tusks with CITES permits. Carvers in Macau were producing many ivory items that Hong Kong businessmen came to Macau to buy.

Government authorities in Macau were fully aware of the activities of the Hong Kong ivory traders then working in Macau. But the CITES Secretariat was unaware of this expansion until it was fully operative. The Secretariat then was extremely concerned. In October 1985 the CITES Secretariat reported to the CITES Standing Committee 'increasingly large volumes of "illegal" trade in rhino horn, musk and ivory were being routed to Hong Kong via Macau' (Reeve 2002). By 19 December 1985 the Macau government reacted to the criticism and said they would only allow the import of tusks that had been sanctioned by CITES. On 10 January 1986 four large containers of ivory originally from Tanzania weighing 35,000 kg shipped from Singapore to Macau were refused entry into Macau (António Pinho, Director, Economic Services, Macau government, pers. comm. 1986).

Macau, however, still had not conformed fully with CITES, so the Secretariat decided to take action in January 1986. On 16 January the Secretariat urged Parties to 'prohibit or prevent trade with or through Macau and any specimens of species included in the CITES Appendices'. Soon afterwards the Secretariat sent a mission to Macau. The Macau government responded almost immediately by announcing that CITES was to come into force on 22 February. Therefore, three months later the CITES Secretariat rescinded its January request to the Parties to ban all trade in CITES-listed species to and from Macau (Anon. 1986, 1987; Reeve 2002).

In early 1986 the Macau government carried out its first registration of raw ivory in stock in Macau, but only for full tusks (Macau, Government 1986). Twenty-nine companies declared 2374 tusks weighing 22,034 kg. By far the largest quantity was registered under Tat and Company Ltd belonging to the wealthy Poon family: 933 tusks weighing 15,305 kg. The next largest was declared by Lung Fung Hong Company: 83 tusks weighing 386 kg (Arnaldo Correia, Department of Commerce, Macau government, pers. comm. 1987).

The implementation of CITES in Macau had drastic effects on the local ivory industry. Many workers lost their jobs, and factories went out of business. The Song Heng Cong Ngai factory, owned by the Poon family, closed down in April 1987 and moved to the



The Lisboa Hotel displays several magnificent ivory carvings in its public areas.

United Arab Emirates with many of its workers; other ivory craftsmen left Macau to work in Dubai. By December 1987 when I was again in Macau, some of the workers were returning as they could not cope with Dubai's heat or food. Finally in late 1989 the United Arab Emirates authorities closed down all the ivory factories (Martin 1992).

The Luen Fat Ivory Factory in Macau, however, was still in business in December 1987, but there were fewer craftsmen, earning HKD 2000 (USD 250) a month, and making mostly figurines that went to Hong Kong or were sold to tourists in Macau. The Un Heng Ivory Factory was also still in business. I saw seven workers, mostly women, semi-processing beads for necklaces that were sent elsewhere in Macau for finishing. They were also producing name seals and cigarette holders. The employees were complaining that business was not good.

Macau's Department of Commerce (pers. comm. 1987) did not know where these new ivory items were going nor who was buying them. They were supposed to provide export licences, but none had been issued. As not enough tourists came to Macau to buy all the ivory items produced there, they realized that many items were being smuggled, probably into Hong Kong and mainland China. The Hong Kong Department of

Agriculture and Fisheries, responsible for Hong Kong's ivory trade controls, agreed with this view (pers. comm. 1987).

On 20 November 1989, as a further step to improve controls on the ivory trade, the first detailed registration was implemented of both raw and worked ivory stocks in Macau. This was at a time when many countries had just brought in national laws prohibiting the import and export of ivory. Twenty-five companies registered a total of 17,734 kg of ivory—10 companies with 773 kg of full tusks, 17 companies with 13,484 kg of pieces, 12 companies with 1439 kg of semi-finished products and 22 companies with 2037 kg of worked items (Macau, Government 1989).

In January 1990 the CITES prohibition on commercial imports and exports of ivory came into effect for all CITES member states, including Macau. This international legislation finally ended Macau's brief importance in the world's ivory trade.

Government controls on the ivory trade in Macau since 1990

After the CITES ban on international trade in ivory in 1990, no new ivory was allowed to be imported into nor exported from Macau in any form. Never-

theless, some traders smuggled in ivory. From 2002 to 2004 three consignments were confiscated. In March 2002 a man from Macau attempted to smuggle in 61 small pieces of ivory, weighing only 1 kg in total, overland from mainland China. He was arrested and fined 2000 patacas (USD 250). In July 2002 another person from Macau was arrested in a shop, having smuggled in 17 pieces of ivory from Hong Kong. He was fined 750 patacas (USD 94). In April 2003 2 people from mainland China were intercepted on a ship trying to smuggle into Macau 52 pieces of ivory weighing 175 kg. They were arrested and fined 5000 patacas (USD 625). Most wildlife product seizures are carried out by the Customs Department. The penalties for dealing in illegal wildlife commodities are fines from 500 to 5000 patacas (USD 63–625) (Lo Pui Kei, Acting Head of Division, Macau Economic Services, Foreign Trade Division, Government of the Macau Special Administrative Region, pers. comm. December 2004).

In most circumstances the personal possession and commercial sale of raw and worked ivory within Macau is legal on the basis that most of it predates the 1989 ban. There is little evidence of recent imported ivory. All shops need business licences from the government, but no special one is required for vendors selling ivory, nor for the ivory items themselves. The government has an inspection team to check shops, but it rarely examines antique or gift shops as these are not thought to be a problem. Instead the inspection team concentrates its efforts on the very large shops with textiles and foods (José Oliveria, head of Investigations Department, Macau Economic Services, pers. comm. December 2004).

Macau's retail ivory trade in 2004

Towards the late 1990s, wealth grew further in Macau, with tourism steadily increasing along with a booming gambling industry (Macao Special Administrative Region 2004a). By 2003, 11,887,876 visitors came to Macau: 48% from mainland China, 39% from Hong Kong and 9% from Taiwan (Macao Special Administrative Region 2004b). Gambling and shopping were, and still are, the main attractions. Thus from 2000 to 2005 Macau's economy expanded phenomenally. The per capita income grew 10% in 2002 and 15.6% in 2003, one of the highest in the world. By 2003 the per capita income was almost USD 18,000, making Macau's 450,000 inhabitants some

of the richest in Asia. Had tourist and local demand for ivory items in Macau thus expanded?

In December 2004 I therefore again surveyed Macau's ivory industry and found that there were no ivory factories remaining and only one full-time ivory carver was still practising. This man, Heong Ka Wa, came to Macau in 1994. Born in Hubei Province in China in 1938, he learned his profession there and taught students how to carve very small ivory figurines; also he had taught calligraphy. He moved to Macau to join members of his family and continued this work. In 2004 he was buying very small pieces of ivory for USD 31/kg to carve his mini-figurines. He also sometimes bought 1-kg pieces for USD 250/kg to make into name seals and sculptures. During the last few years he has used just less than 1 kg of ivory per year. His workshop, where he also sells his items, is near the ruins of the 17th-century church of St Paul. In December 2004 he had on display 159 ivory items, the most numerous being pendants (55), name seals (52) and miniature figurines (34); he also displays his calligraphy work. His ivory miniatures are usually about 1 cm high and 0.8 cm wide and sell for USD 38 to people from Japan, Hong Kong, Macau, Singapore and Taiwan. He sells standard size name seals with carved hallmarks for USD 25 to USD 63 to customers from Japan, Macau, South Korea and Taiwan.

I then surveyed the whole of Macau, known as the Macau Special Administrative Region, for the ivory retail trade: the peninsula and the islands of Taipa and Coloane. I found 21 retail outlets displaying 1718 ivory items, a fraction of the 37,948 that I counted in Hong Kong in late 2004. There were 4 shops in hotels and 16 more in the main shopping area of the peninsula, 7 of which were on Rua de S. Paulo; one in a hotel on Coloane island and none on Taipa island. Of these 21 retail outlets, 11 were gift shops, 9 were antique shops and one was a combined workshop and gift shop (Mr Heong's). Most outlets were small compared with those in Hong Kong, displaying only a moderate number of ivory items: 82 on average compared with 422 in Hong Kong, surveyed also at this time.

All the shops were Chinese-run except for two Indian ones. One was an antique shop in a hotel that sold Indian works of art but also Indian ivory items made before 1990. There were 111 miniature paintings on thin pieces of ivory illustrating traditional Mogul Indian scenes (dancers, battles, parades and



Heong Ka Wa, the last full-time ivory carver in Macau, specializes in carving miniature ivory items.

gardens) and Renaissance-style paintings. There were also 46 typical Indian bangles and five sculptures, the largest being a 40-cm-tall elephant with three men in a howdah. One other shop owned by an Indian was also selling pre-1990 Indian ivory: 47 bangles and 8 necklaces, among other items.

There were at least 289 older objects (made before 1990) going back to three supposedly 18th century pieces: part of a religious statue, a traditional Chinese musical instrument and a card holder. Of these older items 38% were Indian paintings, 32% bangles, 14% figurines and 4% necklaces; 89% were made in India and 11% were made in Hong Kong, Macau and mainland China.

Of the new and old ivory items in Macau that I had time to identify by type, the most common were human and animal figurines (33%), bangles (16%), pendants (10%) and rings (10%) (table 1). Most of these (86%) were from Hong Kong, Macau and mainland China with the rest from India.

Prices of these ivory items varied hugely depending on the shop and on the quality, age and origin of the item. As these items were relatively few and widely variable it was not possible to produce a meaningful average price. For example, name seal prices ranged from USD 10 to USD 188 and 1-cm-thick ban-

Table 1. Types of ivory seen for retail sale in Macau in December 2004

Item	Percentage
Figurine	33
Bangle	16
Pendant	10
Ring	10
Painting	7
Name seal	7
Necklace	5
Earring	4
Miscellaneous	8
Total	100

gles from USD 10 to USD 100. The Indian paintings on ivory varied hugely depending on quality. A 20 x 10 cm miniature of the Virgin and Child was USD 25 as it was so poorly painted, while a 25 x 15 cm portrait of a woman wearing a sari inlaid with real pearls and red stones was USD 4200, both after 35% discounts. Figurines carved in the region mostly in the 1980s that were 2.5 cm high cost USD 23 while the Indian elephant with a howdah mentioned earlier was USD 49,800 after a 20% discount.

The main customers for these ivory items in Macau are Americans, Europeans, Japanese and Tai-

wanese. Chinese from the mainland rarely buy ivory items in Macau, but instead choose diamonds, gold and watches.

Conclusion

Macau has had a long tradition in ivory, but this may be coming to an end, despite its booming economy. The flourishing period for ivory carving was in the mid-1980s when there were several large ivory factories producing thousands of items a year, mostly for the Hong Kong market. With the introduction of controls on the Macau ivory trade in the mid-1980s and the ban on international ivory trade in 1990, all the large factories had closed down by the early 1990s. In 2004 only one craftsman was active although there may have been one or two others working part-time.

There is no economic incentive to try to smuggle tusks into Macau for domestic use as the one active carver uses less than a kilo of ivory a year. Theoretically, Macau could become an entrepot for tusks moving to mainland China, but this is unlikely as the Chinese smuggle it in directly and prefer to avoid transit points where there are reasonable controls at the international boundaries, as is the case now with Macau.

Retail sales of ivory items in Macau are slow, partly because a greater variety of ivory objects for the tourist is available in Hong Kong and Guangzhou. Only if Macau's gambling sector expands to attract many more Japanese, Taiwanese, South Koreans and Malaysians, who still like to buy ivory, might the ivory industry revive for retail sales of the 1700 or so remaining items on display. The locals are not presently interested in buying ivory, despite their increase in wealth.

Presently controls on internal sales on ivory items are minimal, but adequate, as there is only a small turnover in ivory; thus additional government paperwork is not required. But if demand were to pick up, another stock-taking of ivory would be helpful to deter newly made items from mainland China being imported illegally and sold to tourists in Macau. For now, however, Macau's ivory market is small and not a threat to elephants in Africa and Asia.

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Are we winning the case for ivory substitutes in China?

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Abstract

The main manufacturers of objects made of ivory, and nowadays ivory substitutes as well, are in mainland China. Following the 1990 CITES ban on international trade in elephant ivory, carvers and dealers in China, including Hong Kong and Macau, had to find alternative materials. They tried several animal and vegetable products, such as tagua nuts, but they were unpopular and uneconomic so they stopped using them. Objects made from buffalo, camel and cow bone, and hippo teeth are still being used. They are inexpensive compared with elephant ivory but have been accepted for carving items, especially at the lower end of the market. In the mid-1990s businessmen in Hong Kong and south-east China started to import fairly large quantities of mammoth tusks from Russia. The Hong Kong traders sent them to Guangdong and Fujian Provinces for carving as labour was much cheaper there than in Hong Kong or Macau. Although there is considerable wastage in mammoth tusks, and they are a harder material than elephant ivory, thousands of items are now being made from mammoth ivory both for sculptures on the high end of the market and for curios that are relatively cheap. Customers, especially from the USA and western Europe, are attracted to mammoth ivory because it looks similar to elephant ivory and is thousands of years old. The trade in mammoth ivory has continued to expand and should be encouraged, especially for expensive items. It decreases the demand for elephant ivory, which in turn reduces the pressure to poach elephants.

Résumé

Les principaux fabricants d'objets en ivoire, et aujourd'hui en substituts d'ivoire également, se trouvent en Chine continentale. Suite au ban décrété en 1990 par la CITES sur le commerce international d'ivoire d'éléphant, les sculpteurs et les revendeurs qui vivaient en Chine, y compris Hong-Kong et Macao, ont dû trouver une matière alternative. Ils ont essayé plusieurs produits d'origine animale et végétale, comme les noix de tagua, mais elles étaient impopulaires et peu économiques et ils cessèrent donc de les utiliser. Des objets en os de buffle, de chameau ou de vache, et en dent d'hippopotame sont toujours utilisés. Ils ne coûtent pas cher comparé à l'ivoire d'éléphant, mais ils ont été bien acceptés, spécialement au niveau le plus bas du marché. Au milieu des années 1990, les hommes d'affaires de Hong-Kong et du sud-est de la Chine se sont mis à importer d'assez grandes quantités de défenses de mammoths de Russie. Les commerçants de Hong-Kong les envoyaient dans les Provinces de Guangdong et de Fujian pour les sculpter étant donné que la main-d'œuvre y était beaucoup moins chère qu'à Hong-Kong ou Macao. Bien qu'il y ait beaucoup de déchet dans les défenses de mammoths, et qu'elles soient un matériau plus dur que l'ivoire d'éléphant, des milliers d'objets sont désormais fabriqués en ivoire de mammoth, aussi bien pour des sculptures vendues sur le marché haut de gamme que pour des curios qui sont relativement bon marché. Les clients, spécialement ceux des USA et d'Europe, sont attirés par l'ivoire de mammoth parce qu'il ressemble à celui d'éléphant et qu'il a des milliers d'années. Le commerce d'ivoire de mammoth continue à augmenter et il faudrait l'encourager, spécialement pour les objets de luxe. Cela permet de réduire la demande d'ivoire d'éléphant, ce qui réduit la pression sur le braconnage des éléphants.

Introduction and methodology

For elephant poaching to lessen, not only must elephants be well protected and managed in the wild,

but also demand for their tusks must be reduced. One of the best ways is to encourage substitutes and win acceptance for materials that can take the place of elephant ivory.

The CITES ban on the international trade in elephant ivory that came into force in January 1990 caused many carvers and businessmen to lose their livelihoods in Europe, Africa and Asia. However, some of the more enterprising of these people decided to seek alternative animal products to craft. The most successful endeavours with ivory substitutes have been in south-east China, especially in Guangdong and Fujian Provinces.

As no academic study had been carried out on the craftsmen and businesses using substitute materials for elephant ivory in eastern Asia since the 1990 ivory ban, I visited Hong Kong, Macau, Guangzhou (the capital of Guangdong Province) and Fuzhou (the capital of Fujian Province) in November and December 2004. I surveyed shops for ivory and its substitutes, and interviewed craftsmen, sales persons, and owners and managers of factories producing items made from animal products. I also held discussions with government officers in Hong Kong and Macau.

I limited my research to those substitutes for elephant ivory coming from such animals as cattle, buffalo, camels, hippos and, most importantly, mammoths, avoiding synthetic substances such as plastics and resins because elephant ivory carvers do not like to use them. Little creative ability is needed for producing items out of synthetic materials. They have been used for many years but have not found general acceptance because they look cheap and artificial.

I start here with the status of the elephant ivory business in Hong Kong, Macau, Guangzhou and Fuzhou. This is necessary to understand the background of the ivory substitute business. Then I focus on the main substitutes: cow, buffalo and camel bones, hippo teeth, and mammoth tusks.

Results

Elephant ivory

HONG KONG

Hong Kong is still one of the largest elephant ivory markets in the world. In June 2004, Hong Kong traders reported to the government that they had stocks amounting to about 260,000 kg of raw and worked ivory in their possession. At that time, there were 677 registered ivory traders, slightly up from 664 in 2002; 822 commercial ivory possession licences had been issued, again up from 781 in 2002. Under the official personal effects exemption from 2002 to June 2004, only 35 kg of elephant ivory were officially exported, and 51 kg imported (Hong Kong Special Administrative Region, Agriculture, Fisheries and Conservation Department, unpublished statistics, 2004). In addition, other ivory, both raw tusks and worked items, was illegally exported, but statistics do not exist on these quantities.

In 2004 it was extremely difficult to obtain the price for raw elephant tusks as few were sold, although traders said that it remained roughly the same as two years earlier when a 5-kg tusk changed hands for USD 200/kg and a 10-kg tusk for USD 320/kg.

Elephant ivory items offered for sale in Hong Kong in December 2004 numbered 37,948 among 80 retail outlets (table 1), which are similar figures to those from a comparable survey made in 2002: 35,884 items in 85 retail outlets (Martin and Stiles 2003). There were, however, no full-time carvers working in elephant ivory, because the cost of labour in Hong Kong is much higher than on mainland China. For instance, if a businessman wished to hire an ivory

Table 1. Economic indicators, 2004

Site	Wholesale prices, elephant tusks (USD)		Retail elephant ivory (no.)		Wholesale prices, mammoth tusks (USD)		Retail mammoth ivory (no.)	
	1–3-kg tusks	10-kg tusks	Outlets selling	Items for sale	Grade A	Grade B	Outlets selling	Items for sale
Hong Kong	200	320	85	35,884	275	225	29	11,282
Macau	250	–	21	1,718	–	–	4	151
Guangzhou	–	–	72	4,406	–	–	17	3,064
Fuzhou	316	–	39	737	364	243	2	6

– no data



Ornaments made from bone are for sale in large quantities in Hong Kong.

carver in Hong Kong, he would have to pay him between USD 1000 and 2600 per month, depending on his skills, whereas on the mainland a carver would earn as little as USD 85 a month if he had only recently been trained, and up to USD 700 if he were a master carver. Nevertheless, there are a few craftsmen in Hong Kong, who are occasionally asked to repair ivory items.

Types of items for sale in Hong Kong in 2004 included bangles for USD 57 each, 15-cm coloured cabbages for USD 1442, name seals for USD 71, beaded necklaces for USD 70, netsukes for USD 107, 5-cm pendants for USD 10, and a 25-cm carved tusk for USD 1600. There was a range of small sculptures: humans of 5 cm for USD 45 or 12 cm for USD 498, and animals of 2.5 cm for USD 28, or 4 cm for USD 31, or 7 cm for USD 114.

MACAU

Macau's elephant ivory trade is small in comparison with Hong Kong's. There has been only one official stock-taking of both raw and worked elephant ivory,

which was in November 1989, just before the CITES ban. At that time, there were 773 kg of raw tusks, 13,484 kg of pieces, 1439 kg of semi-finished objects and 2037 kg of finished objects, totalling 17,734 kg. Twenty-five companies registered their stocks (Macau 1989).

Only one full-time ivory craftsman was found in December 2004, in a small shop on a street leading to the ruins of Sao Paulo cathedral. His name is Heong Ka Wa and he was born in 1938 in Hubei Province, where he studied painting and calligraphy. He became a specialist in miniature sculptures and engraving Chinese classical literature on tiny pieces of ivory. He moved to Macau in 1994. In 2004 he purchased very small pieces of ivory at USD 31/kg for making miniature sculptures and 1-kg pieces at USD 250/kg for making name seals and small sculptures. Over the past several years, he has used only about a kilogram of ivory in a year. He was probably the only full-time ivory craftsman in Macau at the time, but there could have been a couple of other part-time carvers.

In December 2004, there were 21 retail shops offering for sale 1718 ivory items. The shop with the

most had 557 objects, mostly necklaces, pendants, rings and small sculptures. In USD, there was a bangle for 10, cigarette holder for 87, beaded necklace for 44, netsuke for 186, and a 5-cm pendant for 23. There were small animal sculptures of 2.5 cm at USD 20 and 9 cm at USD 75.

GUANGZHOU

Ivory carving is still active in and around Guangzhou. The number of craftsmen could not be established because many of them work secretly at home in the suburbs and were illegally doing business. I counted in the government-owned Daxin Ivory Carving Factory in Guangzhou 15 craftsmen carving elephant ivory. One master craftsman was making a 50-layer Cantonese ball from a 20-kg ivory tusk.

In early 2002 there had been 21 retail outlets carrying 3855 ivory items in Guangzhou (Martin and Stiles 2003). In December 2004 there were 72 retail outlets displaying 4406 ivory items; 43 of these were small so-called antique shops. With the easing of some restrictions on private enterprises since 2002, more people have opened these shops where they are displaying ivory items, mostly new pieces. They generally have few old ivory items: an average of fewer than 10 per shop, totalling 382. Almost all these old items had been made in China, and the most common were small sculptures (15% of the total), cigarette holders (10%), name seals (8%), arrows (6%), bangles (6%), chopsticks (6%), pendants (6%) and rings (4%).

Of the 4406 old and new ivory items seen in Guangzhou at the end of 2004, the most numerous were pendants (31% of the total), sculptures (27%), other jewellery (10%) and name seals (10%).

Prices were usually less than in Hong Kong. Types of items for sale in Guangzhou included bangles for USD 23, chopsticks for USD 139 a pair, a small cigarette holder for USD 24, name seals for USD 48, beaded necklaces for USD 39, 5-cm pendants for USD 13. There were small animal sculptures of 2.5 cm for USD 27 and of 7 cm for USD 70.

FUZHOU

The number of ivory craftsmen has fallen in this city since the 1990 CITES ivory ban. A few craftsmen were working on ivory sculptures in a large factory, specializing in cow-bone carvings when I was there.

The factory owner bought elephant tusks from government stock, ivory that apparently the government had confiscated. In November 2004 he paid USD 316/kg for 115 kg. If he bought from private people, he claimed he would have had to pay up to USD 485/kg for a 1-kg tusk and up to USD 728/kg for a 5-kg tusk.

Fuzhou is smaller than Hong Kong or Guangzhou with a population of 1,600,000; unlike Hong Kong, Macau and Guangzhou, it attracts few foreign tourists, who are the main ivory buyers. The Chinese in this city are not interested in buying ivory, and there were only 39 shops with 737 ivory items. These objects had mostly been made in Fuzhou in the last 15 years or so. Name seals were most numerous (45% of the total), followed by sculptures (15%), pendants (12%) and cigarette holders (6%). Most of the items were inexpensive compared with those in Guangzhou and Hong Kong. The most expensive item found in Fuzhou was a pair of recently carved tusks for USD 6553, as opposed to Hong Kong where a new sculpture can go for USD 100,000. There were bangles for USD 31, chopsticks for USD 73, small cigarette holders for USD 26 and medium ones for USD 46, name seals for USD 25, beaded necklaces for USD 41, and 5-cm pendants for USD 6. There were small human sculptures of 5 cm for USD 64 and of 12 cm for USD 388.

The main retail buyers of ivory items in Fuzhou are Taiwanese and Japanese, but it is highly unlikely that a Japanese would risk taking a large new ivory carving back home.

Cow, buffalo and camel bones

HONG KONG AND MACAU

Cow, buffalo and camel bones have been used for carving in China for centuries. Since labour is more expensive in Hong Kong and Macau today, craftsmen there do not use these materials. Certainly none of the former ivory craftsmen switched to making items from any bones.

Large quantities of bone carvings made elsewhere in China are for sale, especially in Hong Kong. Superficially they look like ivory, but are cheap. The quality of their carving is poor because little effort is put into the workmanship since bone is not valuable. Only tourists buy them. Examples of items for sale in Hong Kong included a 15-cm coloured cabbage for USD 128, an 8-cm human figurine for USD 38, and a 6-cm animal figurine for USD 8–16. In Macau, 15-



Cow bones are small compared with elephant tusks; thus many bones are glued together to produce large items.

cm human figurines were about USD 20 and 2.5-cm animal figurines USD 6.

GUANGZHOU

The Guangzhou area is one of the main centres for making carvings out of bone. A large factory that I visited on the city outskirts had 80 craftsmen, and it also had a retail outlet with a small workshop employing 10 additional craftsmen in a tourist area. The factory manager purchased his camel bones from north-west China, mainly in Xinjiang Province. His cow and buffalo bones came from various other places. The craftsmen believe there is not much difference between camel and cow bones, but because the latter are more common they make up almost 90% of the total used.

Cantonese do not like working animal bones because they smell and produce a lot of dust when cut on machines. People from poor areas of China are brought into this factory to work on the bones; they receive 1000–2000 yuan (USD 121–242) a month. They make small items since the bones are thin and

hollow. When they need to make a large item, they glue pieces of carved bone together.

Of the 325 finished bone items for sale in the retail outlet mentioned above, 70% were sculptures, 8% pendants and 7% necklaces. Most were bleached white, but some were stained dark (using coffee) or painted. A painted cabbage 15-cm long cost USD 67, a 7-cm elephant was USD 30, a 12-cm tall human figure USD 24, a comb USD 7 and a bracelet USD 3. A more expensive item made from cow bone was a 30-cm tusk consisting of many individual pieces, and it was priced at USD 874. An exceptionally large, 180-cm tusk made of camel bone, with figures on it, which had taken 10 craftsmen almost a year to make, was priced at USD 14,320.

To illustrate the difference in prices, chopsticks here were USD 182 for those made of elephant ivory and USD 4–12 for those of cow bone. The manager told me that he has an office in the United States to facilitate his sales of bone items there, which is his main market. He also exports them to France, Germany and Spain.



Huge imitation tusks made of cow bones are often displayed in Chinese shops to attract customers.

FUZHOU

At the Neolithic site of Hemudu in Zhejiang Province, adjacent to Fujian Province, 20 ivory carvings dating back to 5000 BC have been found. Partly due to the shortage of minerals and precious stones, Fuzhou developed a major crafting industry based on wood, lacquer ware, elephant ivory, buffalo horn and various bones. Wood carving may be the oldest. In the Tang Dynasty (618–907 AD), wood craftsmen in Fuzhou carved images of gods and decorated baldachins (ceremonial canopies) and Buddhist temples, according to information from the Fujian Provincial Museum. This carving tradition has continued over the years in Fuzhou.

There were two large carving factories in Fuzhou in December 2004, and another five elsewhere in the province. I visited the two in Fuzhou; one used mammoth ivory and the other bone, the latter having switched from elephant ivory in 1990 after the CITES ban. In 2004 the factory obtained cow bone from Sichuan Province, the manager saying it was the best quality. Classified according to three types, per tonne, ‘circle bone’ costs USD 971, ‘triangular bone’ USD

765, and ‘rib bone’ USD 607. The factory employs 70 people on its premises and 30 who work elsewhere, mostly from home. At the time of my visit 48 craftsmen were working in the factory. About two-thirds were working on cow bone and one-third using elephant ivory and mammoth ivory. No camel bone was used. The factory consumes about 50 tonnes of cow bone a year.

The process of making a cow-bone carving in this factory is as follows: the bone is first cooked in hot water to eliminate the oil in it. Afterwards, it is cut into pieces of desired sizes and sanded down. A craftsman uses machine tools to shape the item, then another one uses engraving tools for details. When finished, the bone is bleached, dyed or painted. Many small items are made using this process. When a large item is wanted, the pieces of cow bone are glued onto a wooden mould for support. The main large cow-bone carvings are replicas of elephant tusks—Americans, Europeans and Chinese buy them, the latter to put in their shops to impress customers. The other large cow-bone items are usually figures of gods, which Americans and western Europeans occasion-

ally purchase. The factory's wholesale markets are mainly in the United States (60%), and Europe (30%), with lesser quantities going to Japan, Thailand and Malaysia. Only a small amount is bought by Chinese.

Hippo teeth

HONG KONG

Hippo teeth are not good for carving because they are too hard and crack easily. To illustrate this, when Ian Parker was culling hippos in Uganda from 1964 to 1967 to reduce the population, he removed the lower jaws and put them into the Nile for the flesh to rot. He then extracted the teeth and put them on the ground in the shade, intending to examine them later to age the animals. However, within a short period he heard loud noises, similar to pistol shots—made by cracking teeth (Ian Parker, pers. comm. 2005).

Nevertheless, after the CITES ban, Hong Kong businesses imported an annual average of 17,063 kg of 'other ivory excluding mammoth ivory' between 1992 and 2000, according to statistics provided by the Hong Kong Census and Statistics Department (Hong Kong 1993–1997, 1998–2001). Government officers told me that this category of 'ivory' was almost entirely hippo teeth, although a few warthog tusks may have been included (Hong Kong Special Administrative Region, Agriculture, Fisheries and Conservation Department, pers. comm. 2004). Since the Hong Kong figures for this category show that Uganda and Tanzania were the main exporters, and both these countries had large hippo populations during this period, this supports the Hong Kong government's view that the 'ivory' was hippo teeth.

From 2001 to 2003, the annual quantity of hippo teeth and perhaps a few warthog tusks imported into Hong Kong declined to 10,472 kg, mainly due to the fact that mammoth tusk imports increased considerably because they had been recognized in China as a better material for carving. The declared import value for these three years averaged USD 20/kg, and again the exporting sources were Uganda

and Tanzania (Hong Kong 2002, 2003, 2004). The average wholesale price in Hong Kong for the better quality teeth was USD 38/kg.

Almost all the hippo teeth were re-exported to mainland China to be made into a great variety of items and then sent back to Hong Kong for sale both locally and abroad. In late 2004, at least 11 Hong Kong shops had on display a minimum of 1089 hippo-tooth objects. Most of these were netsukes and small sculptures. Hippo teeth rarely weigh more than 2 kg each, and when something large is made from them, several are glued together. I saw a 180-cm-long barge made from hippo teeth, priced at USD 120,000, but this was certainly an exceptional work.

Most of the netsukes and small sculptures, around 6 cm in size, had a retail price between USD 20 and



Esmond Martin

Mammoth tusks have their own unusual shape and can be easily recognized in the raw form from elephant tusks.



Mammoth tusks are often larger and heavier than elephant tusks, and the big ones are prominently curved.

USD 50. Although not especially well carved, they were nicely polished, creamy in colour and shiny in appearance. A large hippo tooth, 20-cm long with carved figures on it was offered for USD 269. A statue of a Chinese emperor, 30-cm tall, made of pieces of hippo teeth, was priced at USD 5385.

GUANGZHOU

One of the main factories producing carvings in Guangzhou today was started by a businessman from Hong Kong who came to Guangzhou in 1990 to set up a factory. He hired 10 apprentices whom he taught to carve tagua nuts; he had trouble selling these, so he then bought wood and cow bone for his apprentices to use. The items made from these materials were not profitable either. So he decided to try hippo teeth for the carvings, found it sold better, and continued with it until 1997, when he started using mammoth tusks, realizing they were far superior. Several other factories in Guangdong Province with Hong Kong connections tried the same alternatives to elephant ivory and had similar experience.

FUZHOU

The two large factories I visited in Fuzhou used hippo teeth for carving in the 1990s, but both switched to alternative materials as sales in hippo-tooth items were poor. One of the factories is still trying to sell its hippo-tooth items and is having difficulty selling the large ones. For example, there was a sculpture entitled *Queen of the Gods*, 150-cm tall and 90-cm wide, priced at USD 24,272, but the manager said that if it had been made of mammoth tusk instead, he could have easily sold it for twice the price.

Mammoth tusks

HONG KONG

Fewer than 10 craftsmen in Hong Kong were working with mammoth ivory in 2004. They used small pieces for calligraphic engraving of names, proverbs and poems. However, Hong Kong is the major entrepot for mammoth tusks and has become the world's largest wholesale and retail market for mammoth ivory carvings. The tusks originate mainly in the tundra of Russia and Alaska, and especially those from Russia are shipped via Hong Kong to mainland

China for carving. In 2002 Hong Kong traders imported 20,022 kg of mammoth tusks, of which 16,696 kg came directly from Russia. In 2003 imports totalled 15,997 kg, and from January to September 2004 the amount was 13,995 kg. The declared import value rose from USD 54.73/kg in 2002 to USD 77.44/kg in 2003 and USD 98.61/kg for the first nine months of 2004 (Hong Kong Special Administrative Region, 2003 and 2004) due to increased demand.

In 2003, the last full year for which statistics are available, over 98% of the mammoth tusks were re-exported from Hong Kong to mainland China. There they were carved into various items that were in turn either exported wholesale to the USA and Europe and a few other destinations or sent back to Hong Kong for sale. The wholesale dealers in Hong Kong sent their items mainly to the USA, but also to France and other western European countries. Some shop owners claimed that Americans bought retail as much as 70% of their stock. The other purchasers were Europeans. In late 2004 there were 29 shops offering for sale a minimum of 11,282 mammoth ivory items. The greatest number in any one shop was 3192. The most common items were netsukes and sculptures; little jewellery was made from mammoth ivory.

Prices were almost the same as for elephant ivory. Small sculptures of mediocre workmanship, 4-cm in size, were priced between USD 32 and 140. The few necklaces and brooches varied in price between USD 50 and 88. Larger, well-carved items included an 8-cm erotic couple for USD 120, a 20-cm female nude for USD 1500 and a 30-cm monkey for USD 9600.

There were in addition some outstanding and beautifully carved items at extremely high prices. One shop in Hollywood Road had a huge mammoth tusk, over 100 kg, covered with intricately carved animals, people and gardens, priced at USD 115,385. Another shop in Wanchi had a 3-m-long mammoth tusk with 38 horses carved on it, priced at USD 270,000 after a 15% discount. The most expensive mammoth carving I saw was a 150-cm-tall dragon with tourmaline and amber eyes, made in

Guangzhou in 1999, offered for sale at USD 959,000. Several shops had large, uncarved but well-polished mammoth tusks. Sometimes the outer brown skin is removed and sometimes it is left intact. Among the most expensive was a pair totalling 195 kg, which had fairly recently been sold to an Italian for USD 100,000.

MACAU

Macau had only 171,885 visitors from the Americas and Europe in 2003, compared with 1,470,791 to Hong Kong from the Americas, the UK, Germany, France and Italy that year. In Macau, most visit for the day whereas they spend three or four nights in Hong Kong (Macau Special Administrative Region, 2004; Hong Kong Special Administrative Region, 2004). Consequently, it is not surprising that there were only 151 mammoth ivory items, mostly small sculptures, carved on mainland China (none made in Macau) found in just four retail outlets in Macau. Items such as 5-cm cigarette holders and pendants were USD 23, while a 25-cm carved tusk was USD 1250.

GUANGZHOU

The main provinces in China for carving mammoth ivory are Guangdong and Fujian. There were about four large factories making mammoth ivory items in and

Esmond Martin



Many mammoth tusks, originating in the Russian tundra, are exported to Hong Kong, where traders send them to mainland China for carving.

around Guangzhou. Some were fully or part-owned by Hong Kong businessmen. One such mammoth ivory-carving business in December 2004 was employing 40 craftsmen. In addition to carvings, they made furniture with inlays of mammoth ivory. There was one government factory using mammoth ivory, the previously mentioned Daxin Ivory Carving Factory—one of the biggest for elephant ivory (15 craftsmen), and I saw two craftsmen working mammoth ivory there in 2004.

Most educated Chinese have never heard of the mammoth, and even if they have knowledge of this extinct animal, they presently prefer to buy items made from gold, jade or other valuable substances. However, foreign visitors do come to Guangzhou in fairly large numbers, especially to attend the Canton Trade Fair, held twice a year, and they do purchase mammoth ivory carvings.

In fact, the number of shops and total number of mammoth ivory items increased significantly from 2002 (Martin and Stiles 2003). In December 2004, 17 retail outlets were offering 3064 mammoth items. The shop with the most had 1130, 93% of which were small sculptures and netsukes. The 1.25-cm animal figurines were selling for only USD 7.30, but the workmanship was not good. In other shops, a beaded necklace was priced USD 55, 5-cm animal figurines such as horses and monkeys were USD 20–34 each, a 5-cm pendant USD 32, and a small cigarette holder USD 8.

FUZHOU

Like Guangzhou, Fuzhou had several factories for crafting mammoth ivory objects in and around the city in 2004. The manager of one of the prominent factories gave me detailed information on the firm's activities. He said he purchased mammoth tusks in five grades. Grade A has almost no cracks and hardly any odour, and in 2004 he paid USD 364/kg for it. Grade B has a few small cracks and cost USD 243/kg. Grade C, with more cracks, was USD 103/kg, and Grade D, with broken outer layers and many cracks, USD 52/kg. Grade E, really poor quality, cost USD



Esmond Martin

A higher percentage of women carve ivory and bone in China than in any other carving centre.



Esmond Martin

Craftsmen usually stain mammoth ivory items brown or red, both to hide imperfections and because customers like an antique finish.

36/kg but the factory rarely used it. These prices were paid directly to the supplier in Moscow, but if the manager needed a supply of mammoth ivory immediately, he ordered it from a dealer in Hong Kong and had to pay USD 60 to 120/kg more for the better grades. Occasionally people from Fuzhou who work near the Chinese–Russian border bring back mammoth ivory to sell to craftsmen.

The manager also told me how the mammoth ivory is treated in the factory. First, the raw tusk is cut with a saw into the required pieces; an artist sketches the shape of the item to be carved from a piece, using a pen for the outline; a craftsman carves it; a polisher uses a secret material on it to make it shiny; and a dye expert adds the first colours, after which a craftsman carves the more intricate details. If necessary, more colours are put on at this time. Unlike elephant ivory, mammoth ivory objects are usually tinted with

colours, quite often brown, to help camouflage any imperfections such as cracks or the dark lines that mammoth ivory often has. Generally, American and European customers (the main buyers) like the brown-stained mammoth pieces because they look older, and prefer them instead of those with bright colours.

Producing a good, detailed netsuke takes about a week, but something simpler, such as a cat of the same size, can be carved in a couple of days. Large pieces, for example a whole tusk with elaborate, intricate figures, or a carved barge with multiple decorations, may take several craftsmen up to two years to complete, according to Fuzhou's craftsmen.

The factory managers in Fuzhou confirmed that there is tremendous wastage in carving mammoth ivory on account of the cracks and imperfections such as conspicuous longitudinal lines. As much as 80% of a smaller tusk may have to be discarded, compared with only 20% of elephant ivory. Another problem with mammoth tusks, they agreed, is that it is not suitable for certain objects. Chopsticks are never crafted from mammoth ivory because they break almost immediately, and large Cantonese balls with over 20 layers cannot be made from mammoth ivory because they then begin to crack. (From elephant ivory a skilled craftsman can produce a Cantonese ball with 57 layers.) Nonetheless, exquisite carvings can be achieved using mammoth tusks, the managers admitted, and some equal the quality of elephant ivory, despite the difficulties of the hardness, lines and tendency to crack.

Fuzhou's mammoth ivory items, such as name seals, pendants and sculptures, are mainly sent to Hong Kong, USA and Europe since few western visitors come to Fuzhou, and Chinese very rarely buy mammoth ivory items. There were only two retail shops in the city selling mammoth ivory items totaling only six pieces. A 5-cm pendant was about USD 46 and an 8-cm name seal was USD 16–24.

Conclusion

No one knows how many mammoth tusks are left in the tundra of northern Russia, but with prices continuing to rise at a rate faster than for elephant ivory tusks due to greater and increasing demand, more efforts are being made to collect them. Mammoth tusks have proved to be the best substitute for elephant ivory in Hong Kong, Macau and mainland China. Unlike cow, buffalo and camel bones or hippo teeth

Esmond Martin



The most expensive mammoth ivory item seen in 2004 was in Hong Kong—a 150-cm-tall dragon that had been made in Guangzhou in 1999 and was priced at USD 959,000.

that were used for carving even before the CITES ivory ban, mammoth ivory carvings were rarely seen in China before the early 1990s. Mammoth ivory became important only after elephant ivory could no longer be legally traded across borders. The acceptance of mammoth ivory has spurred on a long tradition of fine carving, which was in danger of becoming a lost art. It has given more people jobs. Often promoted now as an exotic product because mammoths have long been extinct, and also because it has become expensive, it has a certain cachet. It is the most valuable substitute for elephant ivory.

The optimism for mammoth ivory of former ivory dealers in Hong Kong is obvious: they have opened factories on the mainland to produce mammoth ivory carvings, and have started to market these in Europe and the Americas. They do not believe that there is any future for the elephant ivory trade; those who have old stocks would like to sell them and can legally do so only locally—if they find willing buyers. After the 13th Conference of the Parties to CITES, held in 2004, officials of the Agriculture, Fisheries and Conservation Department of Hong Kong invited licensed elephant ivory dealers to a briefing on the outcome of the conference. But only one showed up, demonstrating the fallen interest in elephant tusks (Chi-son Cheung, Senior Endangered Species Protection Officer, Agriculture, Fisheries and Conservation Department, Hong Kong, pers. comm. 2004).

To encourage the use of mammoth ivory, governments should continue to allow it. Unfortunately, India has banned its use because the authorities claim they cannot distinguish it from elephant ivory and so it could create a loophole for the sale of ivory from Indian elephants. The loophole that the authorities fear in India can be avoided if it is recognized that only tusks resembling mammoth can be traded. Mammoth tusks can be identified from elephant tusks by at least one of three ways: by often being significantly larger, having a distinguishable brown outer layer, and having a noticeably different shape. Similarly, sculptures with streaks can be easily identified as being from the mammoth. Then, assuming that the supply of raw mammoth ivory can continue in reasonable quantities over the next 10 or 20 years by being sensibly harvested, encouragement of its use will decrease the demand for elephant ivory, thereby helping conservation efforts for elephants.

So, too, should the use of the other substitutes, especially bone, continue to be encouraged. Trade in hippo

teeth, however, needs to be carefully controlled to prevent overuse. Hippos have been on Appendix II since 1995, allowing trade only with a CITES export permit. While bones and teeth do not have as much effect on the market by reducing the demand for elephant ivory as mammoth ivory does, they are acceptable at the cheaper end of the market, and if they are better crafted, their role could become more important.

Recommendations

1. The smuggling of elephant ivory into southern China for the carving industry needs to be stopped. Pressure needs to be put on Chinese authorities to enforce their own laws. Chinese government officials and international NGOs with knowledge of the Chinese ivory industry need to inspect retail shops, factories and small-scale family carving businesses.

2. The quality of the carving of cow, buffalo and camel bone needs to be improved so that carvings and trinkets made from these cheaper materials become more popular.

3. To encourage people to buy more items made from mammoth ivory instead of elephant ivory, traders need to publicize and market mammoth ivory further. They should display their best carvings at local and international fairs. They should invite journalists to their factories and showrooms to write about the use of mammoth ivory as an acceptable, beautiful substitute for elephant ivory. Brochures with colour photographs of mammoth ivory carvings and explanations about its suitability for carving intricate works of art should be available to potential customers.

4. Research is needed to try to determine how much mammoth ivory is coming out of Russia and Alaska, and the prospects for future supplies. If it appears that there will not be enough for bulk manufacture in the foreseeable future, then this material should be recognized as rare and valuable, to be used only by master craftsmen for expensive carvings. Bones should be used instead to replace elephant ivory for trinkets.

5. How to identify mammoth ivory such as by its streaks or brown outer coating needs to be made clear to potential buyers through posters and marketing, so that it can be easily distinguished from elephant ivory. Trinkets should not be made. Not only as they are a waste of a valuable raw material, but also as they could be a loophole for elephant ivory as they are often too small to have streaks and thus elephant ivory looks too similar.

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HISTORY

Distribution and extinction of the rhinoceros in China: review of recent Chinese publications

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Introduction

General Western understanding about the distribution of the rhinoceros in China was well stated by Allen (1940: 1279): 'Although rhinoceroses were once widespread over Asia and have left abundant fossil remains in deposits of no great geological age in China, there seems to be no evidence that they have occurred even in southern China within historic times.' The same impression is gained from reading Laufer's (1914) large but rambling survey of ancient works by Chinese authors, who concluded that the rhinoceros was rarely seen in Chinese territories during the Song Dynasty (960–1279) and had completely disappeared in the following Yuan Dynasty (1280–1368). Chang (1926) also looked at ancient Chinese texts and found that in historical times, no elephant or rhinoceros existed in China north of the Yangtze River. However, rhinos were found in numerous places in Hunan Province in the south until the Song Dynasty. It is, of course, well known that the Chinese continued using rhino horn to produce various types of carvings, of which the horn cups are the best known (Jenyns 1954; Chapman 1999).

With this background, it is surprising to read in several recent papers written by Chinese scientists about the existence of the rhinoceros in China as far north as the Yellow (Huang He) River and detailed records of the animal's disappearance in the centuries that followed. Although only a few of these articles are available to me, and most only through an English summary, I present a brief review here. Because it could well be that some of the data refer to fossil rhinoceros material in relatively recent depos-

its, I have also included a few references summarizing the latest findings.

Fossil remains of rhinoceros in China

As I was primarily interested to learn to what extent the fossil material can help establish which species of rhinoceros lived in China, I looked for findings on specimens from the Late Pleistocene (ca. 120,000 years B.P.) and Holocene (ca. 10,000 years B.P.) periods. The work done in China has been summarized in a number of articles in English or French by Dr Haowen Tong of the Chinese Academy of Sciences in Beijing.

Tong and Moigne (2000) state that for the Late Pleistocene, remains of *Dicerorhinus mercki*, *Coelodonta antiquitatis* and *Rhinoceros sinensis* have been recognized.

D. mercki and *C. antiquitatis* were found only in northern China, while *R. sinensis* was restricted to the regions south of the Yellow River. Of the currently living species, *R. unicornis* was recorded only in the Early Pleistocene (2 million years B.P.), while both *R. sondaicus* and *Dicerorhinus sumatrensis* were found in Holocene deposits. The Holocene material dated as 7000 years B.P. was found in the Hemudu neolithic site in Zhejiang Province (ca. 28° N 129° E, just south of Shanghai) and in Hsia-wang-kang (Xiawanggang) in Hsich'uan County, Honan Province (ca. 30° N 115° E, south of the Yellow River). *Dicerorhinus* and *Coelodonta* were confined to the northern parts of China, *Rhinoceros* to the southern parts.

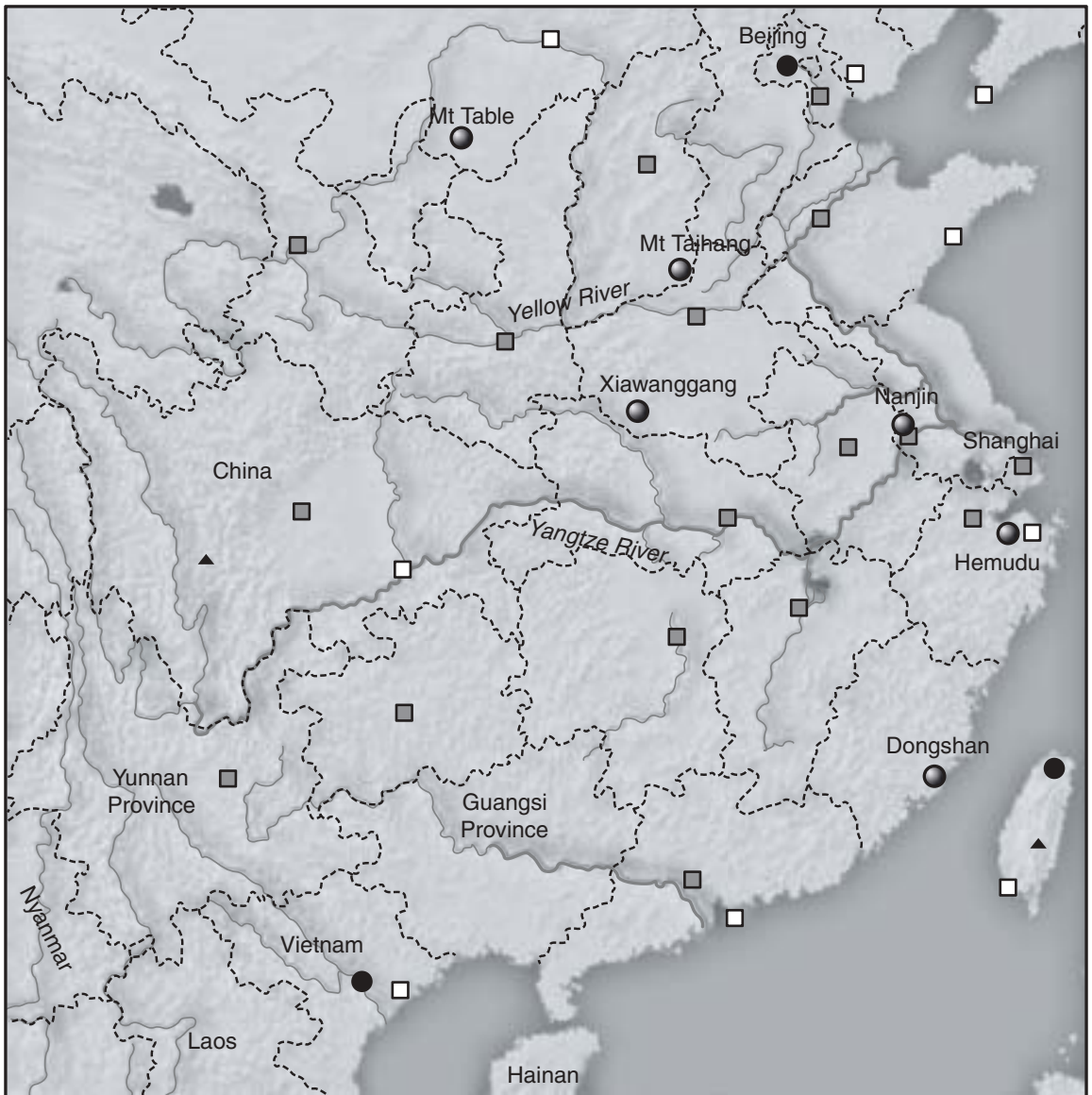


Figure 1. Chinese mainland showing localities mentioned in the text.

Tong (2000) provides a review of rhino material found in sites associated with human remains. Out of 74 palaeolithic sites yielding human remains, 58 (78%) also contained rhinoceros material. For the Holocene, *Dicerorhinus* was found in Hemudu, Xiawanggang and Dongshan (on the eastern shore in Fujian Province), while *Rhinoceros* was found also in Hemudu. It is thought that the rapid decline of rhinoceroses during the later part of the Pleistocene may have been due to human activity.

Tong (2001a) lists 17 names of genera and 62 names of species or subspecies of rhinoceros reported from China. Out of these, 33 taxa were reported only once, in a single locality and a single horizon, indicating that more work is required to understand the relationships of the Chinese rhinoceros remains, especially regarding *D. mercki* and *R. sinensis*.

Tong (2001b) states that fragmented rhino remains were found at the Nanjing *Homo erectus* site (ca. 32° N 119° E), dated to the late Middle Pleistocene. As all

these bones were found in caves, it is concluded that most probably humans hunted the rhinoceros. Tong (2002) further examines the material from Nanjing and refers the material (6 specimens) excavated from the Huludong Cave to *D. mercki*. Although other findings have indicated that this species spread to areas south of the Yangtze River, only the material from Nanjing is reliable; other remains are poorly preserved and are open to question.

Records of the rhinoceros in southern China

The paper by Wang Zhentang et al. (1993), published in English, contains a number of assertions about the distribution of the rhinoceros that seem to need more explanation than the authors provide. Their aim was to illustrate a logistic equation expressing the relationship between population numbers and

environmental capacity. They state that the rhinoceros was widespread in China about 3000 years ago and that their extinction was due to the human destruction of their environment. They use the rhinoceros as an example, because 'the historical documents on the distribution of *Rhinoceros* in China are unique and detailed'. They in fact provide some detail about the earliest records, about 3400 or 3200 years ago, here summarized. For the Shang Dynasty (2000–1027 B.C.), pictographs on bones show places where King Shang captured rhinos (normally 5–6 per trip, sometimes up to 16), at several places north of Huang River and south of the Tai Hang mountains. An ancient book of geography written by Shang Hai Zhing stated the occurrence of rhinoceros in Mt Nu Chuang (now Mt Mi Gang), Mt Xun Wu (now Mt Quwu) and Mt Zuozi (or Mt Table), all situated roughly at 37–38°N. This, therefore, was the northern border of rhinoceros distribution some 3000 years

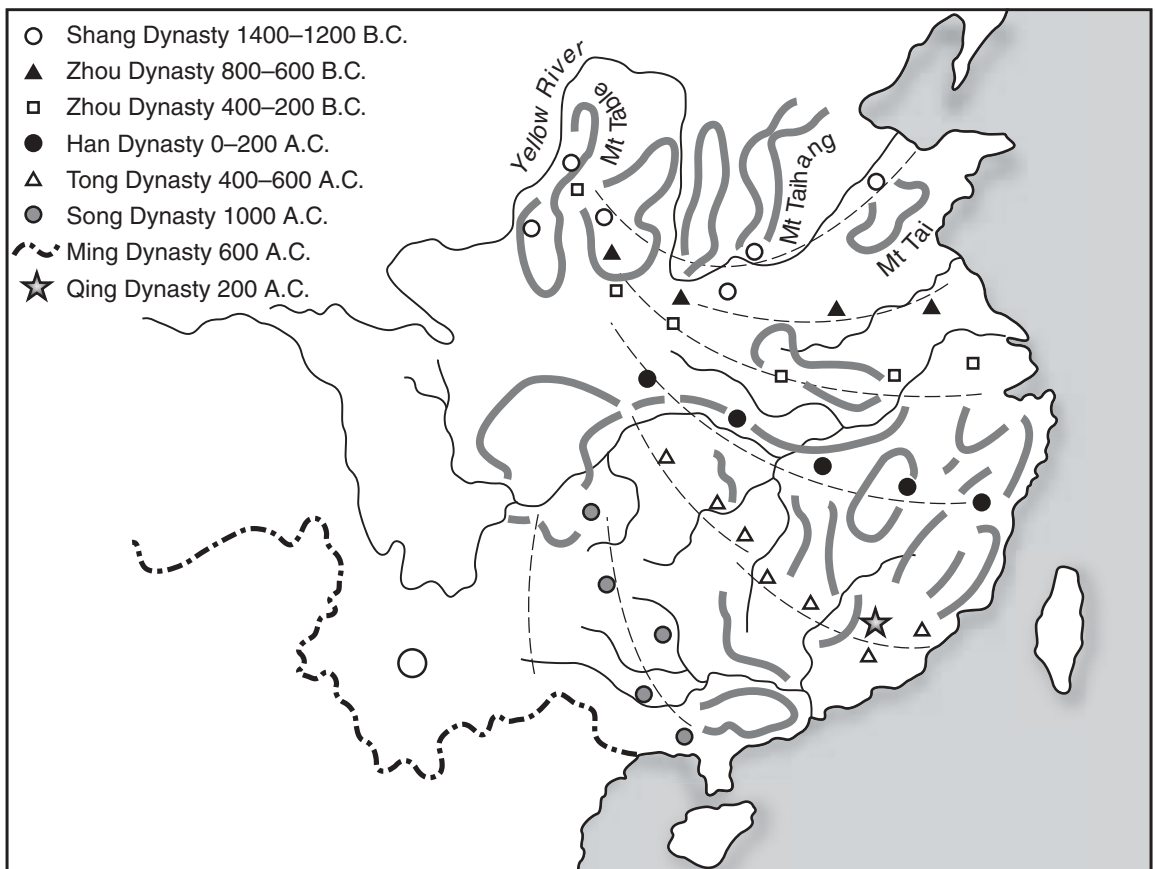


Figure 2. Approximate course of rhinoceros extinction in China (reproduced after Wang Zhentang et al. 1993, fig. 2).

ago. The animals belonged to both *Rhinoceros* (no species given) and *Dicerorhinus sumatrensis*. The subsequent history is said to be divided into eight historical periods, each lasting some 400 years. The rhinoceros retreated southwards in each of these periods, at a higher rate on the eastern coast than in the mainland, coinciding with the spread of the Chinese population. Rhinoceros disappeared from Yunnan in China about 200 years ago.

Although the change of the rhinoceros range from 1400 B.C. to the present is illustrated in two maps, there is no explanation of the historical records underpinning the lines or points shown on them. In a later paper, Wang Zhentang et al. (1997) repeat the same evidence and postulate that the northern distribution boundary of the rhinoceros shrank southwards at a speed of 0.5 km per year, essentially due to human pressure. It is calculated that 4.0 people per square kilometre is the threshold value of human population pressure under which rhinoceros can survive.

Zhou (2003) provides some information on the contents of the Shan Jing part of the ancient book Sang Hai Jing, considering that the ecological material in the book is roughly trustworthy. It describes the environment of the Yangtze River basin, where a rhinoceros identified as *Rhinoceros sondaicus* was found. Lan Yong (1992) discusses the distribution of the rhinoceros in south-west China, but as this paper has only a very short abstract, it can only be said that he refers the animals in this region to *R. unicornis*.

Lefevre (1991) discusses a pictograph found on a Shang oracle bone, which was often translated as 'rhinoceros'. The pictograph was found in an inscription on the head bone of a big animal, excavated on 28 November 1929 in the great connective pit, north-east of Xiaotun village, in the land of Zhang Xuexian. After examining all the evidence about this pictograph, it is concluded that the animal cannot have been a rhinoceros, rather that it referred to a wild buffalo.

Finally, Xu (2000) refers to historical records of the rhinoceros in the southern province of Yunnan. He estimated that between 79 and 123 rhino horns had been paid as tribute to the imperial courts from Yunnan since the 13th century. The rhinoceros became scarce in the area during the 18th century (latter part of the Qing Dynasty) and the last specimen in southern Yunnan was shot as late as 1957. This

payment of tribute has been an important factor in the extinction of the rhinoceros in Yunnan. The present eco-environment is suitable for its reintroduction.

Discussion

It is not easy to judge the value of the records provided by the Chinese authors. The data relating to the Shang Dynasty oracle bones used by Wang Zhentang and his coauthors seem to be contradicted by the interpretation of the relevant pictograph by Lefevre (1991). The records of the ensuing period of the last 3000 years, when the rhinoceros was retreating southwards, need to be further explained in a paper written in a Western language. There is also uncertainty about which species of rhinoceros lived in China. As the double-horned Sumatran rhinoceros (*Dicerorhinus sumatrensis*) is known from Myanmar and Thailand, and the single-horned Javan rhinoceros (*Rhinoceros sondaicus*) was found in North Vietnam, one may expect that the records pertain to one or both of these species, and it would be interesting to discover if the historical records could be separated between these species, or indeed if the Indian rhinoceros (*Rhinoceros unicornis*) existed in China at all. Hopefully one day the position of the rhinoceros in China will be better known to Western scientists.

Acknowledgements

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FIELD NOTE

Past population dynamics and individual information on possible surviving northern white rhinos in Garamba National Park and surrounding reserves

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Since 1983, the Garamba National Park Project (GNPP) in partnership with the Institut Congolais pour la Conservation de la Nature (ICCN) have been monitoring the northern white rhinos (*Ceratotherium simum cottoni*) of Garamba National Park, Democratic Republic of Congo (DRC) as part of the conservation of the park and ecosystem (fig.1). Individual recognition has been one of the key tools. The current crisis facing this population has been and is being reported elsewhere.

The objective of this note is to summarize rhino population dynamics based on the individuals and their families, to demonstrate the past capacity of the natural population to increase, to outline what is known of individual components of the decline of the population since mid-2003 with the likelihood of individual rhinos that could potentially still exist, and to provide background material for individual identification, population management and conservation at all levels of this now severely reduced population.

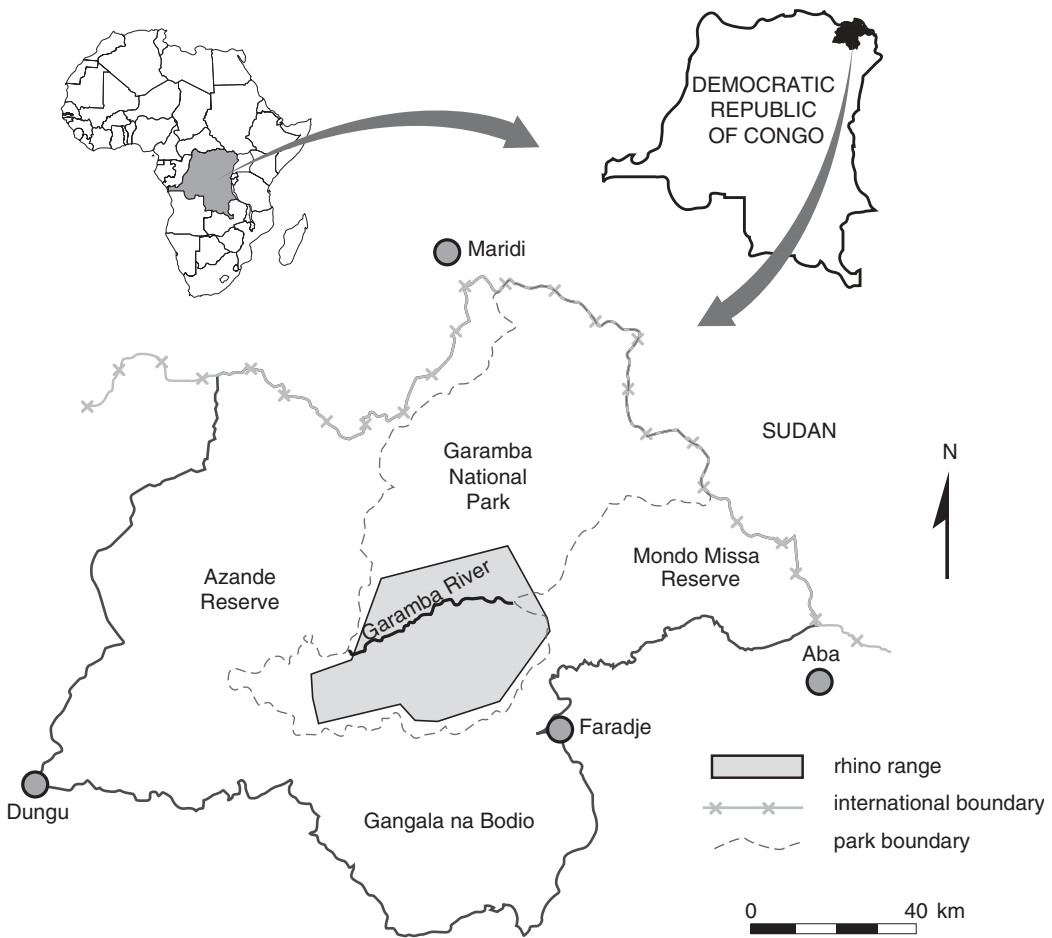
Some of this work was done to update the rhino recognition file and to identify possible surviving individuals, provide guidance for a survey carried out in March 2006 through the auspices of the IUCN African Rhino Specialist Group and the African Parks Foundation, and for ongoing monitoring.

Methods

Full rhino monitoring methods are written up in the Garamba National Park Rhino Monitoring Manual (Hillman Smith et al. 1996).



M2 Eleti, an adult male northern white rhino in Garamba National Park, showing nose wrinkles and ear characteristics.



Figur 1. Garamba National Park and surrounding reserves.

Identification is based on age, sex, horn shapes, ear notches cut on immobilized rhinos, or natural ear marks, tail lengths and hairs, nose wrinkles, associations (such as infant or juvenile with mother). Home ranges and distribution were plotted and observed and once known were additional guidance.

Age and sex: Basic ageing (infant, juvenile, sub-adult, adult) and sexing formats were provided at a series of training courses for ICCN park staff and researchers over the years. All members of the Monitoring and Research Unit, patrol leaders and secretaries of anti-poaching patrol teams, and guards selected for Equipe Rhino followed the training course. Therefore there were some guards in every patrol who could do basic reporting of rhino observations, as well as the specific rhino-monitoring teams. The guidelines and rhino report forms and

maps are carried as part of the patrol data sheets. The diagram of how to determine age for northern white rhinos is given in figure 2. Based initially on age determination of southern white rhinos (Hillman Smith et al. 1986), classification details have been refined over 22 years with long-term observations of known-age animals, body and tooth measurements taken from casts on immobilized animals.

Physical features: Horn shape, earmarks (natural or with cut notches), tail length, hair variations, nose wrinkles, and scars were maintained on individual identification cards and later in an Access database, with drawings and photographs. All rhino observers, from the air or on the ground, use a quick reference guide to all extant rhinos, and a further updated guide was drawn up that new observers used on thhhhhe recent surveys.

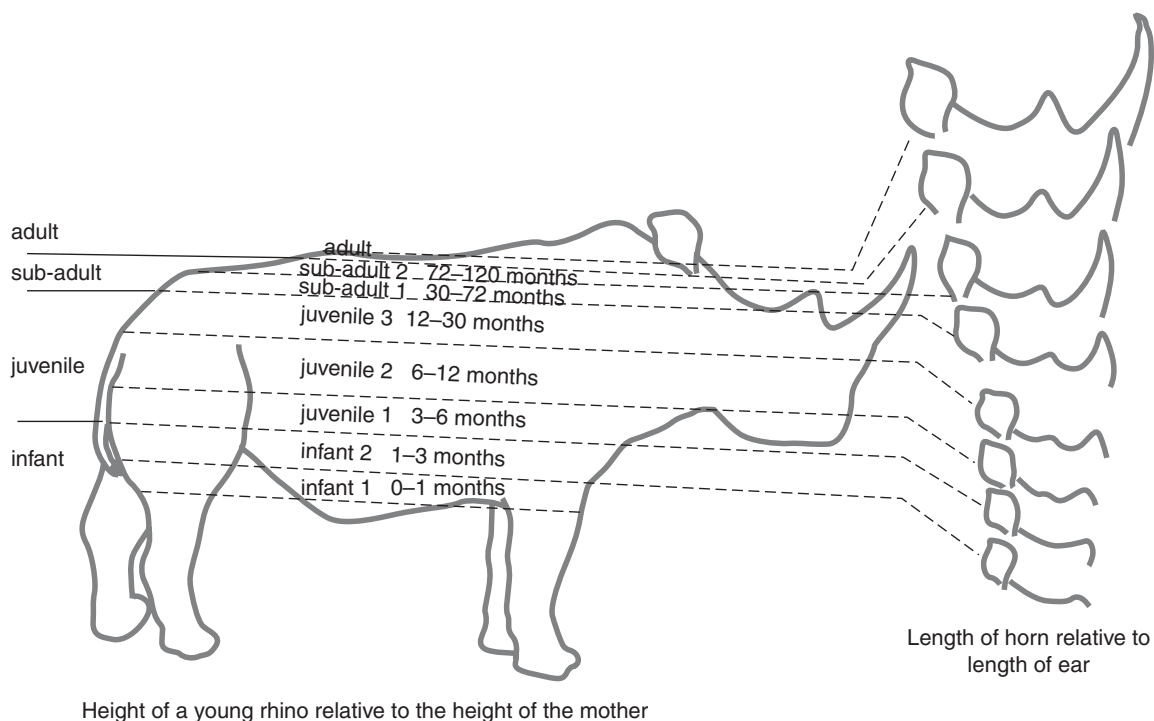


Figure 2. Age determination classification for the northern white rhino.

Association and nomenclature: Each rhino has a name and ID number. The ID number–letter combination is an indicator of family. At the start of the project all males were given the code M plus a number and all females F plus a number. The offspring of any female then take her number plus a successive letter plus F or M depending on sex—for example, F6, Pacque (Easter)’s first known offspring was a daughter, 6aF (Euf de Pacque (Easter Egg)). Her most recent one was 6g, which had not yet been sexed. 6aF’s first calf was 6aaM, Pascal, and the second 6abF, Chocolat. A theme, in this case Easter, often also runs through the naming. When rhinos are very young they clamp their tails down when disturbed and are difficult to sex from the air or from the ground if the grass is long, and the postfix may come later. The infants and juveniles are identified by association with the mother at first until other features are recognizable. The family trees are available for use in conjunction with DNA analyses in future identification and management of the current reduced and disrupted population.

Observations: All rhino observations by anyone—researcher, guard or visitor—have been recorded in a

standard format since 1983. They included date, time, location name, and location coordinates on a Universal Transverse Mercator-compatible kilometre-based grid system that was standard for all monitoring, anti-poaching and aerial surveys at Garamba. It therefore also formed an easy means of communicating between aerial and ground patrols and with the central radio unit and mapping their positions. The total number in the group are given, with age and sex breakdown, habitat and condition based on standardized classifications, activity, associated species, individual identification as far as possible, measurements of tracks and notes. Observations are also classified as original or follow up, by air or ground, and the observer’s initials are recorded. On the back of the data sheet are blank outlines of rhino heads for drawing horn shapes, ear marks and nose wrinkles and room to complete other identifying features observed. All observations are all entered into a computer in a spreadsheet format for analysis.

Survey: Focused monitoring and study of the rhinos has been done from ground and air. Aerial work has included regular surveys of the whole southern

sector comprising the rhino range and adjacent areas, done as total block counts using individual recognition and other general reconnaissance and radio tracking when radios were active. All observations of rhinos, signs of illegal activity and areas of long-grass habitat are plotted. The intensive block counts, used to guide anti-poaching efforts and to maintain field monitoring, were carried out roughly every two months before war started in 1997 but had to be reduced to one to three times a year during the wars.

Radio telemetry: Between 1993 and 1996, initially with collars and then by pioneering horn transmitters with embedded antennae, radio telemetry was used to treble the rate of observations per time unit over the intensive aerial survey and therefore to make monitoring and protecting the rhinos more efficient. While rhinos were immobilized for radio telemetry, their ears were also notched, providing easy and certain identification of a selection of animals, particularly subadults.

DNA analysis: Material from the notched ears and from an earlier programme of biopsy darting and from rhinos found dead, was analysed to evaluate genetic variability and subspecific differences and to try to assess paternity to further guide conservation and management of this small, vulnerable population. Analysis was and is being carried out by the molecu-

lar genetics laboratories at the National Museums of Kenya and Cape Town University.

Results

Before 1984 and the start of the Garamba project, 97% of the population had been lost in eight years due to heavy commercial poaching. In 1984 the rhino population was only 15 individuals comprising five adult females, six adult and one subadult male, and three juveniles. Over a 22-year period 50 births have been recorded. Four died young, one mired in mud, one orphaned and two from unknown causes, but 44 were recruited to the population prior to the recent wave of poaching. It is possible that one to three undetected post-natal losses occurred, considering some long intercalf intervals in females otherwise regularly reproducing.

Figure 3 shows annual recorded births with the annual minimum number of the population and the number of births per year as a percentage of the population of the preceding year (because the current year's population includes the new births). Apart from normal annual fluctuations, there has been no significant trend in rate of reproduction over the 20-year period, with a mean annual rate of reproduction of 9%. Tables 1a and b show individual population histories.

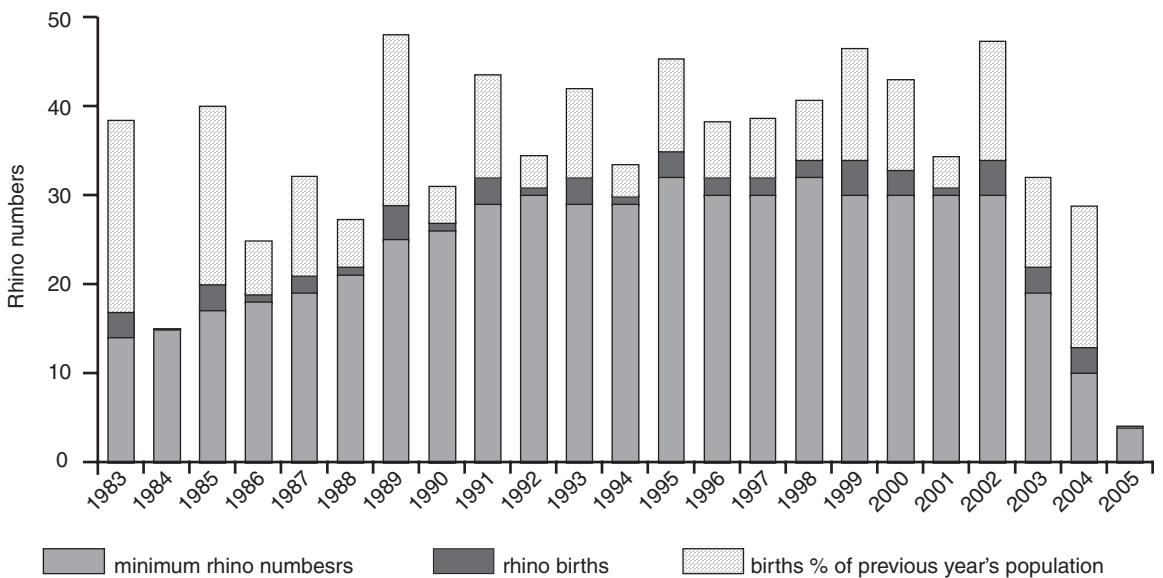


Figure 3. Rhino births between 1983 and 2005 in Garamba National Park.

Table 1b. Garamba National Park: northern white rhino histories (females)

Females and unsexed	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	1aM					1bM		1cF	1cM	1eF	1fM													
F1	Mama moke																							
1cF	Nawango							b 2.91																
1eF	Kasi									b 8.95										1ea				
1ea	Kombolani																			b4-5.02				
F3	Kunalina	3aF	3bF			3cM		3dM	3eF	3fF	3gM						3h			3i				
3aF	Kuni**							3aaM																
3bF	Juillet		b 7.85											3.96P†										
3eF	Etumba								b 7.93								3eaF	3ebF		3ec				
3eaF	Boboto																b11.99							
3abF	Steps																		b11.01					
3ec	November																				b10.04			
3fF	Aligaru																					3fa		
3fa	Nabema									b9.95													b2.04	
3h	Zigba																							
3i	Lisungi																							
F4	Boletina	4aM	4bF	4cF	4cF	4dF		4eM	4f															
4bF	Mai		b5.85						Kenge*															
4cF	Noel				b10.87					4caF	4baM						4cbM							
4caF	Kito									b9.96														
4cc	Espoir																							
4dF	Minzoto (FloppEar)																							
4dbF	Sanza																			4dbF				
4dc	Etoile																			b2.00				
4f	Nauoloko																							
F5	Mama Giningamba		5aM	5bF	5cM	5dF		5eF		1.95														
5bF	Grizmek			b10.87																				
5dF	Jengatu																							
5db	Keba																							
F6	Paoque		6aF	6bM	6cM	6dM		6eM	6fM															
6aF	Oeuf de Pacque		b3.86					3aaMadopt																
6abF	Chocolat																							
6ac	Courage																							
6g	Bunny																							

Key:

Known life history to last observation or confirmed identification of death

Confirmed dead by identification of dead rhino with approximate date

ID codes within the life line of each female indicates the births of calves. (Male calves e.g 1aM then join the Male Table 3a). Female calves e.g 3bF start their life line below that of mother, with approximate date of birth p.date = confirmed poached with date

* Kenge was a newborn rhino found mired in mud. His mother was not seen for identification, but by elimination could possibly have been 4bF Mai

** 3aF Kuni disappeared and her calf 3aaM appeared to have been adopted by F6

Intercalf intervals of all females throughout the 20-year period averaged 30 months, with means ranging from 24 to 41 months and overall ranges from 21 to 57 months (table 2). The mean intercalf interval of young females with their first few calves was 35 months, with a range of 23 to 49 (table 3). It is not clear whether the longer interval is due to social or physical factors.

When the second generation began reproduction, ages at birth of first calves recorded averaged 8 years 3 months, with a variation from 6 years 4 months to 13 years 6 months. The rhino population doubled in the first 8.5 years of the project, with a 9.7% rate of recruitment calculated at that time (Smith and Smith 1991).

From 1991, increase in the rhino population levelled off at around 30 animals, despite continued re-

production (Hillman Smith et al. 1994). This coincided with the nearby town of Maridi in Sudan being captured and the war in adjacent Sudan beginning to have a greater effect on Garamba. With a porous border, easy access to arms and ammunition, 80,000 refugees in areas adjoining park's buffer reserves, and later the establishment of the Sudanese People's Liberation Army camps on the border, poaching for meat increased in the north of the park and, despite strong counter-action, moved down towards the rhino and elephant sector in the south. The first rhinos known to have been poached were in 1996. The situation was further exacerbated with the civil wars in Zaire (now DRC) itself, with initial losses of elephants, hippos and buffalos, but continued project support and development of financial and diplomatic support from

Table 2. Intercalf interval (in months) of northern white rhino females in Garamba National Park, 1984–2004

Individuals	F1	F3	3eF	F4	4cF	4dF	F5	5dF	F6	6aF
	23	22		21			32		27	
	29	53		29			22		32	
	26	21		22			23		57	
	31	22		28					23	
		26		24	39	42		41	28	29
		27			49	46			48	22
		23	24							
		28	23							
Average indiv.	27	28	24	25	44	44	26	41	36	26
Range	23–31	21–53	23–24	21–29	39–9	42–46	22–32	41	23–57	22–29
Overall ICI			(n = 35)							30
Overall range			(n = 35)							21–57
Young females			(n = 10)							35
ICI – intercalf interval										

Table 3. Age at first calving, northern white rhinos, Garamba National Park, 1984–2004

Individual no. and name	AFC	Mean ICI (m.)
1eF Kasi	6 y 8 m	
3aF Kuni	7 y 3 m	
3eF Etumba	6 y 4 m	24
3fF Aligaru	8 y 5 m	
4bF Mai	7 y 9 m	
4cF Noel	8 y 11 m	44
4dF Minzoto	6 y 10 m	44
5dF Jengatu	8 y 7 m	41
6aF Oeuf de Pacque	13 y 6 m	26
Average	8 y 3 m	35
Range	6 y 4 m – 13 y 6 m	

AFC – age at first calving; ICI – intercalf interval; y – year and m – month

the UN Foundation and UNESCO held rhino and elephant populations stable from 1998 to 2003. Since the rate of reproduction remained stable there must have been more rhino deaths than the war time reduction in ground and aerial monitoring was able to detect.

The extreme downward trend of the population that started in 2003, shown in figure 3, is reported elsewhere (Hillman Smith et al. 2003; Hillman Smith and Ndey 2005). It coincided with the cease-fire in southern Sudan and with changes in the type, distribution and intensity of poaching. The trend was detected by both rhino and law-enforcement monitoring.

The alarm was raised, and major collaborative efforts were made to counter it and conserve the ecosystem and rhinos. But as reported elsewhere, the minimum number of rhinos detected in surveys decreased and nine rhino carcasses were found in 2004 and a further two in 2005 (Hillman Smith and Ndey 2005) (table 4). Reduction in numbers was due both to deaths and to rhinos crossing the Dungu River and moving out of the park to the wooded Gangala na Bodio Reserve to the south.

Since late 2004 it is believed that there are fewer than 10 northern white rhinos remaining. Successive surveys have found 4, 4 and 2 plus a possible further 2 later as minimum numbers within the park (pers. data; pers. comm. with E. de Merode, IUCN AfRSG and J Tello), but there are almost certainly an additional few within the reserve.

Discussion and conclusions

The initial rate of increase of the population of 9.7% per annum and the overall mean rate of reproduction of 9% over the 22-year period (1983–2004) reported compare favourably with rates of increase of 9.5% found by Owen Smith in a well-protected southern white rhino (*C.s. simum*) population (Owen Smith 1973). The average intercalf interval of 30 months or

2.5 years was also the same. The rate of reproduction was maintained throughout despite disruptions from civil wars and increased poaching. There was no sign of inbreeding depression, and preliminary results of genetic analysis indicated a relatively high variability and a far greater difference between the subspecies of white rhinos than that found between any of the subspecies of black rhinos. (R. Aman pers. comm. 1993; Harley and O’Ryan pers. comm. 1995). Nor was reproduction compromised by low densities, as home ranges were found to be up to 10 times greater than those of southern whites (Smith and Smith 1993). In terms of habitat, behaviour and genetics the northern white rhino population was healthy and reproducing well over the 22-year period and probably has potential to increase again if sufficient animals can be found even on a meta-population scale.

The overriding cause of its recent numerical decline was illegal offtake in a border region of political instability, and easy access to weapons by poachers. Most of the recent illegal exploitation was of elephants, which share the same range, but with lower numbers the proportional loss of the rhinos has been more serious. Protection by all means possible is clearly vital to prevent total extinction.

Table 4. Rhinos found dead in Garamba National Park, 2004–05.

Date found.	Age/sex	Probable ID	Region	Cause and notes	Skull ref.
25 Jan 04	Young adult male 14–20 yr	Elikya 6bM	Willibadi II	Poaching	PNG 22
09 Apr 04	Adult male 25–30 yr	Notch M9; confirmed ID from horns	Willibadi I	Wounded by horsemen poachers and died; horns recovered	PNG 23
13 Apr 04	Adult	Skull not recovered	Willibadi I	Poaching by horsemen; seen from air in water	
07 July 04	Young female adult 7–9 yr	Kito 4caF, Kasi 1eF or Aligaru 3fF	Dinakpio near Willibadi II	Poaching, seen from air and followed up on ground; lower jaw smashed, horns gone	PNG 24
01 Aug 04	Adult male c. 28 yr	Kondo Akatani M3	Willibadi I	Poaching (bullet in head); marks of head wound seen before death	PNG 25
29 Aug 04	Young adult female 8–9 yr	Kito 4caF, Kasi 1eF or Aligaru 3fF	Willibadi II	Poaching	PNG 26
30 Sep 04	Young adult female 8–11 yr + infant male +- 4 mo	Aligaru 3fF + 3fa	Willibadi II	Poaching	PNG 27 and 28
08 Oct 04	Adult female pregnant	Skull not yet recovered	Source Nakule	Poaching in the triangle	
Feb 05	2 adults	Patrol report skull not recovered	Block 3 near confluence Dungu Willibadi II	Poaching	

Results of the monitoring and previous conservation efforts however, provide positive indications for future increase if protection is sufficient. In addition to physical identification, the use of DNA analysis from dung to help new observers to identify the rhinos is also proposed. Individual relationships and the ongoing analysis of genetic material is therefore of further importance.

Adequate protection and informed management of such a small population should be enhanced by information from previous monitoring. Data presented here and available in more detail can, we hope, contribute to future conservation and management.

Acknowledgements

We of the Garamba Project, are grateful to International Rhino Foundation for having supported the conservation of Garamba National Park and its ecosystem and staff for many years, to the UN Foundation and UNESCO throughout the war, and to WWF, the Frankfurt Zoological Society, and others before that. The support of the Wildlife Conservation Fund by partnering in the monitoring aircraft has been vital. We are very grateful to the Institut Congolais pour la Conservation de la Nature for a long partnership and the opportunity to have lived and worked in Garamba and done our utmost for its conservation. The IUCN African Rhino Specialist Group and the African Parks Foundation have supported conservation efforts and some of the analysis. We thank you all.

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TRIBUTE

Thomas John Foose (1945–2006)

Nico van Strien

International Rhino Foundation

Tom Foose, lately program director for the International Rhino Foundation, unexpectedly passed away on 17 May 2006 at his home in Waynesboro, Pennsylvania, USA.

Tom was one of my closest friends. For many years we had almost daily we spoke over the phone and exchanged many emails on the rhino programs that we were both involved with. We met in person several times a year either in Asia or in the US. Our lives became more and more entwined through our common interests and Tom became part of my family. His untimely death is a tremendous loss for me as for everyone who knew and worked with him. He was a remarkable person, with quite a few special traits in his character, methods and likings, but he was a true and warm friend, though always cautious with his emotions and forever somewhat distant.

Tom was born on 7 March 1945 in Waynesboro. He received a BA in Biology from Princeton University in 1969. From 1970 till 1980 he held several positions at Cornell University and the University of Chicago and at the Philadelphia and Oklahoma City zoos.

His close association with rhinos and rhino con-



The late Dr Thomas John Foose

servation started with a PhD study at the University of Chicago on feeding strategies for ruminant as opposed to non-ruminant ungulates. His intention was to do the

the research in Kaziranga National Park in Assam, India, but he had to leave Assam after a few months because of security risks in the area. He completed his studies at zoos and in 1982 he obtained his doctorate.

From 1981 to 1990 he served as the conservation director for the American Zoo and Aquarium Association (AZA), and along with Dr Ulie Seal, developed the concept for the species survival plan (SSP) program for endangered species. Such programmes now are the cornerstone for managing captive species for all regional zoo associations.

From 1990 to 1992, Tom served as Executive Officer of the IUCN/SSC Conservation Breeding Specialist Group. He shaped its programmes and focus to include using computer simulation modelling to examine the risks of species extinction, as well as global risk assessments of broad taxonomic groups including making recommendations for species management and research.

In 1991, Tom was one of the founders of the International Rhino Foundation (IRF), initially called the International Black Rhino Foundation. The foundation embodies his lifelong passion for rhino conservation, both in zoos and in nature. Tom was the IRF program director from 1993 and the driving force behind its conservation programmes that now span all rhino species and most range states, focusing on long-term support for the most endangered rhino types and areas.

Tom was a program officer of the IUCN/SSC Asian Rhino Specialist Group for as far as memory goes back and had several other functions in executive, scientific and curatorial capacities. He was involved in designing and implementing many programmes, projects, strategies and action plans, including the IUCN/SSC Global Captive Action Plan and Global Animal Survival Plans for all species of rhino. There are too many to list them all.

After having moved for his jobs to several places in the US, Tom returned to his home town to take care of his ailing mother. He managed to combine his many duties with loving care for her until her death. Later, Tom took up part-time teaching at a local high school for several years. He enjoyed the contact with young people and found that it gave extra meaning to his life. He was sad that he had to give up the teaching because

of the demands his other positions made on his time.

Tom was always trying new avenues for raising funds for his programmes and never tired of getting another meeting or workshop together. He was a prolific writer and a master in formulating concise and precise summaries and points of agreements. A wordsmith of repute, he would always come up with the right word.

Throughout his work with many organizations and groups on conservation and management issues, Tom touched people around the world and inspired them to set aside their personal, national and institutional agendas to focus on preventing species extinctions. Over the past 10 years, his primary focus was leading the development and implementation of global and national conservation strategies and action plans for rhinos in Asia and Africa.

Most recently, Tom initiated the Sumatran Rhino Captive Global Management and Propagation Board; he was closely involved with designing the Vision 2020 Program for Indian Rhino in Assam and the Rhino Century Program to restore the populations of Javan and Sumatran rhino in Indonesia to viable levels. Tom was involved in designing the European Association of Zoos and Aquaria Rhino Campaign. He initiated the North American Save the Rhinos Campaign, whose goal was to double the number of rhinos in critically endangered populations in select protected habitats in the wild within 10 years.

He dedicated his life to bridging gaps among people with diverse interests and perspectives, as well as using science to foster national and global collaboration for threatened species management. We will miss Tom's many unforgettable characteristics: his sporty safari attire, his mischievous smile and the twinkle in his eye whenever a rhino came into view. We will miss his dry sense of humour, and his love for Coca Cola, durians, rendang and coconut ice cream. Memories abound and the many anecdotes about Tom will continue to enlighten our lives.

Tom is survived by his children Rebecca Foose Nesmith, Thomas John Foose III and their mother, Virginia Foose; children Susan Foose and Michael Foose and their mother, Ellen Foose; and one grandson, Daniel Nesmith.

BOOK REVIEW

Ivory markets of Europe

Esmond Martin and Daniel Stiles, drawings by Andrew Kamiti

Care for the Wild International, West Sussex, UK, and Save the Elephants, Nairobi and London 2005; 104 pages. ISBN 9966 9683 4 2

Review by Kees Rookmaaker

Chief Editor, Rhino Resource Center (sponsored by the International Rhino Foundation and SOS Rhino); Research Assistant, Darwin Online Project, Centre for Research in the Arts, Social Sciences and Humanities, University of Cambridge; Researcher, Strickland Archives at the University Museum of Zoology, Cambridge

The African elephant in 1989 was added to Appendix I of animals governed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), where the Asian elephants had been listed since 1975. For CITES Parties this meant a ban of all international commercial trade in elephant products, which came into effect in January 1990. The European Union now allows only the import of ivory antiques, defined as items manufactured before 1 June 1947, while raw and worked ivory can be exported from EU countries subject to the destination country issuing a certificate to authorize the import. Because obviously illegal trade in ivory can easily be linked to poaching wild elephants, Esmond Martin and Daniel Stiles have been engaged in a series of surveys to monitor the extent of ivory trade around the world.

Their latest report, the subject of this review, is the fourth in a continuing series of surveys to establish baseline figures that can assist in monitoring current ivory trade. After covering the markets in Africa, South-East Asia and East Asia in three previous books, the authors now for the first time look at the extent of the trade in a region where elephants have not occurred naturally in the modern epoch. The authors surveyed the trade in selected cities in Germany, the

United Kingdom, France, Spain and Italy. It is not altogether clear why these countries were selected, or rather why their neighbours were excluded. One would equally expect some trade in Holland or Belgium, in Scandinavia, or in some of the countries in the eastern section of Europe.

Ivory carving has been practised in Germany for many centuries. Erbach on the Rhine has been a centre for this industry from the middle of the 18th century, and at its peak in the 1870s and 1880s some 200 craftsmen were employed as carvers. Since that time, the trade has had its ups and downs, based on fashion, economy and the ability to export. In the 1980s, Germany imported on average 19.76 tonnes of ivory per annum, less than the domestic consumption in previous decades of 24 tonnes per annum. At the time of the survey, there were only 7–10 carvers active in Erbach, producing mostly small figurines and ornaments. In Michelstadt, close to Erbach, where in four shops surveyed, 8639 ivory items were offered for sale, all new items processed from legally acquired stock. Most products are bought by Germans for private use.

In the United Kingdom, ivory has mostly been worked to produce piano keys, bagpipe mounts, small jewellery and similar items. In 2004, the survey

counted 8325 items in various London outlets, mostly in stalls in antique markets. Only 166 of these were found to have been manufactured after the 1989 ban on ivory trade. Traders said that Americans bought most of the items and in all probability exported them without official permits.

There was relatively little ivory for sale in France, Spain or Italy. About 40% of the items were made in Asia. Claims that the figurines and jewellery items were imported before 1989 could not be verified. Spain had a commendable record of law enforcement and record keeping on ivory seizures, while the statistics kept by Italy were far from complete.

One of the outcomes of the survey, which possibly was least expected, was that the ivory markets in Germany and the UK ranked sixth and ninth from the top according to the minimum number of items found for sale during the surveys in Africa, Asia and Europe. Hence the demand in Europe far exceeds that in China, Japan, Cameroon and Nigeria, which are all viewed as important ivory markets. Most of the European ivory, however, was manufactured pre-1989 and is therefore legal, while the African and Asian markets use material obtained from freshly poached elephants. Some raw ivory and small amounts of worked ivory are still entering the European countries surveyed, mainly from Africa and East Asia. Sizeable quantities of worked ivory are imported from the USA. The quantities, however, seem to be diminishing and the demand falling.

Like its predecessors, this is a handsome volume, A4 size, soft cover, well printed. It is illustrated by original drawings prepared by Andrew Kamiti, but I missed a short biography of this artist in the book. There are maps showing places mentioned in the text, some black-and-white photographs in the text, as well as eight (unnumbered) pages with colour pictures taken by the authors in the course of their survey. Had they been numbered, it would have been easier to refer to them in the text, which might have given them something more than just decorative value. The bibliography with 66 references is carefully prepared and properly presented. There is a list of tables, but no list of illustrations and no index—which with the

growing number of pages in these reports might be something to consider in future instalments.

Because the four reports thus far published in this series deserve to be kept for future reference, I was curious how many copies were available in the larger libraries. I was somewhat surprised to find that a search of the major depositories in the UK (accessible globally through www.copac.ac.uk) found only one copy of one of the reports in one library. A search through European national libraries as well as the Library of Congress (accessible through www.ubka.uni-karlsruhe.de/hylib/en/kvk.html) did not show any copies beyond the one mentioned. The books are provided with an ISBN number, but they are not sold by the large Internet book stores like Amazon or the Natural History Book Service. I then had a look at the websites of the publishers. Care for the Wild International mentions this latest report (on the trade in Europe) on their website, but without any information on price or availability. Save the Elephants gives details of the first three reports among their publications, with an email link to request a copy. Possibly the distribution of copies could be improved.

Esmond Martin and Daniel Stiles have again provided valuable baseline statistics to help in monitoring the trends in the availability of ivory. The attention to detail in the report is remarkable, and the text guides us through the myriad of numbers and trends carefully and confidently. It should provide a basis for policymakers to review the impact of the ivory ban on the populations of elephants in the range states and the use of stockpiles of ivory obtained from elephants that died naturally. I assume that the current team will have a chance to continue their efforts to provide more badly needed statistics, maybe by surveying the markets in the USA and Australia, and possibly after a while re-visiting the major ivory hotspots in Africa and Asia. Wherever they go, they will assemble large amounts of data not available elsewhere, they will ensure that the results are properly published, and they will make every effort to alert the press to the most important outcome. I recommend this report to everybody interested in elephants or animal trade issues.

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GUIDELINES TO CONTRIBUTORS

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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 disseminating information concerning the activities of the African Elephant, the African Rhino, and the Asian Rhino Specialist Groups of the IUCN Species Survival Commission.

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Use common names of animals and plants, giving scientific names in italics on first mention.

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- Adams JX. 1995b. Seizures and prosecutions. *TRAFFIC Bulletin* 15(3):118.
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- Tchamba MN. 1996. Elephants and their interactions with people and vegetation in the Waza–Logone region, Cameroon. PhD thesis, University of Utrecht, The Netherlands. 142 p.
- Woodford MH. 2001. [Title]. [*Journal* or publisher]. Forthcoming. [if publication date is known]
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