

Pachyderm

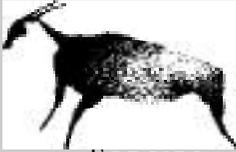
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SPECIES
SURVIVAL
COMMISSION**Editor**

Helen van Houten

Editorial Assistant

Pam Mwangore

Editorial Board

Holly Dublin

Esmond Martin

Leo Niskanen

Robert Olivier

Nico van Strien

Lucy Vigne

Design and layout

Damary Odanga

Address all correspondence,
including enquiries about
subscription, to

The Editor, *Pachyderm*
PO Box 68200, 0100 GPO
Nairobi, Kenya

tel: +254 2 576461

fax: +254 2 570385

email: afesg@ssc.iucn.org

Web site: www.iucn.org/afesg



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Photo: Daniel Stiles

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Rapport de Groupe des Spécialistes des Eléphants d'Afrique

Holly T. Dublin, Chair / Président

PO Box 68200, GPO 00100, Nairobi, Kenya
email: holly.dublin@ssc.iucn.org

As I reflect over the last few months I am pleased to report that we have made considerable progress in all our main fields of activity. The new Reintroduction Task Force met for the first time to discuss the development of guidelines for elephant translocation, and the Human–Elephant Conflict working group also convened to discuss ongoing projects and to deliberate on its future work plan. In the meantime, the African Elephant Database (AED) manager has intensified his efforts to digitize survey reports and other information to be incorporated into the 2002 African Elephant Status Report, and the programme officers in Yaoundé and Ouagadougou have continued their efforts to bring AfESG expertise to bear in their respective subregions.

Human–Elephant Conflict working group

The newly reappointed Human–Elephant Conflict working group held its first meeting on 30 and 31 May in Nairobi. This meeting was fully funded by the European Commission.

The main topic for discussion was the new WWF-funded project aimed at reducing levels of human–elephant conflict (HEC) at selected sites in Africa. The goal of this project is to build the capacity of wildlife managers and local communities to mitigate HEC through supervised use and testing of AfESG technical products over the next three years. The HEC working group consultants will be training WWF project executants and enumerators of elephant damage in field data collection (using the AfESG HEC data collection protocol), data processing and analysis.

At the end of the project, mitigation reports will be produced for each of nine selected sites. In central and West Africa these are Tai and Comoë in Côte

Quand je pense à ces derniers mois, je suis heureuse de pouvoir dire que nous avons fait des progrès considérables dans tous nos principaux domaines d'activité. La nouvelle Force Spéciale de Réintroduction s'est réunie pour la première fois pour discuter de la mise au point de lignes directrices pour la translocation des éléphants, et le Groupe de travail chargé des conflits hommes-éléphants s'est aussi rassemblé pour discuter des projets en cours et de son futur plan de travail. Pendant ce temps, le responsable de la Base de Données pour l'éléphant d'Afrique a intensifié ses efforts pour numériser les rapports de recherches et toutes les autres informations à intégrer au rapport 2002 sur le statut de l'éléphant d'Afrique, et les responsables de programme à Yaoundé et à Ouagadougou ont poursuivi leurs efforts pour faire profiter leur sous-région respective de l'expertise du GSEAf.

Groupe de travail chargé des conflits hommes-éléphants

Ce groupe de travail qui vient d'être reconduit a tenu sa première réunion les 30 et 31 mai à Nairobi. Cette réunion était entièrement financée par la Commission Européenne.

Le sujet de discussion principal était le nouveau projet, financé par le WWF, destiné à réduire le niveau des conflits hommes-éléphants (HEC) sur les sites choisis, en Afrique. L'objectif de ce projet est de construire les capacités nécessaires en matière de gestionnaires de la faune et de communautés locales pour tempérer les HEC, au moyen de l'utilisation supervisée et des mises à l'épreuve des moyens techniques du GSEAf, au cours des trois prochaines années. Les consultants du groupe de travail HEC assureront la formation des exécutants du projet WWF et de ceux qui sont chargés de recenser les dégâts

d'Ivoire, Waza and Mt Nlonako in Cameroon, and Gamba in Gabon. In eastern and central Africa the sites include Tarangire and Selous in Tanzania, Luangwa in Zambia and Niassa in Mozambique. These sites were selected on the basis that they cover a range of habitats with suspected variation in conflict intensity and are spread across the four sub-regions of Africa. It is hoped that this project will result in reduced levels of HEC at the sites as well as help the working group to update and improve their conflict mitigation tools. The first sites for running training courses for project executives have been tentatively agreed as Luangwa and Tarangire.

To help produce the site mitigation reports for each of the sites listed above, the AfESG recently started a pilot project to produce working maps from satellite images of human–elephant conflict sites with the help of a geographic information system. As HEC is a spatial phenomenon, the production of up-to-date, standardized maps of sufficient resolution is expected to be an invaluable tool for designing effective HEC mitigation strategies. This is particularly so as only very basic and often out-of-date maps of many of the HEC zones are currently available. This pilot project is nearing its end and satellite-generated maps of the three pilot sites in Guinea-Conakry, Kenya and Zambia are currently undergoing last stages of ground-truthing and georeferencing.

Another issue that was discussed at length at the working group meeting was the idea of making HEC information available for updating elephant range in the *African elephant database*. For such information to be useful for the AED it should at a minimum have the location of the HEC incident (GPS coordinates) and date. The collection of such data is useful for the purposes both of establishing the extent of conflict and of helping define elephant range. In particular, point data on HEC incidents from areas where elephant population survey data are not available reveal important information about the presence of elephants. However, HEC reporting and data collection systems vary tremendously from country to country. In some countries, information on each reported incident of HEC is carefully recorded while in others it is not because resources are lacking or the locations of many HEC sites are remote.

Although AfESG has already taken great strides in updating and improving the HEC Web page <http://iucn.org/afesg/hectf/> it was, nevertheless, extremely

causés par les éléphants dans le domaine de la récolte de données (en se servant du protocole de récolte des données de HEC du GSEAf), du traitement des données, et de leur analyse.

A la fin du projet, on produira des rapports sur les mitigations pour chacun des neuf sites sélectionnés. En Afrique Centrale et de l'Ouest, ce sont Tai et Comoë en Côte d'Ivoire, Waza et le Mont Nlonako au Cameroun, et Gamba au Gabon. En Afrique de l'Est et Centrale, ces sites comprennent Tarangire et Selous en Tanzanie, Luangwa en Zambie et Niassa au Mozambique. Ces sites ont été sélectionnés parce qu'ils recouvrent une gamme d'habitats où l'on s'attend à ce que les niveaux de conflits soient différents et qu'ils sont dispersés dans les quatre sous-régions d'Afrique. On espère que ce projet aboutira à une réduction des HEC sur les sites et qu'il aidera le groupe de travail à mettre à jour et à améliorer ses instruments pour la mitigation des conflits. Comme premiers sites pour les cours de formation pour les executives des projets, on a provisoirement choisi Luangwa et Tarangire.

Pour aider à rédiger les rapports qui seront faits pour chacun des sites de mitigation nommés ci-dessus, le GSEAf a lancé récemment un projet pilote pour produire des cartes de travail à partir d'images satellite des sites de conflits hommes-éléphants, grâce à un système d'information géographique (GIS). Etant donné que les HEC sont des conflits concernant des surfaces de terrains, des cartes actualisées, standardisées, à une échelle adéquate, devraient être un outil inestimable pour la conception de stratégies efficaces de mitigation des HEC. Ceci est particulièrement important parce qu'on ne dispose actuellement que de cartes très simplifiées et souvent périmées de nombreuses zones de HEC. Ce projet pilote touche à sa fin, et les cartes satellite des trois sites pilotes situés en Guinée-Conakry, au Kenya et en Zambie subissent actuellement les dernières étapes de vérification de terrain et de géo-référencement.

Une autre question qui fut longuement débattue au cours de la réunion du groupe de travail concernait l'idée de pouvoir se servir des informations sur les HEC pour actualiser l'aire de répartition des éléphants sur la *Base de données sur l'éléphant d'Afrique*. Pour que ces informations soient utiles pour la BDEA, elles devraient au minimum contenir la localisation des incidents HEC (coordonnées GPS) et leur date. La récolte de ces données est importante si l'on veut avoir

useful to have the opportunity to discuss the future development of the site with members of the working group. The outcome of the discussion was as follows:

- 1) It is desirable for the Management and Research Recommendations section to include a section outlining specific research hypotheses that need to be tested to help guide researchers interested in human–elephant conflict.
- 2) The Products under Development section will be split into Current Activities and Activities Seeking Support. The former will provide information about ongoing activities of the HEC working group such as the WWF-funded site-based project, while the latter will include activities and projects planned for the future.
- 3) A number of links to other sites that contain information about a variety of simple, low-cost deterrent methods were also suggested.

Elephant translocation

Between 1 and 12 July, an AfESG-nominated team consisting of AfESG members Hugo Jachmann and Moses Litoroh, together with the IUCN Veterinary Specialist Group Co-Chair, Richard Kock, travelled to Burkina Faso and Senegal to assess the feasibility of a proposed translocation of 12–15 elephants from Arly National Park in Burkina Faso to Niokolo Koba National Park in Senegal. This mission, which was funded by USAID, was organized in response to a request by the Senegalese wildlife authorities for a technical opinion on the proposed translocation. The team visited both source and recipient sites and interviewed government representatives, national park staff and representatives of non-government organizations and local communities. The final report and recommendations are being finalized and will soon be sent to the concerned range states.

This was the first elephant translocation feasibility mission that AfESG organized. It is likely that other similar missions will be necessary in the future as interest in elephant translocation for reintroduction, re-enforcement or management purposes continues to grow despite the lack of information on the various technical aspects requiring consideration when undertaking such moves. In an effort to fill this technical vacuum, AfESG together with the IUCN/SSC Reintroduction Specialist Group recently set up

une idée de l'ampleur des conflits et aider à définir l'aire de répartition des éléphants. Les données ponctuelles sur des incidents HEC qui se sont produits à des endroits pour lesquels on ne dispose pas de données sur la population d'éléphants fournissent des informations particulièrement importantes sur leur présence. Cependant, les systèmes en vigueur pour les rapports et les récoltes de données sur les HEC varient énormément d'un pays à l'autre. Dans certains pays, ces informations sont minutieusement rapportées tandis qu'ailleurs, ce n'est pas le cas parce qu'on manque de ressources ou que l'emplacement de nombreux sites de HEC est très reculé.

Bien que le GSEAf avance à grands pas dans l'actualisation et l'amélioration de la page Web de HEC <http://iucn.org/afesg/hectf/>, il a néanmoins été très utile de pouvoir discuter du développement futur du site avec les membres du groupe de travail. Les résultats de la discussion sont les suivants :

- 1) Il est souhaitable que la section Recommandations en matière de Gestion et de Recherche comprenne une sous-section qui reprend les hypothèses de recherche spécifiques qu'il faut tester pour aider les chercheurs qui s'intéressent aux conflits hommes-éléphants.
- 2) Les Produits qui se trouvent dans la Section Développement seront séparés en Activités en cours et Activités requérant un support. Les premières fourniront des informations sur les activités actuelles du groupe de travail HEC, telles que le projet basé sur les sites financé par le WWF, et les secondes incluront les activités et les projets prévus pour plus tard.
- 3) On a aussi suggéré d'ajouter un certain nombre de liens avec d'autres sites qui donnent des informations sur des méthodes de dissuasion simples et bon marché.

Translocation des éléphants

Du 1^{er} au 12 juillet, un groupe choisi par le GSEAf, composé d'Hugo Jachmann et de Moses Litoroh, auxquels s'était joint le co-président du Groupe de Spécialistes Vétérinaires de l'IUCN, Richard Kock, s'est rendu au Burkina Faso et au Sénégal pour évaluer la faisabilité de la translocation de 12 à 15 éléphants du Parc National d'Arly, au Burkina Faso, vers le Parc de Niokolo Koba, au Sénégal. Cette mission, financée par USAID, était organisée pour répondre aux

a task force to begin drafting guidelines of best practices for translocation. This task force held its first meeting on 25 and 26 July to identify the issues and to decide on work assignments and deadlines. The document, which will give guidelines on all main technical issues that need to be taken into account at both source and recipient sites, is expected to be ready for distribution by mid-2003, provided that sufficient funding can be made available. The task force is expected to consult with a number of relevant experts, and the final draft will be made available for public review on the AfESG Web site. It is hoped that this new tool will become a highly useful reference document for African elephant translocation practitioners and their donors by raising awareness of the problem areas and best practices relating to translocating African elephants and by discouraging inappropriate and ill-informed translocations.

African elephant status report

With all the planned modifications to the structure and functionality of the AED now implemented, preparations for producing the African Elephant Status Report 2002 (AESR 2002) are in full swing. Data from survey reports and other sources of information are being digitized and entered in the database, in preparation for the analysis stage. As AESR 2002 will include data generated up to the end of the present year, there is still time to send any information you may have for this update. So, if you haven't already done so, please drop the AED manager a line on julian.blanc@ssc.iucn.org.

MIKE update

Over 80% of the African MIKE sites have started delivering data on law enforcement monitoring, and plans are in place to ensure that over 90% of the sites will have completed population surveys by the end of 2003. All the MIKE forms are close to being fully incorporated in the MIKE database and the computer systems have been purchased and will soon be delivered to the sites. These developments will greatly facilitate data entry into the database.

MIKE also held a major regional meeting (10–11 September) at which the African and Asian range states heard progress reports from MIKE and ETIS intended for delivery at the 12th meeting of the Con

autorités sénégalaises de la Faune qui avaient demandé un avis technique sur ce projet de translocation. L'équipe a visité le site de départ et celui d'arrivée et a interrogé les représentants des gouvernements, le personnel des parcs nationaux et des représentants des organisations non gouvernementales et des communautés locales. Le rapport final et les recommandations sont en bonne voie et seront bientôt envoyés aux Etats concernés de l'aire de répartition.

Ceci était la première mission de faisabilité d'une translocation qu'organisait le GSEAf. Il est probable que d'autres missions semblables seront nécessaires à l'avenir étant donné que l'intérêt concernant la translocation d'éléphants s'accroît, qu'il s'agisse de réintroduction, de renforcement ou de gestion, malgré le manque certain d'informations sur les divers aspects techniques qui doivent être pris en compte lorsqu'on entreprend de tels déplacements. Afin de combler ces lacunes techniques, le GSEAf, avec le Groupe des Spécialistes de la Réintroduction de la CSE/UICN, a récemment créé une force spéciale chargée d'établir les lignes directrices des meilleurs méthodes de translocation. Ce groupe s'est réuni pour la première fois les 25 et 26 juillet pour identifier les problèmes et décider des attributions des tâches et du calendrier. Le document qui donnera les directives concernant toutes les principales questions techniques sur le site d'origine et celui d'arrivée devrait être prêt pour la diffusion vers le milieu de 2003, pour autant qu'on ait réuni les fonds nécessaires. La force spéciale devrait consulter un certain nombre d'experts en la matière, et le document final sera disponible pour tous sur le site Web du GSEAf. On espère que ce nouvel instrument deviendra un document de référence extrêmement utile pour ceux qui pratiquent des translocations d'éléphants et pour leurs donateurs, en les sensibilisant aux zones qui font problèmes et aux meilleures façons de faire en ce qui concerne la translocation d'éléphants africains, et en freinant les déplacements inappropriés et mal documentés.

Rapport sur le statut de l'éléphant africain

Maintenant que toutes les modifications prévues de la structure et de la fonctionnalité de la BDEA ont été faites, la préparation du Rapport 2002 sur le statut de l'éléphant africain (AESR) bat son plein. Les données

ference of the Parties in November in Santiago. The AfESG Secretariat participated in this meeting and presented ways that it can assist the African elephant range states in their conservation efforts. This presentation was well received by the meeting delegates.

West Africa programme office

The protection of elephant habitat, especially migration corridors in cross-border areas, and the need to establish and manage such corridors are recognized as priority activities in the Strategy for the Conservation of West African Elephants. Indeed, a number of the most important West African elephant populations straddle international borders. This creates special conservation challenges for wildlife management authorities. To respond to these challenges, AfESG's West Africa Programme Office is organizing a workshop in December 2002 to develop a strategic plan for establishing and protecting cross-border elephant corridors. The main objectives of the meeting, which will be attended by national wildlife authorities and technical experts, are to identify the main cross-border corridors and to discuss ways that their long-term protection can be assured through close cooperation between the range states. The workshop is fully funded by Conservation International's Critical Ecosystem Partnership Fund.

Central Africa programme office

Elie Hakizumwami, the AfESG programme officer for central Africa, is continuing his work to establish closer links with organizations and individuals involved in elephant conservation activities in the sub-region. Discussions have been held with government representatives from several range states and NGOs. Generous financial assistance from the European Commission and the US Fish and Wildlife Service has enabled Elie to travel to the Democratic Republic of Congo, Congo-Brazzaville and Equatorial Guinea to gain a better understanding of the specific challenges facing elephant conservation in those countries. The rest of the range states in the subregion will be visited in the coming months. These discussions are reaffirming AfESG's belief that there exists throughout the central African range states a continuing interest in developing a subregional elephant conservation strategy to help address the various elephant

fournies par les rapports de recherche et d'autres sources sont numérisées et encodées dans la Base de données, en prévision de l'étape de l'analyse. Comme l'AESR 2002 reprendra les données générées jusqu'à la fin de cette année, il est encore temps d'envoyer toutes les informations que vous pourriez avoir jusqu'alors. Donc, si vous ne l'avez pas encore fait, contactez le manager de la BDEA sur julian.blanc@ssc.iucn.org.

Mise à jour de MIKE

Plus de 80% des sites africains de MIKE ont commencé à délivrer des informations sur le contrôle du maintien des lois, et les plans sont en place pour s'assurer que plus de 90% des sites aient terminé leur étude de population à la fin de 2003. Tous les formulaires de MIKE sont près d'être complètement introduits dans la base de données de MIKE, et les systèmes informatiques ont été achetés et seront bientôt livrés sur les sites. Cette évolution va vraiment beaucoup faciliter l'entrée des données dans la base de données.

MIKE a aussi rassemblé une importante réunion régionale (les 10 et 11 septembre) pendant laquelle les Etats de l'aire de répartition ont entendu les rapports sur les progrès de MIKE et de ETIS qui devront être communiqués à la 12^{ème} réunion de la Conférence des Parties, en novembre, à Santiago. Le secrétariat du GSEAf a participé à cette réunion et a fait des présentations sur les manières dont il peut assister les Etats de l'aire de répartition dans leurs efforts de conservation. Cette présentation a été bien accueillie par les délégués.

Bureau du Programme en Afrique de l'Ouest

La protection de l'habitat des éléphants, et spécialement des corridors de migration dans des zones trans-frontières, et la nécessité de bien identifier et de gérer ces corridors, sont reconnues comme des activités prioritaires dans la Stratégie de Conservation des Eléphants d'Afrique de l'Ouest. En effet, un certain nombre des plus importantes populations d'éléphants d'Afrique de l'Ouest franchissent des frontières internationales. Ceci pose des défis spéciaux aux autorités chargées de la gestion de la faune qui

conservation challenges such as managing cross-border elephant populations and harmonizing wildlife legislation. It is therefore considered a priority for AfESG to continue encouraging support for the development of such a subregional strategy.

Seizing the opportunity presented by the September MIKE Regional Meeting in Nairobi, I met with the wildlife authorities from the central African range states of Cameroon, Central African Republic, Chad, Congo-Brazzaville, Democratic Republic of Congo, Equatorial Guinea and Gabon to discuss the way forward for this strategy. During our discussions, all the representatives of these states reiterated their firm belief in the need for a subregional elephant strategy, and it was agreed that Elie Hakizumwami would work closely with these countries in the coming weeks and months to kick-start the process for putting such a strategy in place. I hope to be able to report that considerable progress will have been made on this important initiative in the next Chair report.

The AfESG small grants fund

AfESG manages a small grants fund to finance proposals or supplement ongoing projects for small amounts (USD 2000–10,000 each) to help build capacity of African students, researchers and organizations while also increasing the growing knowledge base that helps conserve the African elephant. Grants are awarded through a competitive process and proposals are evaluated against clear criteria to ensure that the results both benefit elephant conservation and contribute to AfESG objectives. AfESG encourages applications from researchers, students and wildlife management authorities (both within and outside AfESG membership) concerned with management and conservation of African elephants.

So far the AfESG small grants fund has helped support the following projects:

- A study of the chemical composition of mineral licks in Aberdare National Park, Kenya, and use elephants make of them
- A survey of the status of elephants in Arabuko Sokoke and Shimba Hills National Reserves, Kenya
- An aerial count of elephants in Nasolot, South Turkana, Rimoi and Kamnarok National Reserves and the surrounding areas in northern Kenya (reported in this issue of *Pachyderm*)

doivent les protéger. Pour répondre à ces défis, le Bureau du Programme du GSEAF en Afrique de l'Ouest organise un atelier en décembre 2002 pour mettre au point un plan stratégique pour l'établissement et la protection des corridors trans-frontières. Les principaux objectifs de la réunion, à laquelle assisteront les autorités nationales de la faune et des techniciens experts, sont d'identifier les principaux corridors trans-frontières et de discuter des moyens d'assurer leur protection à long terme par une étroite collaboration entre les Etats de l'aire de répartition. L'atelier est entièrement financé par le *Critical Ecosystem Partnership Fund* de *Conservation International*.

Bureau du Programme en Afrique Centrale

Elie Hazikumwami, le Responsable de Programme en Afrique Centrale, poursuit sa mise en place de liens plus étroits avec les organisations et les personnes impliquées dans les activités de conservation des éléphants dans la sous-région. Il y a eu des discussions avec des représentants des gouvernements de plusieurs états de l'aire de répartition et des ONG. Une généreuse aide financière de la Commission Européenne et du *Fish and Wildlife Service* américain a permis à Elie de se rendre en République Démocratique du Congo, au Congo-Brazzaville et en Guinée Equatoriale afin de mieux comprendre les challenges spécifiques que rencontre la conservation des éléphants dans ces pays. Il ira aussi dans les autres pays de l'aire de répartition de la sous-région dans les mois qui viennent. Ces discussions confortent la conviction du GSEAF qu'il existe dans les états de l'aire de répartition d'Afrique Centrale un intérêt soutenu pour la mise au point d'une stratégie de conservation des éléphants de la sous-région qui devrait aider à relever les différents défis posés par la conservation des éléphants, tels que la gestion de populations trans-frontières et l'harmonisation de la législation en matière de faune. Le GSEAF considère donc comme une priorité de continuer à encourager le support du développement d'une telle stratégie sous régionale.

Saisissant l'opportunité que m'offrirait la réunion régionale de MIKE en septembre, à Nairobi, j'ai rencontré les autorités de la faune du Cameroun, de la République Centrafricaine, du Tchad, du Congo-

- A project for monitoring law enforcement and illegal activities in south-western Ethiopia
- A project for monitoring law enforcement and illegal activity in the northern sector of Virunga National Park in the Democratic Republic of Congo, with a focus on elephant poaching
- A study of the role of law enforcement in the protection of the elephant population in Kasungu National Park, Malawi
- An aerial survey in the extreme west of Tete Province, Mozambique
- A project for capacity building for implementing elephant census, research, monitoring and education activities, Ghana
- A study of human–elephant conflict and the movements of elephants between Kabore Tambi National Park in Burkina Faso and Ghana
- A study of the impact of human incursions on elephant range and migration corridors in Togo

The way ahead

Elephant conservation continues to present serious challenges and AfESG will continue to provide technical assistance to help deal with many of them. However, such efforts require substantial financial support, which is why AfESG will kick into a major fund-raising drive from the beginning of 2003. I am fortunate to have been given the opportunity to give a series of talks in Europe at the end of this year in which I will highlight some of the pressing conservation challenges facing the African elephant and discuss the ways in which AfESG is contributing to meeting these challenges. In addition to increasing general awareness I hope that these talks will serve as a useful platform from which to launch our fund-raising efforts.

Brazzaville, de la République Démocratique du Congo, de la Guinée Equatoriale et du Gabon pour discuter de la progression de cette stratégie. Pendant ces discussions, tous les représentants de ces états ont réitéré leur conviction de la nécessité d'une stratégie sous régionale pour les éléphants, et il fut décidé de commun accord qu'Elie travaillerait en collaboration étroite avec ces pays dans les semaines et les mois qui viennent pour lancer le processus de mise en place de cette stratégie. J'espère pouvoir annoncer que cette initiative importante a connu de vrais progrès dans mon rapport prochain de présidente.

Le fonds de petites subventions du GSEAF

Le GSEAF gère un fonds de petites subventions destiné à financer des propositions ou à compléter des projets en cours avec de petits montants (USD 2.000 – 10.000 chaque fois) pour aider à construire des capacités pour des étudiants, des chercheurs ou des institutions africains tout en aidant à accroître la base croissante de connaissances qui aide à conserver l'éléphant africain. Les subventions sont accordées par un processus de concours, et les propositions sont évaluées par rapport à des critères bien définis qui garantissent que les résultats vont profiter à la conservation des éléphants et contribuer aux objectifs du GSEAF. Le groupe encourage les demandes de chercheurs, d'étudiants et d'autorités en gestion de la faune (parmi les membres du GSEAF, mais aussi en dehors) qui s'intéressent à la gestion et à la conservation des éléphants africains.

Jusqu'à présent, le fonds du GSEAF a aidé à soutenir les projets suivants :

- Une étude de la composition chimique et de l'utilisation des *salt licks* par les éléphants du Parc National des Aberdares, au Kenya,
- Une étude du statut des éléphants des Réserves Naturelles d'Arabuko Sokoke et de Shimba Hills, au Kenya,
- Un comptage aérien d'éléphants des Réserves Naturelles de Nasolot, de South Turkana, de Rimoi et de Kamnarok, et de leurs environs dans le nord du Kenya [le rapport se trouve dans cet issue de *Pachyderm*],
- Un projet pour contrôler le respect des lois et les activités illégales au sud-ouest de l'Ethiopie,
- Un projet pour contrôler le respect des lois et les

activités illégales dans le secteur nord du Parc National des Virunga en République Démocratique du Congo, avec un intérêt spécial pour le braconnage des éléphants,

- Une étude du rôle du maintien des lois dans la protection de la population d'éléphants du Parc National de Kasungu, au Malawi,
- Une étude aérienne de la Province de Tete, à l'extrême ouest du Mozambique,
- Un projet de construction de capacités pour réaliser des recensements d'éléphants et des activités de recherches, de surveillance continue et d'éducation au Ghana,
- Une étude des conflits hommes-éléphants et des déplacements des éléphants entre le Parc National de Kabore Tambi, au Burkina Faso et le Ghana,
- Une étude de l'impact des incursions humaines sur l'aire de répartition des éléphants et les corridors de migrations au Togo.

L'avenir

La conservation des éléphants continue de poser de défis sérieux, et le GSEAF continuera à apporter son assistance technique pour aider à en relever beaucoup. Cependant, ces efforts nécessitent un support financier conséquent, et le GSEAF va se lancer dans une campagne importante de récolte de fonds dès le début de 2003. J'ai la chance d'avoir la possibilité de donner toute une série de conférences en Europe à la fin de cette année. Je vais y souligner certains des défis de conservation urgents que rencontre l'éléphant africain et discuter les moyens par lesquels le GSEAF contribue à les relever. Je compte bien que ces causeries vont, non seulement participer à la sensibilisation générale, mais aussi servir de plate-forme utile d'où nous pourrions lancer nos efforts de récolte de fonds.

African Rhino Specialist Group report

Rapport du Groupe des Spécialistes des Rhinos d'Afrique

Martin Brooks, Chair/Président

PO Box 13055, Cascades, 3202, KwaZulu-Natal, South Africa
email: mbrooks@kznwildlife.com

The 2002 AfRSG meeting

The sixth AfRSG meeting was successfully held at Malilangwe, Zimbabwe, from 1 to 6 June 2002. As usual, the continental numbers and trends of African rhinos both in the wild and in captivity were updated at the meeting and details of this review are given by the Scientific Officer, Richard Emslie, in the 'Rhino Notes' section of this publication. While numbers of two subspecies—the western black rhino (*Diceros bicornis longipes*) and the northern white rhino (*Ceratotherium simum cottoni*)—remain very low, I am pleased to report that at a species level, numbers of black and white rhino continue to increase reaching 3100 and 11,670 respectively by the end of 2001. The number of AfRSG-rated *Key* and *Important* populations has also been increasing. While this is most encouraging, as the press release from the meeting stated, there is still much to be concerned about and certainly there is no room for complacency.

A presentation by one of the Asian Rhino Specialist Group's programme officers, Nico van Strien, informed the membership on the status of the three Asian rhino species and briefly outlined some of the main current Asian rhino conservation initiatives.

In addition to compiling the continental statistics, the AfRSG meetings also fulfil an important role by facilitating information exchange and collaboration among range state members, other members and invited delegates. The 2002 meeting was no exception, and achieving this aim was facilitated through a combination of factors including choice of venue (where delegates were based in a rhino conservation area at Malilangwe and were able to socialize and network throughout the day during meals and in the evenings); the participatory nature of working groups; and the field study visit where delegates were exposed to how Malilangwe had successfully reintroduced both black and white rhinos, their monitoring and security systems.

La Réunion 2002 du GSRAf

La sixième Réunion du GSRAf qui s'est tenue à Malilangwe, Zimbabwe, du 1^{er} au 6 juin 2002 fut une réussite. Comme d'habitude, on a remis à jour les chiffres et les tendances concernant les rhinos africains tant sauvages que captifs, à l'échelle du continent, et vous pouvez lire les détails de cette révision, donnés par le Responsable Scientifique, Richard Emslie, dans la section « Rhino Notes » de ce numéro. Si les chiffres concernant deux sous-espèces – le rhino noir de l'ouest (*Diceros bicornis longipes*) et le rhino blanc du nord (*Ceratotherium simum cottoni*) – restent très bas, je suis heureux de pouvoir annoncer qu'au niveau des espèces, le nombre de rhinos noirs et de rhinos blancs continue à augmenter et qu'ils ont atteint le chiffre de 3.100 et 11.670 respectivement, à la fin 2001. Les chiffres concernant les populations-clés et importantes – selon les critères du GSRAf – sont aussi en hausse. Si ceci est extrêmement encourageant, comme le disait le communiqué de presse de la réunion, il reste des motifs d'inquiétude, et ce n'est pas encore le moment de baisser la garde.

Une présentation faite par un des Responsables de Programme du Groupe des Spécialistes des Rhinos d'Asie, Nico van Strien, a renseigné les membres sur le statut des trois espèces de rhinos d'Asie et a donné un bref aperçu de certaines des tendances actuelles en matière d'initiatives de conservation des rhinos asiatiques.

En plus du fait qu'elles compilent les statistiques à l'échelle du continent, les réunions du GSRAf remplissent un rôle important en facilitant les échanges d'informations et la collaboration entre les membres venus de l'aire de répartition, les autres membres et les délégués invités. La réunion 2002 n'a pas fait exception, et son objectif a été rendu plus aisé grâce à une combinaison de facteurs tels que le choix de l'endroit (les délégués étaient basés dans

tems, as well as being able to see a transmitter being implanted in the field. One example illustrating the success of this networking was that in one working group members were able to give technical advice and comment on the fencing of a proposed rhino sanctuary in Uganda.

The meeting began with reports from the various African range states on the management of their rhino populations. This was followed by a variety of technical and research papers informing delegates on a wide range of issues including

- TRAFFIC's rhino horn trade programme
- rhino horn trade between eastern Africa and Yemen
- use of population indicators derived from monitoring
- performance of selected black rhino metapopulations and populations—lessons from case studies
- importance of maximizing black rhino population growth rates and the newly recommended removal strategy for achieving this (to emerge from the RMG biological management workshop reported in *Pachyderm* 31)
- assessing black rhino body condition
- updated RHINO software for population estimation; Kenyan rhino database management system
- SADC WILDb database system
- resuscitation and recent activities of the Rhino and Elephant Security Group of southern Africa
- rhino horn fingerprinting—validation of initial work, results of further analyses and recommended future programme
- black rhino carrying capacity estimation model for SADC RMG areas
- update on veterinary developments relating to rhino
- re-establishment guidelines, including implications of small populations
- preliminary guidelines for the creation of male-only black rhino populations
- rhino re-establishment plans for Uganda
- black rhino re-establishment programme for North Luangwa, Zambia
- white rhino re-establishment programme for Chief's Island, Botswana
- South Africa: summary of the 2001 survey of white rhinos on private land in South Africa
- potential of biosphere reserves for rhino conservation
- reviews of rhino custodianship programmes and

une aire de conservation des rhinos à Malilangwe et ils ont pu socialiser et faire des échanges toute la journée pendant les repas et le soir), la nature participative des groupes de travail et l'accès à la recherche de terrain qui a permis de montrer aux délégués comment on a pu réintroduire avec succès des rhinos noirs et des blancs, les systèmes de contrôles et de sécurité, et aussi l'implantation sur le terrain d'un radio-émetteur. Un exemple qui illustre bien le succès de ce réseau est que, dans un des groupes de travail, les membres ont pu donner des conseils et faire des commentaires techniques sur la pose des clôtures d'un sanctuaire de rhinos en projet en Ouganda.

La réunion a commencé avec les rapports des différents pays de l'aire de répartition sur la gestion de leur population de rhinos. Ceci fut suivi de toute une variété d'articles techniques et de recherche qui renseignaient les délégués sur toute une gamme de problèmes tels que :

- le programme de TRAFFIC sur le commerce de corne de rhino
- le commerce de corne de rhino entre l'Afrique de l'Est et le Yémen
- l'utilisation des indicateurs de population dérivés des contrôles continus
- les performances de méta-populations et de populations choisies de rhinos noirs – les leçons tirées des études de cas
- l'importance de l'optimisation du taux de croissance de la population de rhinos noirs et la nouvelle stratégie de prélèvements recommandée pour y arriver (à retirer de l'atelier de gestion biologique du MRG dont le rapport se trouve dans *Pachyderm* 31)
- l'évaluation de la condition physique des rhinos noirs
- un software remis à jour pour les estimations de population ; système kenyan de gestion de la base de données sur les rhinos, le système SADC WILDb de base de données
- la remise sur pied et les activités récentes du Groupe de Sécurité sud-africain pour le Rhino et l'Eléphant
- l'empreinte génétique de la corne de rhino – validation du travail initial, résultats des analyses ultérieures et programme recommandé
- le modèle d'estimation de la capacité de charge potentielle en rhinos noirs des zones SADC RMG
- une actualisation des développements vétérinaires

updates on the SADC Rhino Programme, SADC Rhino Recovery Group (RRG), WWF's African Rhino Programme, WWF Netherlands/KZN Wildlife focal rhino project, and details of the support provided to rhino conservation by the US Fish and Wildlife's Rhino and Tiger Fund, Frankfurt Zoological Society, International Rhino Foundation and African Wildlife Foundation

A number of workshops were also held that provided direction to facilitate decision-making and development and implementation of appropriate rhino policies and strategies, and to advise on the implications of the various options. The themes included discussing pros and cons of intensive protection zones (IPZs) and sanctuaries versus releases into large unfenced areas, evaluating advancements in community-based rhino conservation, and assessing the potential implications of some rhino use options. A short meeting restricted to AfRSG members was also held to evaluate the contributions of the group over the past two years and to identify future priorities.

Cameroon

As I reported in the last issue, although spoor confirmed the likelihood that a small number of rhino remained in Cameroon, the WWF-funded survey had failed to sight any. The survey also raised concerns about the number of poaching camps and cable snares encountered during the survey and the apparent low intensity of law enforcement. Given the situation in Cameroon and the failure to establish whether a nucleus for a viable population remained, together with the extreme difficulty and cost of procuring and conserving a consolidated population in the medium to longer term, AfRSG had decided that it would not continue to actively support the programme given that limited donor money could probably be used more effectively in other areas. However, the Cameroon government was encouraged to protect the remaining rhino and to create the conditions conducive to their long-term survival. Since then Campbell Scott has developed a rather novel approach, which will not divert any traditional funding away from other rhino conservation projects (see 'Rhino Notes'). Campbell Scott proposes to undertake another survey to try again to confirm whether a nucleus for a viable population remains, and to dart and radio any rhino seen. Should their project succeed in demon-

liés aux rhinos

- des directives en matière de réinstallations, y compris l'implication des petites populations
- des directives préliminaires à la création de populations de rhinos noirs composées uniquement de mâles
- des plans pour la réinstallation de rhinos en Ouganda
- un programme de réinstallation de rhinos noirs à Luangwa Nord, en Zambie
- un programme de réinstallation de rhinos blancs sur Chief's Island, au Botswana
- un résumé de l'étude des rhinos blancs faite en 2001 sur des terres privées en Afrique du Sud
- le potentiel en matière de réserves de biosphère pour la conservation des rhinos
- révisions des programmes de responsabilisation envers des rhinos et mises à jour du Programme Rhinos de la SADC, du *Rhino Recovery Group* (RRG) de la SADC, du Programme pour les Rhinos Africains du WWF, du projet focal sur le rhino du WWF Netherlands au KZN, et des détails sur le support fourni à la conservation des rhinos par le Fonds Tigres et Rhinos de US Fish and Wildlife, par la Société Zoologique de Francfort, par l'*International Rhino Foundation* et par *African Wildlife Foundation*.

Il y eut aussi un certain nombre d'ateliers qui ont fourni des orientations pour faciliter les prises de décisions ainsi que le développement et la mise en activité de politiques et de stratégies appropriées pour les rhinos et pour donner des conseils quant aux implications des différentes options. Les thèmes comprenaient le pour et le contre des zones de protection intensive (IZP) et des sanctuaires, par rapport aux lâchers dans de grandes zones non clôturées, l'évaluation des progrès réalisés en matière de conservation communautaire des rhinos, et l'évaluation des implications potentielles de certaines options d'utilisation des rhinos. Une brève réunion, limitée aux membres du GSRAf, s'est aussi tenue pour évaluer les contributions du groupe au cours des deux dernières années et identifier les nouvelles priorités.

Cameroon

Comme je le rapportais dans le numéro précédent, bien que des traces confirment la probabilité qu'il subsiste un petit nombre de rhinos au Cameroon,

strating that a viable founder group still remains, then funding can be sought to try to put the rest of the recovery plan into action (as outlined during the Cameroon technical assistance mission workshop).

SADC RMG Biological Management Workshop recommendations

The findings of this workshop continue to be circulated widely. In addition to the discussion and adoption of the proposed new harvesting strategy by Ezemvelo KZN Wildlife in South Africa (reported on in the last issue of *Pachyderm*), in the current reporting period the Scientific Officer has given presentations on the workshop findings and recommendations at the AfRSG meeting, at a South African National Parks (SANParks) workshop to develop a revised SANParks rhino strategy, and to three different meetings at Kenya Wildlife Service headquarters. In October the new recommended strategy will also be presented to the Namibian Ministry of Tourism and Environmental Affairs' Technical Rhino Advisory Group as well as to selected park officers in the field. An electronic form of the proceedings has been submitted to the SADC regional rhino programme for eventual publication on its Web site. This process is helping meet one of the workshop recommendations, namely that the proposed revised strategy should be actively communicated to relevant conservation agencies and management teams. It is hoped that the adoption and implementation of the revised recommended harvesting strategy will help reverse the trend of declining metapopulation performance in some areas.

Visit to potential rhino sanctuary site in North Luangwa, Zambia

After the AfRSG meeting, the AfRSG Chair, Scientific Officer and specialist members Keryn Adcock, Rob Brett and Raoul du Toit visited proposed black rhino sanctuary sites within North Luangwa National Park. The AfRSG team examined the habitat in the two areas proposed for phase 1 and phase 2 of sanctuary development, as well as examining aspects of security and patrol deployment. Work has started on the electrified fencing of the initial area to receive the expected five founder rhinos, and some sugges-

l'étude financée par le WWF n'a pas réussi à en repérer un seul. Cette étude a cependant suscité des inquiétudes à propos du nombre de camps de braconniers et de pièges de câbles rencontrés pendant cette période et du manque apparent de gardiens des lois. Etant donné la situation au Cameroun et le fait qu'on n'ait pas pu établir s'il reste un noyau suffisant pour une population viable, à quoi s'ajoutent les difficultés et le coût extrêmes pour apporter et conserver une population consolidée à moyen et à long terme, le GSRAf a décidé qu'il ne continuerait pas à soutenir activement le programme, parce que les fonds limités apportés par les donateurs seraient probablement mieux utilisés à d'autres endroits. Toutefois, le Gouvernement camerounais a été encouragé à protéger les rhinos restants et à créer les conditions adéquates pour leur survie à long terme. Depuis lors, Campbell Scott a mis au point une approche assez novatrice, qui ne détournera aucun financement traditionnel des autres projets de conservation des rhinos (voir « Rhino Notes »). Campbell propose d'entreprendre une autre étude pour réessayer de confirmer s'il subsiste un noyau suffisant pour une population viable et pour anesthésier et équiper d'un radio-émetteur tout rhino aperçu. Si ce projet réussissait à montrer qu'il existe un groupe fondateur viable, on pourrait solliciter des fonds pour essayer de mettre le reste du plan de rétablissement en action (comme cela a été souligné lors de l'atelier de la mission d'assistance technique au Cameroun).

Recommandations de l'Atelier de Gestion Biologique du SADC RMG

Les conclusions de cet atelier continuent à beaucoup circuler. En plus de la discussion et de l'adoption par Ezemvelo KZN Wildlife de la nouvelle stratégie de récolte proposée, en Afrique du Sud (reprise dans le dernier numéro de *Pachyderm*), dans le courant de la période dont nous faisons ici le rapport, le Responsable Scientifique a fait des présentations sur les conclusions et les recommandations de l'atelier lors de la réunion du GSRAf, au cours d'un atelier des Parcs Nationaux sud-africains (SANParks) pour mettre au point une nouvelle stratégie des rhinos de SANParks, et lors de trois différentes réunions au quartier général de Kenya Wildlife Service. La nouvelle stratégie conseillée sera aussi présentée en

tions on improvements were made. The AfRSG team concluded that the carrying capacity of the proposed sanctuaries was suitable for the proposed introductions, and the team was impressed with the work being put in by ZAWA staff working in collaboration with Frankfurt Zoological Society project staff based in the park (Hugo and Elsabe van der Westhuizen). Ken Maggs and Markus Hofmeyer of SANParks subsequently visited the area to assess its security and suitability for receiving the first group of rhinos (hopefully next year). Should the initial introduction be a success, then phase 2 of the sanctuary can go ahead, provided sources can be found for the desired additional 15 or so founders to bring the founder number up to the recommended 20 animals. We will keep readers informed of developments through 'Rhino Notes' in future editions of *Pachyderm*.

White rhinos look set to return to the wild in Uganda

Plans by Rhino Fund Uganda to establish a population of white rhinos in a sanctuary in Uganda look set to happen soon. I will keep you posted on developments in future issues of *Pachyderm*. This proposal, the proposed reintroduction of black rhinos back to Zambia and the re-establishment of white rhinos at Chief's Island, Botswana, as well as the increase in the number of founder black rhinos in Mkhomazi Game Reserve in Tanzania, coupled with the holding of the inaugural meeting of the SADC Rhino Recovery Group in Malawi in May 2002, all herald an exciting time in African rhino conservation where populations of rhinos are being increasingly re-established back into areas of their former range but in such a way that these projects have a good chance of success.

Acknowledgements

My sincere thanks are extended to the WWF African Rhino Programme, WWF-US and WWF-SA, who together have supported both the AfRSG secretariat over the past two years and the holding of the AfRSG meeting in June 2002.

octobre au Ministère du Tourisme namibien et au Groupe Technique Consultatif pour les rhinos des Affaires Environnementales ainsi qu'à des responsables des parcs sur le terrain. Une version électronique du processus a été soumise au programme rhino régional de SADC pour publication sur le site Internet. Ce processus permettrait de répondre à l'une des recommandations de l'atelier, à savoir que la proposition de stratégie révisée soit communiquée aux agences de conservation et aux équipes de gestion. On espère que l'adoption et la mise en œuvre de la nouvelle stratégie de récolte recommandée aideront à inverser la tendance des performances de la méta-population à certains endroits.

Visite sur un site proposé comme sanctuaire de rhinos à Luangwa Nord, en Zambie

Après la réunion du GSRAf, son Président, le Responsable Scientifique et les spécialistes membres Keryn Adcock, Rob Brett et Raoul du Toit ont visité le site proposé pour un sanctuaire de rhinos dans le Parc National de Luangwa Nord. L'équipe du GSRAf a examiné l'habitat de deux zones proposées pour le développement des phases 1 et 2, et en a étudié les aspects de la sécurité et du déploiement des patrouilles. Les travaux d'électrification de la zone qui sera la première à recevoir les cinq rhinos reproducteurs sont commencés, et on a suggéré quelques améliorations. L'équipe du GSRAf a conclu que la capacité de charge des sanctuaires proposés était suffisante pour les introductions proposées et elle a été impressionnée par le travail accompli par le personnel de ZAWA qui œuvre en collaboration avec le personnel du projet de la Société Zoologique de Francfort basé dans le parc (Hugo et Elsabe van der Westhuizen). Ken Maggs et Markus Hofmeyer de SANParks ont aussi visité l'endroit pour évaluer s'il était sûr et à même de recevoir le premier groupe de rhinos (l'année prochaine, si tout va bien). Si la première réintroduction est un succès, la phase 2 du sanctuaire pourrait être lancée pour autant que l'on puisse trouver les quinze reproducteurs supplémentaires, ce qui porterait le nombre de reproducteurs à 20 andéveloppements grâce aux « Rhino Notes » des prochaines éditions de *Pachyderm*.

Des rhinos blancs devraient retrouver la liberté en Ouganda

développements grâce aux « Rhino Notes » des prochaines éditions de *Pachyderm*.

Des rhinos blancs devraient retrouver la liberté en Ouganda

Les plans du *Rhino Fund* ougandais pour établir une population de rhinos blancs dans un sanctuaire en Ouganda semblent près d'aboutir. Je vous tiendrai au courant dans les prochains numéros de *Pachyderm*. Cette proposition, la réintroduction éventuelle de rhinos noirs en Zambie et la réinstallation de rhinos blancs sur Chief's Island, au Botswana, auxquelles s'ajoutent l'augmentation du nombre de rhinos noirs reproducteurs dans la Réserve de Faune de Mkhomazi, en Tanzanie, et la tenue de la réunion inaugurale du SADC Rhino Recovery Group au Malawi, en 2002, tout ceci annonce une période excitante pour la conservation des rhinos africains, où des populations de rhinos sont de plus en plus réintroduites dans des zones de leur ancienne aire de répartition, de telle façon que ces projets ont de grandes chances de réussir.

Remerciements

Mes remerciements vont au Programme du WWF pour le Rhino d'Afrique, au WWF-US et au WWF-SA qui, ensemble, ont soutenu le secrétariat du GSRAf ces deux dernières années et la tenue de la réunion de juin 2002.

Asian Rhino Specialist Group report

Rapport du Groupe des Spécialistes des Rhinos d'Asie

Mohd Khan bin Momin Khan, Chair/Président, with/avec Thomas J. Foose and Nico van Strien, Programme Officers/Responsables de Programme

International Rhino Foundation
20 Pen Mar Street, Waynesboro, PA 17268, USA
email: irftom@aol.com

Indonesia

The conservation situation in Indonesia continues to become more difficult. Since 1995, there has been a programme of anti-poaching teams known as rhino protection units or RPUs operating in the major areas where Sumatran rhino are known to survive.

These RPUs have been successful in suppressing rhino poaching and other illegal activities in the areas of operation. But over the last 18 months, there have been several incidents of rhino poaching in one of the major areas where RPUs operate: Bukit Barisan Selatan (BBS) National Park. BBS has been one of the most challenging areas to protect because it has long borders and massive encroachment in many areas (see map). Moreover, while civil law and order have declined throughout Indonesia, the situation has been particularly severe in the vicinity of BBS, where local authorities ignore, condone, or even encourage encroachment and exploitation.

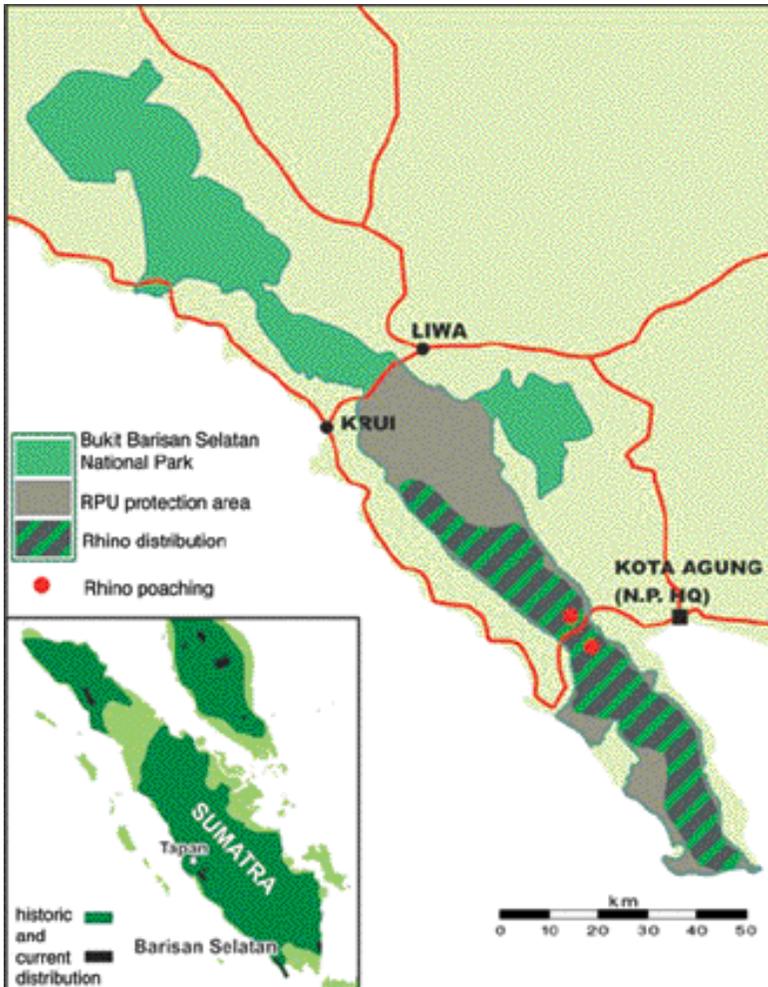
In the first case of rhino poaching, which occurred in April 2001, a rhino was actually discovered alive in a poacher snare by the RPUs. Despite valiant efforts, it was not possible to save the animal. Professional rhino poachers from the notorious Tapan village rather far to the north of BBS had placed the snare in the park just a few days earlier. Tapan poachers were responsible for the near annihilation of the large population of

Indonésie

La situation de la conservation en Indonésie est toujours plus pénible. Depuis 1995, il existe un programme qui comprend des équipes anti-braconnage, connues sous le nom d'unités de protection des rhinos ou « RPU » qui opèrent dans les principales régions où l'on sait qu'il subsiste des rhinos de Sumatra.



The aftermath of rhino poachings.



Bukit Barisan Selatan National Park in Indonesia, where several incidents of rhino poaching have recently occurred.

Sumatran rhino in Kerinci Seblat National Park in the early 1990s before the RPU programme became operational. The RPUs were able to detect and destroy a number of other Tapan snares and apparently deterred any further attempts by this group.

However, in a more recent case (June 2002), the BBS RPUs discovered a large series of traps in which two rhinos had been killed over a period of probably six months. From both carcasses, poachers had removed both horns and hooves. Local villagers, not professional rhino poachers, had placed these snares in BBS. The snares were in areas that the RPUs regularly visit. However, the snares escaped detection because the perpetrators received inside information on the RPU patrol routes from people formerly employed by some other

Ces RPU ont réussi à supprimer le braconnage des rhinos et d'autres activités illégales dans les zones où elles travaillent. Mais au cours des 18 derniers mois, il y a eu plusieurs cas de braconnage de rhinos dans une des zones principales où opèrent les RPU : le Parc National de Bukit Barisan Selatan (BBS). Le BBS couvre une des régions les plus difficiles à protéger parce qu'il a des frontières étendues et que les empiètements massifs y sont nombreux. De plus, au moment où le respect de l'ordre et des lois a dégénéré dans toute l'Indonésie, la situation est devenue particulièrement grave aux alentours du BBS, où les autorités locales ignorent, ferment les yeux, voire même encouragent les empiètements et les exploitations.

Dans le premier cas de braconnage, qui a eu lieu en avril 2001, ce sont en fait les RPU qui ont découvert un rhino vivant pris dans un piège de braconnier. Malgré des efforts intenses, il ne leur a pas été possible de sauver l'animal. Des braconniers professionnels de rhinos, venus du village bien connu de Tapan,

situé assez bien au nord du BBS, avaient placé le piège en câble dans le parc quelques jours plus tôt. Les braconniers de Tapan sont déjà responsables de l'anéantissement presque complet de la grande population de rhinos de Sumatra du Parc National de Kerinci Seblat au début des années 1990, avant que le programme des RPU devienne opérationnel. Les RPU ont réussi à détecter et à détruire un certain nombre d'autres pièges des gens de Tapan et ont, semble-t-il, découragé toute nouvelle tentative chez ce groupe.

Cependant, lors d'un cas plus récent (Juin 2002), les RPU du BBS ont découvert un grand nombre de pièges dans lesquels deux rhinos avaient été tués en probablement six mois. Des deux carcasses, les

conservation organizations for surveys in BBS. Encroachers and poachers in BBS are also more frequently carrying firearms, which increase the danger for both rhinos and RPU members.

Intensive efforts are now in progress to reinforce the RPUs and intensify their activities to prevent any further losses to the BBS population. This remedial action will require more funds, which AsRSG is helping to locate.

Peninsula Malaysia

The situation and news is better from Peninsula Malaysia. In Taman Negara National Park, RPUs have succeeded in apprehending six Thai poachers before they could obtain any large animals (rhinos or tigers). These poachers were successfully prosecuted and they are now in prison for a year.

United States

Andalas, the Sumatran rhino calf born at the Cincinnati Zoo, last year, celebrated his first birthday on 13 September 2002. His weight is now over 400 kg, 10 times what he weighed at birth.

braconniers avaient enlevé les cornes et les ongles. Ce sont des villageois locaux, et non des braconniers professionnels, qui avaient placé ces pièges à l'intérieur du BBS. Les pièges se trouvaient dans des zones que les RPU visitent régulièrement, mais ils ont échappé à leur vigilance parce que les contrevenants recevaient des informations internes sur le trajet des patrouilles des RPU auprès de personnes précédemment employées par certaines autres organisations de conservation pour faire des contrôles dans le BBS. Les personnes responsables des empiètements et les braconniers portent aussi plus souvent des armes à feu, ce qui accroît le danger tant pour les membres des RPU que pour les rhinos.

On est en train de renforcer considérablement les RPU et d'intensifier leurs activités pour prévenir toute perte supplémentaire dans la population du BBS. Cette nouvelle action de prévention va requérir des fonds que le GSRAs aide à trouver.

Péninsule Malaise

La situation et les nouvelles qui nous parviennent de la Péninsule Malaise sont meilleures. Dans le Parc National de Taman Negara, les RPU ont réussi à appréhender six braconniers thaïlandais avant qu'ils puissent faire main basse sur quelque gros animal important (rhino ou tigre). Ces braconniers ont été légalement poursuivis et ils sont maintenant en prison pour un an.

Etats-Unis

Andalas, le petit rhino de Sumatra qui est né au zoo de Cincinnati l'année dernière a fêté son premier anniversaire le 13 septembre 2002. Il pèse maintenant plus de 400 kilos, dix fois plus qu'à la naissance.

Movement of elephants in the Selous–Niassa wildlife corridor, southern Tanzania

D. G. Mpanduji,^{1,2} H. Hofer,¹ T. B. Hilderbrandt,¹ F. Goeritz¹ and M. L. East¹

¹ Institute for Zoo and Wildlife Research, Alfred-Kowalke-str. 17, D-10315 Berlin, Germany

² Sokoine University of Agriculture, Department of Veterinary Surgery and Theriogenology, Box 3020, Morogoro, Tanzania

Correspondence: dgmpanduji@hotmail.com or dgmpanduji@suanet.ac.tz

Abstract

This study reports on distribution and movements of elephant and their associated migratory pathways through the Selous–Niassa wildlife corridor (SNWC). Data were obtained through village public meetings, questionnaire surveys and field observations in 21 villages found in the corridor. Results show that elephants are abundant, occurring throughout the year, with peak occurrences between April and May. The corridor harbours a number of well-established traditional migratory routes and numerous areas that are important as seasonal or year-round habitat for elephants and other wildlife species. Three major migratory routes from Ruvuma to the centre of the corridor and four other routes from the centre of the corridor northwards have been identified, which elephants use for their movements, ultimately connecting the Ruvuma River and Selous Game Reserve. Similar connections have been reported to exist between the centre of SNWC and the eastern corridor. Elephant migratory routes described from the centre of the corridor to Selous Game Reserve are Malimbani, Ritungula and Nampungu ya Chakame while the Sasawala–Lukumbule elephant route connects SNWC and Mwambesi Game Reserve on the eastern side of the corridor. It was further observed that the major elephant movement routes are likely to depend on large, permanent river systems. Movements of elephants are reported to proceed from south to north between March and April, and from north to south between June and December. The key factors responsible for these movements and migrations are thought to be availability of water, food and in some places, increased disturbance from humans.

Résumé

Cette étude traite de la distribution et des déplacements des éléphants et de leurs voies de migration à travers le corridor pour la faune Selous-Niassa (SNWC). Les données ont été récoltées grâce à des réunions de villages, des enquêtes et des observations de terrain dans 21 villages situés dans le corridor. Les résultats montrent que les éléphants sont abondants et qu'il y en a toute l'année, avec des pics en avril et mai. Le corridor contient un certain nombre de voies de migration traditionnelles bien établies et de nombreux endroits qui sont importants en tant qu'habitats saisonniers ou permanents des éléphants et d'autres espèces sauvages. On a identifié trois voies de migration importantes qui vont de Ruvuma vers le centre du corridor, et quatre autres qui partent du centre vers le nord ; les éléphants les empruntent lors de leurs déplacements reliant de ce fait la Ruvuma à la Réserve de Faune de Selous. On a rapporté des connections semblables entre le centre du SNWC et le corridor de l'est. Les voies de migration des éléphants décrites du centre du corridor vers la Réserve de Faune de Selous sont Malimbani, Ritungula et Nampungu ya Chakame, tandis que la voie Sasawala-Lukumbule relie le SNWC à la Réserve de Faune de Mwambesi, du côté est du corridor. On a aussi remarqué que les principales voies de migration des éléphants dépendent probablement des réseaux des plus grandes rivières, qui sont permanentes. On rapporte que les déplacements des éléphants se font du sud vers le nord en mars – avril et du nord vers le sud entre juin et décembre. On pense que les facteurs clés responsables de ces déplacements et des migrations sont la disponibilité en eau, en nourriture et, à certains endroits, les perturbations croissantes d'origine humaine.

Introduction

The Selous–Niassa ecosystem in southern Tanzania and northern Mozambique is one of the largest trans-boundary natural ecosystems in Africa, covering over 154,000 km². In this ecosystem various categories of protected areas currently contribute to an official protection status of about 110,685 km². This area in Tanzania includes Selous Game Reserve (48,000 km²), wildlife management areas as buffer zones (7500 km²), Mikumi National Park (3000 km²), the Kilombero game-controlled area (6500 km²), the Muhuwesi game-controlled area and forest reserve (1500 km²), the Mwambesi game-controlled area and forest reserve (1000 km²), Lukwika Lumesule–Msanjesi Game Reserve (400 km²), and Sasawala Forest Reserve (385 km²). In Mozambique it includes Niassa Game Reserve (23,400 km²) and several hunting blocks as buffer zones of Niassa Game Reserve (19,000 km²). SNWC connects Selous Game Reserve in Tanzania with Niassa Game Reserve in Mozambique, covering approximately 8000 km² of an area that is currently sparsely settled over a distance of 160 km.

SNWC connects across a distance of 160 km the world's largest protected areas and provides a major link between the two largest miombo forest ecosystems. In addition to enhancing animal movements and gene flow, it has great value as habitat for plant and animal communities. It supports large numbers of globally significant large animal species like the African elephant, the Roosevelt sable antelope, the wild dog, the Nyassa wildebeest and the Nile crocodile. It is one of the main migration routes for elephants between Tanzania and Mozambique. The entire corridor is currently threatened by poaching for meat and ivory as a trans-boundary problem, habitat degradation because of uncontrolled and destructive bush fires, and a high population growth rate with associated agricultural expansion (such as raising tobacco and cashew nuts), which may result in converting this biologically intact corridor into cultivated land. This process will ultimately prevent movement of the wildlife populations between Selous Game Reserve and Niassa Game Reserve, increasing human–wildlife conflict. Long-term effects include genetic isolation of wildlife populations, which increases the potential for inbreeding and chances of population extinctions in both reserves. This study reports on major elephant migration routes and movement patterns in SNWC.

The study area

SNWC is located in southern Tanzania, north of Niassa Game Reserve in Mozambique. The corridor is separated from Niassa Game Reserve by the Ruvuma River, which forms the international boundary between Tanzania and Mozambique. The corridor lies within the Ruvuma region in the two districts of Songea (major western section of SNWC) and Tunduru (smaller eastern section). In total, SNWC covers approximately 6000 to 8000 km² and extends some 160 to 200 km in a north–south direction. The area is mostly covered by miombo woodland and wooded grassland, with substantial areas of open savannah, seasonal and permanent wetland, and riverine forests along numerous rivers and streams (fig. 1). Major wildlife species include but are not limited to African elephant, sable antelope, duiker species, eland, Liechtenstein's hartebeest, greater kudu, leopard, lion, spotted hyena, Cape buffalo, warthog, waterbuck, wild dog, Nyassa wildebeest and zebra. Minor species include aardvark, yellow baboon, bushbuck, bush pig, crocodile, hippo, jackal, porcupine, and African hare. Cattle are rare, and in most villages goats, sheep and poultry are present but in modest numbers. Twenty-one villages surround SNWC. The 1988 national census showed a total population of 37,298 people with an estimated density of 3 persons per square kilometre and a projected annual growth rate of 4.1%. Currently, the figure is likely to be higher as new villages emerge. Subsistence farming is the main activity for the local people supplemented by fishing in areas near major rivers and streams and by hunting—usually illegal. The farming system is extensive; it is based on shifting cultivation with crop acreage expanded by clearing bush, using the hand hoe. Cashew nuts and tobacco are major cash crops; maize, rice, cassava, sorghum and millet are the main food crops. Coconut trees are becoming increasingly common in some areas since public campaigns conducted by the Songea District Rural Development Programme (formerly Songea Development Action, SODA). Other commonly grown crops include pigeon pea, simsim, sweet potato, various legumes, onion, groundnut, banana, sugar cane and orange.

Research objective

The principal objective of this study was to trace and locate the traditional migratory routes of elephants,

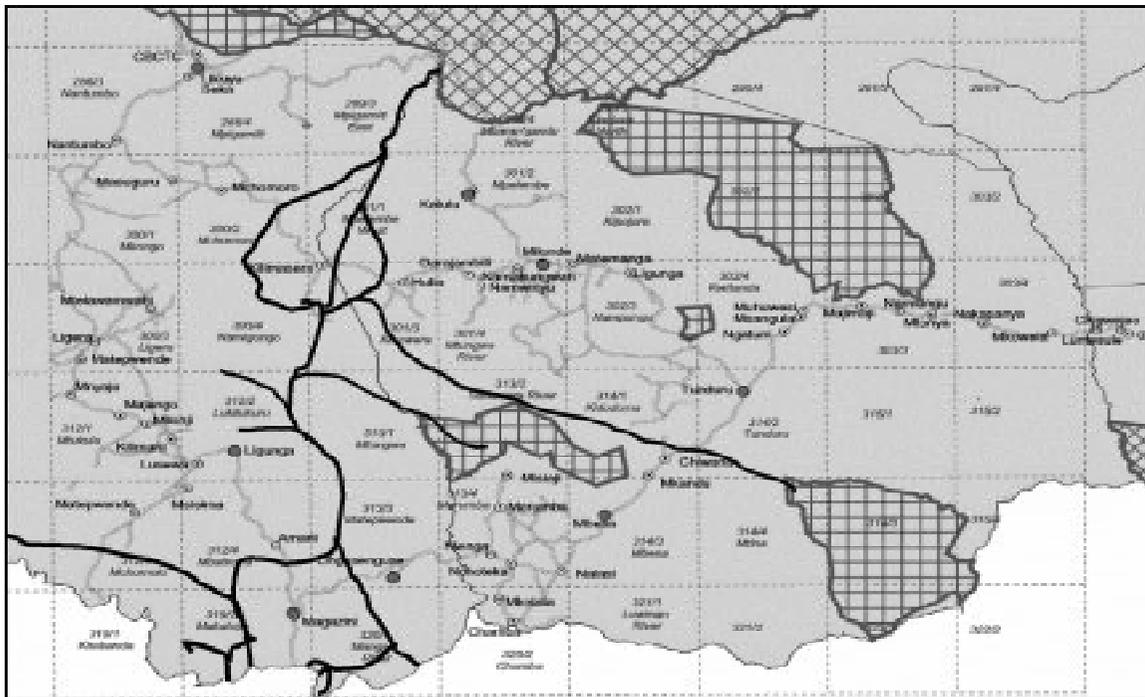


Figure 1. The Selous–Niassa Wildlife Corridor—bordered in the north by Selous Game Reserve (large hatched area) and in the south by the international boundary between Tanzania and Mozambique along the Ruvuma River. Sasawala Forest Reserve is in the centre of the corridor. Each square is approximately 33.3 km. Elephant migratory routes run from the Ruvuma River to Selous Game Reserve and from the centre of the corridor to Mwambesi Game Reserve in the south-east.

which would provide baseline data to be used in planning for the long-term requirements for wildlife conservation in SNWC and implementing them.

These data will be used to assist in preserving the genetic viability and persistence of two of the largest elephant populations in Africa and implementing methods that should minimize conflict between wildlife and local communities.

Method

Data were collected by conducting public village meetings, using questionnaires for standardized personal interviews, and making field observations. Individual questionnaires were filled in to obtain more detailed information, particularly on the presence or absence of elephants on village lands and seasonality of their presence, plant species that elephants might

prefer as food plants, and the timing of their fruiting or peak maturity in relation to elephant migrations. Direct field observations were made in remote areas of village land to confirm information previously recorded in the public meetings and questionnaires. Elephant signs such as tracks, faeces and feeding sites were observed and entered in a field observation book. Plant species that had been reported during interviews as being preferred foods were identified, collected and stored for future identification. The locations of tracks and migratory routes for elephants were recorded using the global positioning system (GPS) and later downloaded to computer (Fugawi® software, Northport system, Canada) and the routes marked out. For each village, field observation took a minimum of two days and was carried out by the first author, accompanied by one or two traditional hunters, porters and an armed game ranger.

Results

Distribution and migration routes of elephants in SNWC

Elephants were reported to occur frequently and everywhere. According to 74% ($n = 65$) of the informants, elephants were reported to be common and widely distributed everywhere except near Lusewa in the southern section of the corridor, an area conspicuous for its impoverishment in wildlife species. It was further pointed out that both resident and migratory herds of elephants occur in the corridor, with the migratory herds moving all along from Selous to Niassa in Mozambique. In most cases, mixed herds of adults and young elephants were reported to be common, occurring all year round with peak occurrence during April and March (fig. 2).

Three major migratory routes were identified through which elephants move from the Ruvuma River to the centre of SNWC (fig. 1).

The first migratory route starts at Lukawanga, about 27 km east of Magazini village, at a junction between the Lukawanga River in Mozambique and the Ruvuma River. This route continues northward along the Msanjesi, Majimahuu and Matepwende Rivers to the Changalanga and Mtungwe mountain area in the centre of the corridor.

The second route starts as four separate crossing points some 14 km west of Magazini village; the area

includes the Mkasha Mountains, and Lusanyando, Ajemsi and Rutukila along the Ruvuma River. All these routes join at the Binti Uredi seasonal stream and proceed north-east via the Namisegu River to join the Lukawanga route.

The third route also starts at four separate points, which include a point near the Ndalala River in Mozambique, Binti Hasani, Msawisi and Kipembele Rivers south-west of Magazini village in Tanzania; it runs north-west to the southern face of London Mountain near Msisima village and also northwards along the Msawisi River to Luyati and Tingilafu Mountains and their associated rivers and forests near Amani village.

From here, some elephants cross the Amani–Magazini road to join the Lukawanga route. However, those from London Mountain and the associated forest are reported to proceed westwards via Nambwela Forest and the Lisugu and Kimbande Mountains and their associated forests to Lukimwa River and Ngoma Litako swamp. They are then reported to change their course northwards by the way of Lukimwa River to Mtela-mwahi areas at the centre of SNWC.

From the centre of the corridor, elephants appear to have four separate migration routes—Malimbani, Nampungu ya Chakame, Ritungula and Sasawala-Lukumbule—that ultimately connect Ruvuma River in the south with Selous Game Reserve in the north and Mwambesi Game Reserve in the southern east.

The Malimbani elephant route links Mbarangandu in the north and Kitwanjati in the south near Mtungwe (fig. 3). The elephants use nine small tributaries that drain into the Lukimwa River, but they do not follow the main river course. The route crosses the Songea–Tunduru main road between Mchomoro and Kilimasera, about 16 km from Kilimasera.

The Nampungu ya Chakame elephant route, which has its origins on Mbarangandu River catchments, crosses the Songea–Tunduru main road at Mt

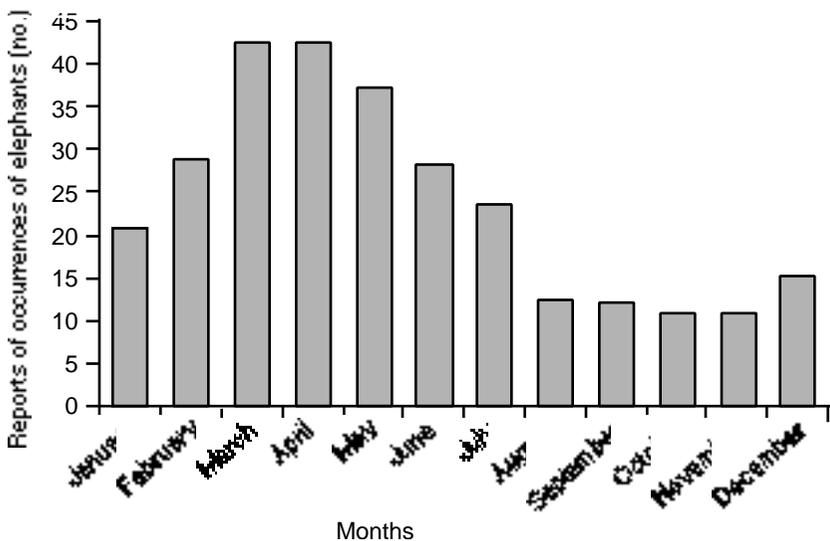


Figure 2. Monthly occurrences of elephants in SNWC ($n = 47$).

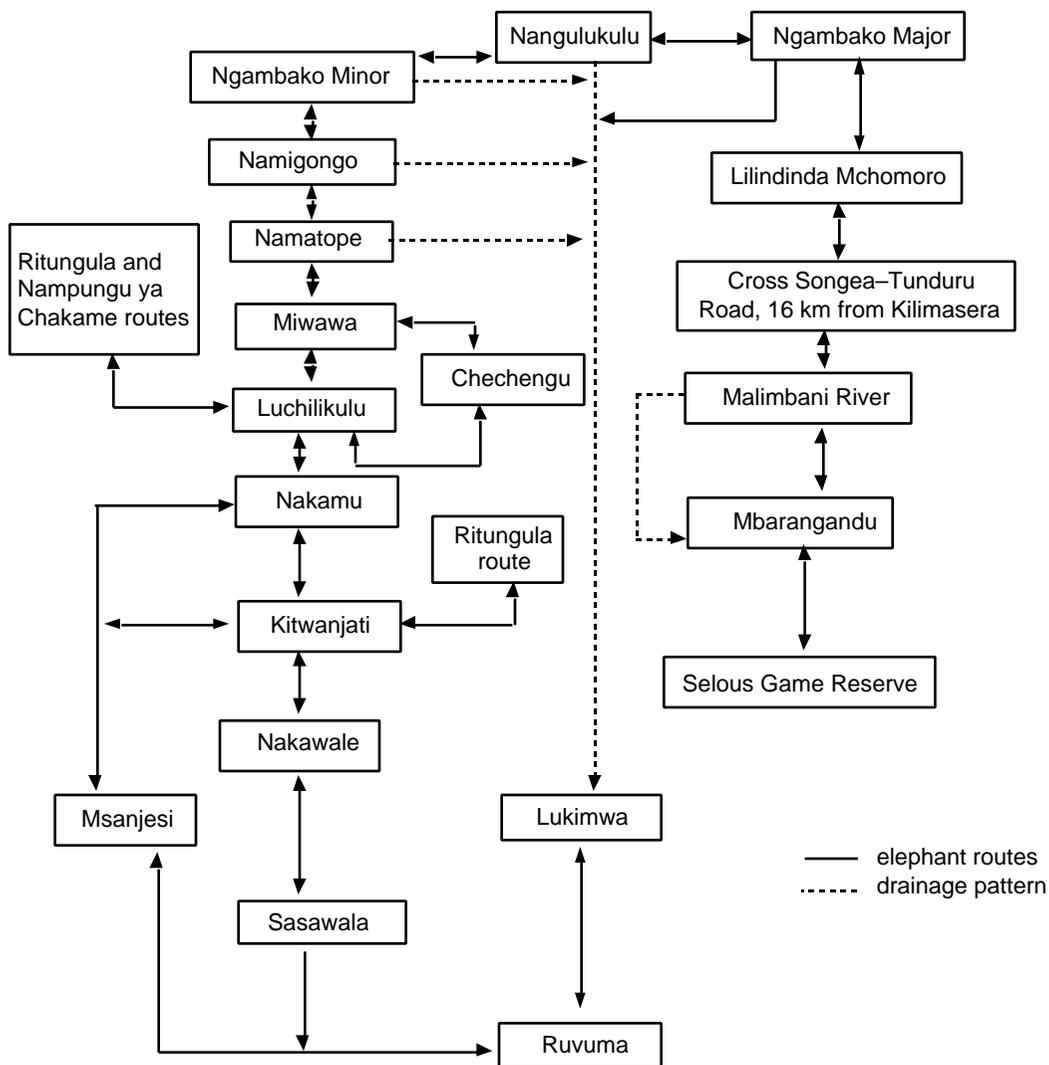


Figure 3. Tree diagram showing the Malimbani elephant route.

Kilimasera. It continues south via three important tributaries: Nampungu ya Chakame, Nampungu ya Kalwembe and Nampungu ya Wazee, to the Mbawa River, which drains into the Nampungu River (fig. 4). From here, the route continues via the Luchilikulu River and Nkalela Forest to the upper banks of the Msanjesi River.

The Ritungula elephant route broadens as it emerges from Selous Game Reserve. The elephants are reported to follow the Ritungula River or the Muhuwesi River via a series of small tributaries: Manoni, which drains into Mbarangandu, or Miwawa, which drains into Muhuwesi, to Kumbuja

(which itself drains into Miwawa). The elephants then enter the Kapesula River and thereafter go to Muhuwesi before proceeding to the Ritungula River (fig. 5).

The route crosses the Songea-Tunduru main road at Mlima Simba and the former Mwembenyani village near Hulia. The elephants then proceed southwards via a series of three small tributaries draining into the Nakapeye before it enters the Nampungu River. From Nampungu the elephants raid crops in the nearby villages of Changalawe, Hulia, Mbatamila, Mnenje, Nampungu and Namwinyu. The route continues farther south through Nkalela Forest and Mtumbitumbi and Malisafi

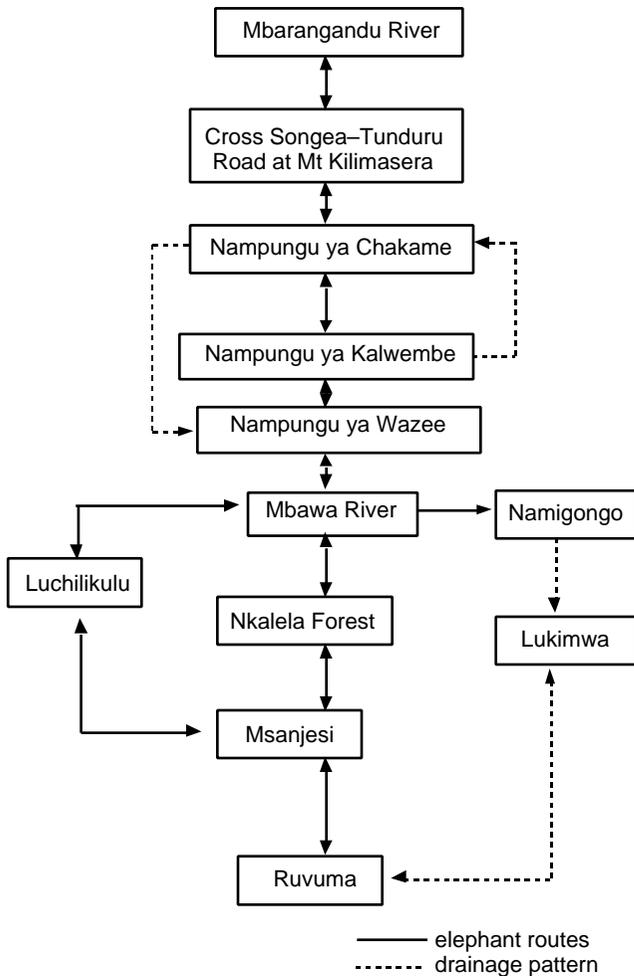


Figure 4. Tree diagram showing the Nampungu ya Chakame elephant route.

Rivers to the upper banks of the Msanjesi River. Nkalela Forest links the Ritungula elephant route with the Malimbani and Nampungu ya Chakame routes via the Luchilikulu River and its associated forest. Another link is reported to exist between Ritungula and Malimbani routes via Kitwanjati River (figs. 3, 5). The elephants are also reported to traverse between Msanjesi and Sasawala Rivers via Nakawale and Namakong streams. Namakong is a small permanent stream draining into Msanjesi. It is known to provide good shelter and grazing ground for elephants and other herbivores year round.

The Sasawala-Lukumbule elephant route uses a series of eight small tributaries draining into Sasawala

before it enters Kiumbe Forest, Lukumbule River and the Mwambesi Game Reserve (fig. 6). Mwambesi Game Reserve is separated from Niassa Game Reserve by the Ruvuma River. This route suggests a link between the eastern and the western wildlife corridors. Elephants from Mwambesi Game Reserve were reported to have killed one person during April 2001. These animals (a cow and two calves of different age groups) were followed and reported to have gone as far as Nampungu village in the central portion of the corridor.

Seasonal elephant movements

In all villages, the peak occurrences of elephants were reported between March and April, which corresponds to the peak rainy season (fig. 2). This is the same period during which the elephants are reported to proceed from south to north. The north-to-south movements are reported to occur between June and December. The key factors responsible for these movements are thought to be the availability of water, food, and in some places, increased disturbances by humans. During early March to April, elephants are likely to move northwards upstream to avoid swollen rivers and flooded wetlands after heavy rain. The north-to-south movements are probably

triggered by a decline in availability of forage and water. At this time of the year, most of the trees shed their leaves and the seasonal streams run dry. The major sources of tree foliage and water are then permanent water sources such as the Ruvuma River, permanent swamps, and some smaller permanent streams. Thus, elephants are likely to concentrate in riverine forests during the dry season. Interviews also revealed that on the Mozambiquan side, elephants move towards the Tanzanian border during the dry season between June and December. This movement had been linked to lack of water and food plants on the Mozambiquan side as most rivers and streams are seasonal and dry up completely, and bush fires occur then.

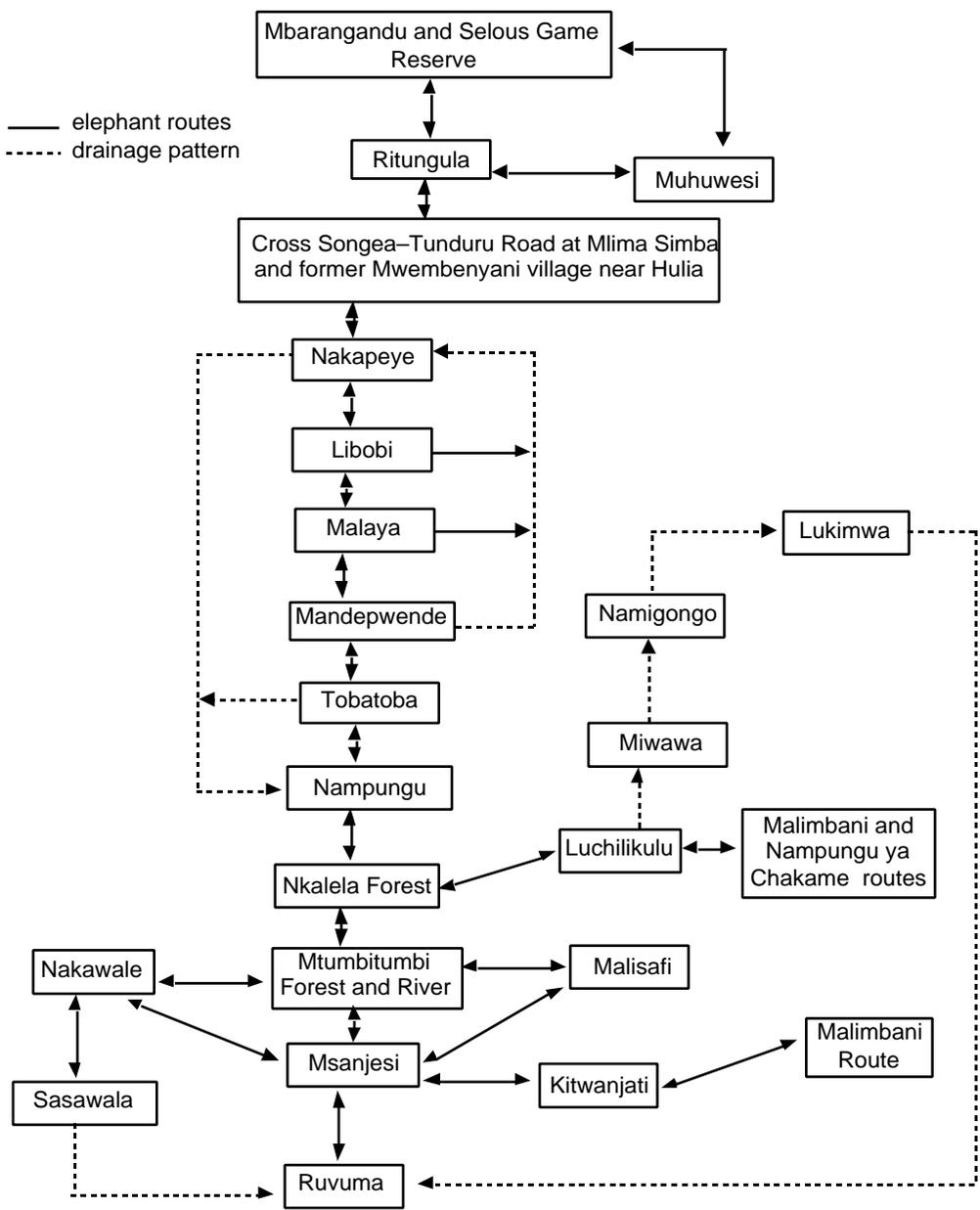


Figure 5. Tree diagram showing the Ritungula elephant route.

During this time the elephants cross the Ruvuma and its associated islands to Tanzania in search of riverine food plants. Both personal field observations and interviews suggest that all major elephant movement routes are likely to depend on large, permanent river systems. Table 1 describes in greater detail several of these river systems in the centre of the corridor. The Msawisi River

system forms another important elephant migratory route in the southern section of the corridor.

Common food plants for elephants

During this study, 31 plants were named as food plants preferred by elephants that were subsequently identified during field observation. Elephants were reported

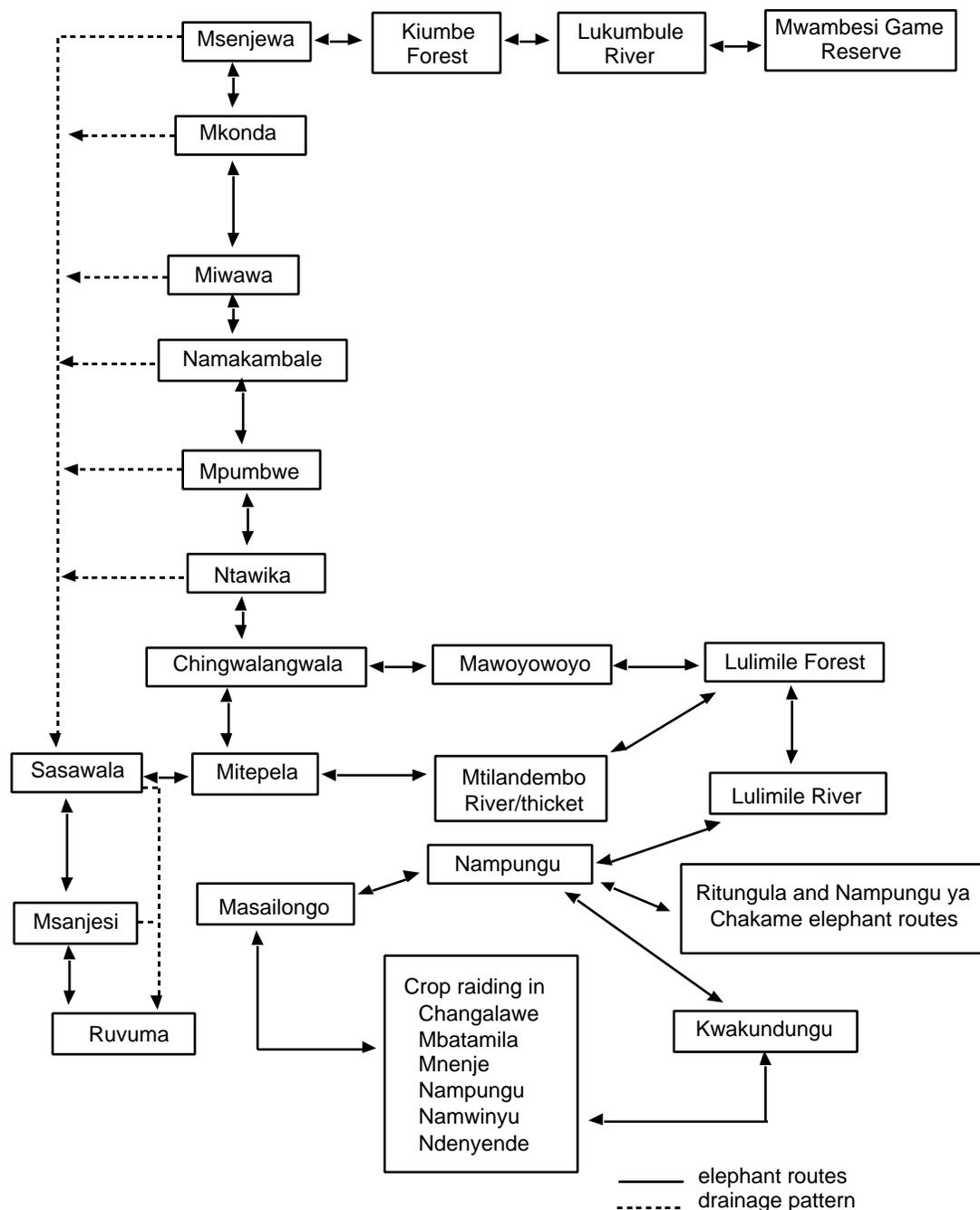


Figure 6. Tree diagram showing the Sasawala–Lukumbule elephant route.

to forage on leaves, bark, tubers, or whole plants in 20 tree species, fruit in 10 tree species and in one species on both leaves and fruit.

Table 2 summarizes the detailed information on edible parts, possible habitat and time of maturation

of these plants. The peak fruiting period of marula fruit (*Sclerocarya birrea*) was associated with peak occurrences of elephants along the major rivers where these fruit are found. Other fruits and plants were not associated with seasonal congregation of elephants.

Table 1. Major river systems in the centre of SNWC associated with elephant presence

River system and location	Seasonal status	Movement route	Wildlife
Kitwanjati Western side of Mtungwe Mountain to south and slightly to the eastern side where it joins the Lijumu River before entering Msanjesi	Permanent	Between Mtungwe and Msanjesi or Litemela Forest and its associated river	Resident and migratory elephant groups of variable size
Litemela Tributaries starting from Ligunga village then running eastwards through a dense forest until meeting the Msanjesi River	Completely dries up during dry season		Resident and migratory elephants and buffaloes stay during rainy season
Nakamu Along the eastern side of Mtungwe Mountain towards Mtumbitumbi	Permanent in upper parts, dries seasonally downstream	Forms an important link between route from Msawisi to Mtungwe Mountain	Elephants and buffaloes found throughout the year
Msanjesi In the middle of the corridor between Mtungwe and Sasawala River	Permanent throughout the year	Forms important link between the elephants from Ruvuma to Kitwanjati, Lijumu, Naluwale, Milia and Litemela	Both resident and migratory elephants are found here; other animals found are sable, bushbuck and waterbuck
Luchilikulu Small tributary originating from Nkalela thicket and draining to Miwawa, which drains into Lukimwa; situated south of Songea–Tunduru road near Kilimasera on the north, Mtungwe Mountain on the far south	Permanent stream, provides permanent food and water for a number of wildlife species	Forms a link between Malimbani, Ritungula and Nampungu ya Chakame elephant routes	Migratory and resident elephants are found here; other species known to be resident are sable, reedbuck, waterbuck, buffaloes and zebra
Nampungu Important elephant area is the Kwakundungu swamp and its associated riverine forest	Permanent river	Forms a link between Sasawala, Msanjesi and elephants from Selous and Mwambesi Game Reserves	Permanent and migratory elephants; other residents include crocodiles, bush pigs, sable, warthogs and migratory groups of buffaloes

Discussion

African elephants, the largest of all land animals, were originally found throughout the African continent (Haltenorth and Diller 1986). However, in many areas, populations have been greatly reduced by poaching (Dublin and Douglas-Hamilton 1987; Siege 1999) and increase in human population with associated increase of demand for land for agriculture and habitat loss (Lamprey et al. 1967; Laws 1970; Western and Lindsay 1984; Barnes et al. 1998). As a result, most of Africa's elephants are now forced to seek refuge

in isolated pockets of protected areas (Cumming et al. 1990; Shauri and Hitchcock 1999).

Having no conservation status, SNWC is faced with many threats attributed to an increase in human activities including human population growth, agricultural expansion, deforestation, uncontrolled bush fires, and illegal fishing and poaching. Uncontrolled human activities will ultimately result in considerable loss of biodiversity, obstruct movements of large herbivores such as elephants and consequently intensify human–wildlife conflicts. SNWC supports large numbers of wildlife (CIMU 2001; Hofer et al. 2001;

Table 2. Tree, shrubs and grass preferred by elephants as food in SNWC

Scientific name	Common name	Part consumed by elephant	Habitat	Time of maturity
<i>Acacia brevispica</i>	mtonya (Y)	soft young tips	swamps, rivers	throughout year
<i>Acacia polyacantha</i> (<i>Acacia campylacantha</i>)	mkwanga (Y)	soft young tips	swamps, rivers	throughout year
<i>Acacia robusta</i>	mchongwe (Y)	bark, leaves, preferably the growing tips	swamps, rivers	throughout year
<i>Acacia xanthophloea</i>	mchonge (Y)	bark, leaves, preferably the growing tips	swamps, rivers	throughout year
<i>Bauhinia petersiae</i>	camel foot (E), kitabu ndogo (S)	bark and leaves	open savannah	throughout year
<i>Boscia albitrunca</i>	chiguluka (Y)	whole tree	open savannah, bushland	throughout year
<i>Borassus</i> spp.	mkonda (Y)	fruit	swamps, rivers	June–November
<i>Brachystegia longifolia</i>	mpapa (Y)	tree bark	widely distributed	throughout year
<i>Brachystegia utilis</i>	miombo (S)	tree bark	widely distributed	throughout year
<i>Burkea africana</i>	mjini (S), mnyongandembo (Y)	bark and leaves, often by old males	widely distributed	throughout year
<i>Catune regum spinosa</i> (<i>Xeromphis obovata</i>)	chisondoka (Y)	fruit	forests, rivers	June–November
<i>Cussonia arborea</i>	mtumbitumbi (Y)	bark	widely distributed	throughout year
<i>Cussonis</i> spp.	mbutibuti (Y)	bark	widely distributed	throughout year
<i>Diospyros</i> spp.	msakala (Y)	fruit	along rivers	July–September
<i>Diplorhynchus condylocarpon</i>	mtomoni (S)	tree bark	widely distributed	throughout year
<i>Esente ventricosum</i>	ndizi pori (S)	leaves and fruit	swamps, rivers	March–April
<i>Julbernardia globiflora</i>	mchenga (S)	leaves and bark	hilly areas	throughout year
<i>Margaritaria discooides</i>	mserechete (Y)	leaves	widely distributed	throughout year
<i>Oxytenanthera abyssinica</i>	mianzi (S)	whole plant, early stage of growth		
<i>Parinari curatellifolia</i>	mbuni (S, Y)	fruits	widely distributed	June–September
<i>Penisetum purpureum</i>	elephant grass (E), matete or mabingobingo (S)	whole plant	swamps, riverbanks	throughout year
<i>Phoenix recliata</i>	mkindu (S)	fruit and leaves	swamps, rivers	throughout year
<i>Piliostigma thonningii</i>	camel foot (E), kitabu kubwa (S)	leaves and bark	widely distributed	throughout year
<i>Sclerocarya birrea</i>	marula (S), nNtondowoko (Y)	fruit	along rivers	March–June
<i>Strychnos cocculoides</i>	madonga (S)	fruit	everywhere	May
<i>Swartzia madagascariensis</i>	mng'eng'e (S, Y)	fruit	scattered	June–October
<i>Tamarindus indica</i>	mkwaju (S, Y)	leaves	scattered	throughout year
<i>Vangueria</i> spp.	mavillo (S, Y), mburugutu (Y)	fruit	along rivers	March–April
<i>Ziziphus pubescens</i>	mpenjere (Y), mraba tatu (N)	fruit	along rivers	March
	kitupa (S)	tubers	swamps	wet season
	jack fruit (E), maya (Y)	fruit	along rivers	February–April

Information provided by people interviewed in various villages. Language of common names is indicated in parentheses: D – Kindendeule, E – English, N – Kingoni, S – Kiswahili, Y – Kiyao.

D. Mpanduji pers. obs.). The 1990 IUCN Red List of threatened and endangered species included two species that are present in SNWC. These species (with their status in parentheses) include the African elephant *Loxodonta africana* (Vulnerable) and the African hunting dog *Lycaon pictus* (Endangered). The corridor links the gene pools between the two largest protected areas in Africa, the Selous in Tanzania and the Niassa in Mozambique.

Experience in wildlife conservation for over a century in Africa has shown that the critical areas for survival of wildlife species outside protected areas such as breeding sites, migratory corridors, dispersal areas and foraging grounds have been neglected, resulting in intensified land-use conflicts and considerable loss of biodiversity (Kideghesho 2000). The degradation occurring within and surrounding individual protected areas may affect the rate of extinction of some species, particularly the large mammals and other migrant animals that require habitat beyond protected areas (Wilfred and Ruzika 2000). In Tanzania for example, land around protected areas and migratory corridors between them are particularly hard hit in the crowded 'northern circuit'. The areas of Serengeti, Ngorongoro, Lake Manyara, Tarangire, Arusha and Kilimanjaro are reported to have lost most of their wildlife migratory corridors and dispersal areas (Shauri and Hitchcock 1999; Kideghesho 2001a,b, c and 2002), as a result a number of large mammal species have been reported locally extinct in some of these areas (Gamasa 1998; Shombe-Hassan 1998 as quoted by Kideghesho 2002; Silkiluwasha 1998). The situation is quite different south of Selous. In its current status, SNWC passes through sparsely populated villages. The northern section of this corridor, which passes through 17 villages, is currently protected by a series of wildlife management areas managed by local people as part of the Selous Game Reserve buffer zone project guided by the Wildlife Division and the Selous Conservation Programme. However, the southern section of the corridor, which is about 3000–4000 km² and contains 18 sparsely located villages, is currently not protected and is vulnerable to unsustainable exploitation of land resources incompatible with wildlife conservation.

Many human development activities are reported to be detrimental to elephant habitats. Construction of roads, railways and human settlements are activities that have been reported to impede the movement

of elephants (Johnsingh and Christy-Williams 1999). Already the Songea–Tunduru main road crosses SNWC. Its impact is, however, minimal as elephants traverse the road at different sites. Human habitation and expanded agricultural activities between Mchomoro and Kilimasera and between Kilimasera and Hulia had already increased the number of incidents of conflict between human and elephant (Hahn 2001; Nalim Madatta pers. comm.). Similar phenomena are very likely to occur between Magazini and Amani, Magazini and Likusanguse, and at Ligunga-Amani in the southern end of the corridor.

During this study, all critical elephant migratory routes along the Songea–Tunduru main road were identified. Through the efforts made by the Selous Conservation Programme, a workshop including all stakeholders was conducted in Ruvuma region to include the two districts under SNWC. The district commissioners of Songea and Tunduru; district game, forest, bee, fishery, agriculture and livestock officials; councillors; village chairpersons; and other district and village officials under SNWC attended the workshop. Other invited delegates came from the United Nations Development Programme (UNDP), the Global Environment Facility (GEF) and Niassa Game Reserve in Mozambique. It was agreed during this meeting that areas already identified as important elephant migration routes be protected and kept free of human development activities (fig. 7). It was further agreed to incorporate this decision in village bylaws. Through this decision, the Litungula elephant route was saved from total obstruction, as encroachment was already severe, and the former Mwembenyani village was slowly growing. Inhabitants from this village shifted voluntarily to the nearby villages of Hulia, Kilimasera and Pachani near Milonde and Matemanga. Efforts are being made using satellite telemetry to identify other routes and important elephant ranges.

In this study, elephants are reported to proceed from south to north between March and April and from north to south between June and December; these times conform with the dry and rainy seasons. Haltenorth and Diller (1986) reported movements of large herds over great distances, amounting to approximately 500 km during the late dry season, in search of new growth and fruiting food plants. The peak fruiting period of marula in March was associated with peak occurrences of elephant congregations along the Ruvuma River; other fruits had no known influence on elephant movements.



Figure 7. One of the signboards showing where SNWC (Malimbani route) crosses the Songea–Tunduru main road between Mchomoro and Kilimasera in Songea District. Six such signs have been placed in places identified as important elephant crossing areas along the Songea–Tunduru road, to alert people not to carry out activities that will prevent elephant movements.

Several well-established elephant migration routes have been found in the corridor through which elephants and other wildlife move during long-distance migrations. These routes were found to be contiguous with large, permanent water systems, which in most cases are considered to be the dry-season refuge for elephants (Kingdon 1997).

The wet- and dry-season aerial census (CIMU 2001) in SNWC reported high concentrations of elephants in the centre of the corridor towards the Nampungu River and Sasawala Forest Reserve while few or no elephants were found on the south-central parts of the corridor. High levels of human activity in the southern half likely interfered with the movements of elephants between the southern and northern halves. This may equally be true between Niassa Game Reserve and SNWC (Hofer et al. 2001). Detailed information on home ranges, seasonal or periodic long-distance movements, foraging behaviour and spatial use of resources by elephants in SNWC will be understood after detailed analysis of movement data in 10 radio-collared elephants in different areas of the corridor. The information obtained during the present study and in future from the

radio-collared elephants is vital for the long-term conservation and management of elephants and other wildlife in SNWC.

An early report by Said et al. (1995) and Barnes et al. (1998) mentioned the possible cross-border movements of elephants between the now-named SNWC north of Ruvuma and Niassa Game Reserve south of the Ruvuma River. Our study identified nine such crossing points through which elephants from either side are reported to cross the Ruvuma River. Uncontrolled wildfires, poaching, and increased human activities, mainly fishing and encroachments along the Ruvuma River, will ultimately prevent the

movement of elephants and other wildlife in SNWC. Human habitation and expanded agricultural activities between Mchomoro and Kilimasera and between Kilimasera and Hulia had already affected elephant movements with the associated human–elephant conflicts likely to increase (Hahn 2001). Similar phenomena are likely to take place between Magazini–Amani, Magazini–Likusanguse and Ligunga–Amani in the southern end of the corridor.

The wildlife potential of SNWC has been noted in reports by Hofer et al. (2001) and CIMU (2001). Although SNWC seems to be a critical area for the survival of a diverse number of wildlife, large portions of the southern section completely lack official protection, and hence they are vulnerable to all kinds of use unsustainable for wildlife (Hofer et al. 2001). Participation of local communities in wildlife management decisions, the sustainable use of natural resources, and the distribution of income generated by natural resources on a local level can help to limit over-exploitation and habitat degradation by local communities (Lewis and Alpert 1997).

This aspect has been recognized by the govern-

ment of Tanzania in its wildlife policy published in March 1998, in which it commits itself to 1) involving all stakeholders, particularly local communities, in the conservation and management of wildlife areas, 2) establishing wildlife management areas as a new category of protected area, with local people having a full mandate of managing and benefiting from conservation efforts, and 3) cooperating with neighbouring countries in conserving migratory species and trans-boundary ecosystems.

This study was therefore initiated by the Selous Conservation Programme in collaboration with the Germany Agency for Technical Cooperation (GTZ) Tanzania to provide baseline data for planning and implementing the SNWC development cooperation project whose aim is to protect and manage the southern part of the corridor through a network of village wildlife management areas.

The goal of this project is to protect the wildlife corridor by having local communities participate and benefit from sustainable utilization, and to combat trans-boundary elephant poaching through an agreement of cooperation and law enforcement between the governments of Tanzania and Mozambique. Benefits could include 1) legally supplying game meat, obtained through annual hunting quotas for each participating village, 2) empowering participating villages to protect themselves and their property against problem and crop-raiding wild animals, 3) generating cash income for community projects from sustainable use of wildlife through photo or hunting tourism, and 4) providing employment for youths as village game scouts. The results of the present study are therefore important prerequisites for establishing management procedures for SNWC, particularly in reducing competition between people and wildlife—in this case, elephants.

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Community-based methods to reduce crop loss to elephants: experiments in the communal lands of Zimbabwe

Ferrel V. Osborn and Guy E. Parker

Mid Zambezi Elephant Project

37 Lewisam Avenue, Chisipite, Harare, Zimbabwe

Corresponding author: F.V. Osborn, mzep@africaonline.co.zw; www.elephantpepper.org

Abstract

Crop damage by elephants is a widespread conservation concern across Africa and Asia where humans and elephants coexist. Elephant damage to crops and property creates intensely negative attitudes towards conservation by those affected. Methods for deterring crop-raiding elephants are problematic, as traditional deterrent methods that rural farmers use become ineffective over time, and interventions by NGOs or wildlife authorities tend to be both expensive and unsuitable in remote locations. In this study an experimental community-based strategy for protecting crops was developed and compared with current deterrent methods. The experimental deterrents included warning systems, barriers and active deterrents and were designed to increase the capacity of farmers to detect and repel elephants. Individual experimental methods were more effective at deterring elephants than current traditional methods and the 'integrated strategy' significantly reduced the total crop damage in study villages. The results of this study suggest that elephants can be deterred from crop raiding using inexpensive materials that are locally available and that local communities can administer.

Additional key words: African elephants, human–elephant conflict, *Loxodonta africana*, rural communities, problem animal control, wildlife management, semi-subsistence agriculture

Résumé

Les dommages causés aux récoltes par les éléphants sont un problème fréquent dans toute l'Afrique et en Asie, partout où hommes et éléphants coexistent. Les dommages causés par les éléphants aux récoltes et aux biens engendrent chez ceux qui en sont victimes des sentiments extrêmement négatifs envers la conservation. Les méthodes destinées à dissuader les éléphants qui font des dégâts posent problème dans la mesure où les méthodes traditionnelles utilisées par les fermiers deviennent inefficaces avec le temps et que les interventions des ONG ou des autorités en charge de la faune ont tendance à être coûteuses et mal adaptées aux régions reculées. Dans cette étude, on a développé une stratégie expérimentale communautaire pour protéger les récoltes et on l'a comparée aux méthodes de dissuasion actuelles. Les moyens expérimentaux comprenaient des systèmes d'alarme, des barrières et des instruments actifs et ils étaient conçus pour augmenter la capacité qu'ont les fermiers de repérer et de repousser les éléphants. Les méthodes expérimentales individuelles étaient plus efficaces pour dissuader les éléphants que les méthodes actuelles, et la « stratégie intégrée » a significativement réduit le total des dommages causés aux récoltes dans les villages couverts par l'étude. Les résultats de l'étude suggèrent qu'on peut dissuader des éléphants de dévaster des récoltes en utilisant des moyens peu coûteux qui sont disponibles sur place et que les communautés locales peuvent employer elles-mêmes.

Introduction

Conflict between rural farmers and elephants is a major conservation concern across Africa and Asia (Sukumar 1989; Dublin et al. 1997). Subsistence

farmers' livelihoods can be seriously affected by crop damage. In some semi-arid rural farming areas of Zimbabwe and Kenya elephant damage to food crops accounts for 75 to 90% of all incidents by large mam-

mal pest species (Waithaka 1997). In Africa, 80% of elephant range lies outside protected areas (Taylor 1999) and responsibility for elephant management increasingly falls to local authorities. The widespread adoption of community-based natural resource management (CBNRM) schemes has simultaneously made elephants the most valuable and the most problematic resource in many wildlife-rich areas. The attitudes of rural communities and their relationship with wildlife are critical to the success of community-based schemes (O'Connell-Rodwell et al. 2000). In Africa, rural populations incur the primary costs of living with wildlife but receive few of the benefits (Barnes 1996; Naughton-Treves 1998), and their attitudes towards wildlife are frequently negative as a result.

A common approach to reducing the costs of living with wildlife has been the development by wildlife managers of problem animal control (PAC) strategies. Although many wildlife management authorities and conservation agencies have been involved in implementing conflict-reducing programmes, current measures only partially address the problem (Lahm 1996; AfESG 2001). Disturbance shooting continues to be the method that wildlife managers throughout southern Africa use, despite evidence to suggest that it has little deterrent effect upon crop-raiding elephants (Bell 1984; Osborn 1998). In addition, centralized units are unable to respond to the demand for their services at the peak conflict time during crop harvest (MZEP and Zambezi Society 2000).

Electric fencing can be a highly effective intervention (Thouless and Sakwa 1995), but the high costs of establishing and maintaining the fence make it unaffordable for most rural communities unless an international donor assists.

Communal farmers commonly resort to their own methods of deterring crop-raiding elephants. These include burning fires around the fields, beating drums and throwing missiles at approaching elephants. Farmers and wildlife managers in general, however, perceive these traditional methods as deterring crop-raiding elephants only minimally (Thouless 1994; Osborn 1998). At present, no single management option successfully deals with all problem elephant and conflict situations (Hoare 1999; Taylor 1999).

Over the past two years, the Mid Zambezi Elephant Project (MZEP) has been working with rural district councils and communities of the mid Zambezi Valley

to develop appropriate, community-based methods for crop protection that are effective, use local materials, and enable rural farmers to tackle their own problems of conflict with wildlife.

In this paper we present the results of an experiment comparing the effectiveness of current and experimental PAC methods. We discuss the involvement of communities in selecting and evaluating deterrents. We explore the problems of assessing PAC in situ and make recommendations for developing PAC interventions in communal farming areas.

Study area

Lower Guruve District encompasses an area of 2700 km² in the mid Zambezi Valley in northern Zimbabwe (fig. 1). The Zambezi Valley (altitude 350–500 m) receives low rainfall (650–850 mm per year), which falls mainly between December and mid-March. There is a long dry season from April to November. The dominant vegetation is mopane–*Terminalia* and mopane–*Combretum* woodlands, with dense riverine thickets of mixed species along the major rivers. Agriculture is practised mainly in bands of colluvial soil along the Zambezi escarpment and in alluvial soils bordering the major rivers. Most farming is small-scale dryland cultivation, and the main wet-season crops include maize, groundnut and cotton. These rainfed crops are planted extensively in November and harvested between April and June.

The human population is expanding rapidly in response to a government resettlement scheme; the population increase is estimated to be 9% per annum. The elephant population is circa 3000 (Davies 1999) and is contiguous across the entire area. Human–elephant conflict occurs in distinct seasonal patterns; it is both chronic and predictable (Parker and Osborn 2001).

Materials and methods

We selected seven villages within the mid Zambezi Valley that experienced high levels of crop damage during the 2001 cropping season. Each village displayed similarities in the number of crop damage incidents, the number of homesteads and the area of cultivation. A series of participatory rapid appraisals were conducted by MZEP within these communities to identify key problems with elephant crop raiding.

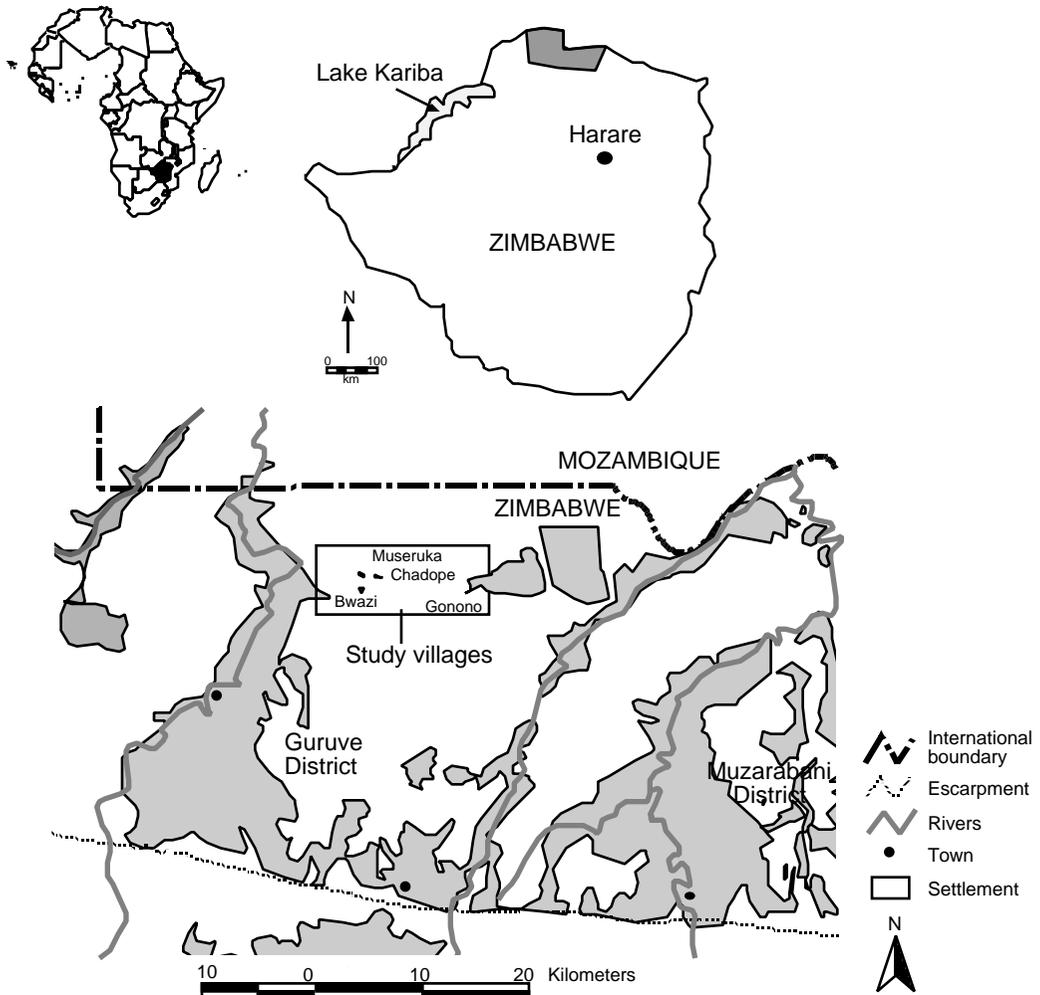


Figure 1. Map of the study area.

From these surveys it was ascertained first that farmers often could not detect when elephants entered their fields. Second, the traditional methods used to deter the elephants were ineffective.

The experimental methods that MZEP developed were therefore designed to increase the farmers' capability to detect crop-raiding elephants and to effectively chase the elephants away once detected. To improve vigilance, a 5-m buffer zone was cut between the edge of the fields and the surrounding woodlands. Within the buffer zone a fence was constructed comprising poles bound with thatching twine. Cowbells were attached to the fence to act as a warning system. If any large animal moved against the fence, the bells would ring. Active deterrents to chase the ele-

phants away included locally made firecrackers and dry chillies, which were burnt in fires to produce an irritating smoke.

In three of the villages, experimental PAC methods were introduced (table 1). In the remaining four villages, traditional methods that farmers commonly used were employed, and these were considered the control plots. The traditional active methods currently being used by farmers included beating drums and throwing stones at crop-raiding elephants.

To establish the relative pressure of elephant activity in each village, the number of elephant incidents was recorded at every site. An elephant incident was described as a situation where elephants came to within 25 m of the edge of the fields.

Table 1. Passive and active, traditional and experimental problem animal control methods used

Method	Category	Description
Watchtowers	Passive traditional	Farmers with fields on the forest boundary built watchtowers at approximately half-kilometre intervals to increase their vigilance capacity.
Fires	Passive traditional	Fires were kept burning all night in areas where elephants came regularly. These fires were also used to burn pepper dung (see below).
Buffer zones	Passive experimental	Farmers were asked to clear a 5-m buffer zone around their fields (or in some cases along the edge of the whole village) to increase sightings of advancing elephants.
Cowbells	Passive experimental	Cowbells were placed at 30-m intervals along a string fence (see below) to alert farmers when elephants came to the fields.
String fences	Passive experimental	Farmers cut 3-m poles and placed them at 30-m intervals along the buffer zone. Bailing twine was strung between them and squares of burlap were tied at 5-m intervals along the string.
Beating of drums	Active traditional	Farmers beat on drums or metal objects when elephants approached the fields.
Throwing rocks with catapults	Active traditional	Catapults made of wood and rubber were used to shoot small rocks at approaching elephants.
Firecrackers	Active experimental	Farmers used firecrackers to chase elephants from the fields by throwing them towards the animals.
Dung and chillies	Active experimental	Farmers mixed elephant dung with ground chillies then sun-dried the bricks they made of the mixture. When farmers heard elephants in the bush, they burned these bricks along the field boundaries to create a noxious smoke.

Farmers set up passive systems before elephants approached fields and used active systems when elephants were either near or in the fields.

Three indicators were used to assess the effectiveness of the PAC systems. In each case, for each PAC method, enumerators recorded the time it took to repel elephants. Enumerators recorded elephant reactions to each type of method during crop raiding by noting the time an elephant entered a field, the time at which PAC began, and the time it took to drive the elephant from a field.

To measure the effect of alarm systems, enumerators recorded the number of occasions elephants entered the fields and the proportion of times they were detected by farmers. Figures were compared for villages with alarm systems and those without.

The overall effectiveness of the systems was assessed by quantifying crop damage in each of the study villages: how many incidents of crop damage occurred, and what was the total area of crop damage in each

case. Crop damage incidents were monitored in all seven villages, six days a week, by eight local staff over the study period (1 January–30 June 2001). For each incident the total field and the area of damage were measured by pacing. The method followed is according to that described in detail in Parker and Osborn (2001). Inter-observer reliability of data collection by field staff was assessed throughout the season.

All data collection occurred in the fields at night during crop-raiding incidents. It was therefore impossible to attain clinical experimental conditions, and many confounding variables existed, including noise, smell and human presence.

Results

The number of elephant incidents within each of the

seven villages was found to be similar, ranging from 27 to 43, indicating that elephant pressure was similar in each village during the 2002 season.

Figure 2 shows that in the experimental (E) villages, crop damage was consistently lower than in traditional (T) villages. The smallest traditional value (T2) was compared with the largest experimental value (E2) using the Mann-Whitney U test, but there was not a statistically significant difference between the medians of the two data sets.

The effectiveness of four different problem animal control methods was tested, and the mean elephant reaction time to each method was compared (fig. 3). The mean reaction time of elephants to traditional (T) methods was slower than to the experimental (E) methods, and the difference was highly significant (Kruskall-Wallis $K = 133$, $p = 0.01$). There was no significant difference between the reaction times to the three experimental methods ($U = 188$, $p = 0.01$).

In the experimental villages with alarm systems, farmers detected elephants as they entered the fields 67% of the time, as compared with only 42% of the time when no alarm systems were implemented.

Discussion

Elephants were deterred more rapidly by experimental methods of PAC than by methods traditionally used by

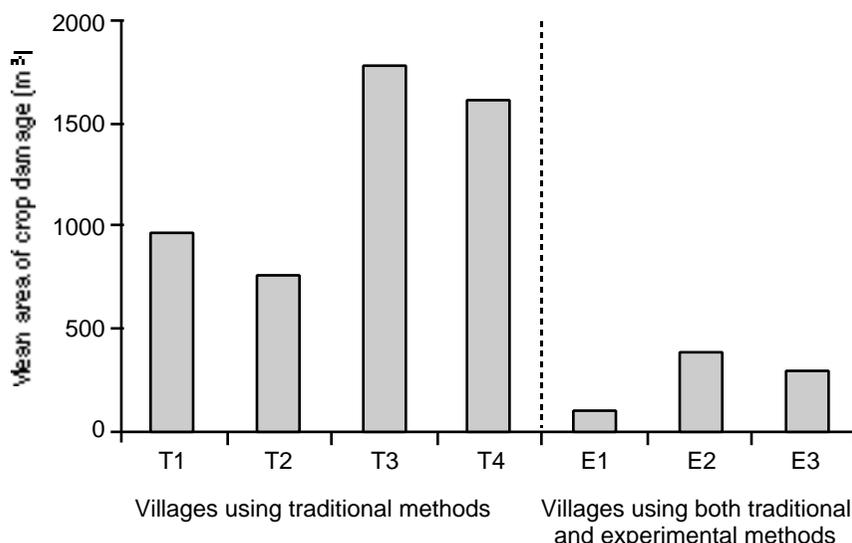


Figure 2. Mean area of crop damage. Crop damage is expressed as mean area of damage per crop-damage incident, in square metres.

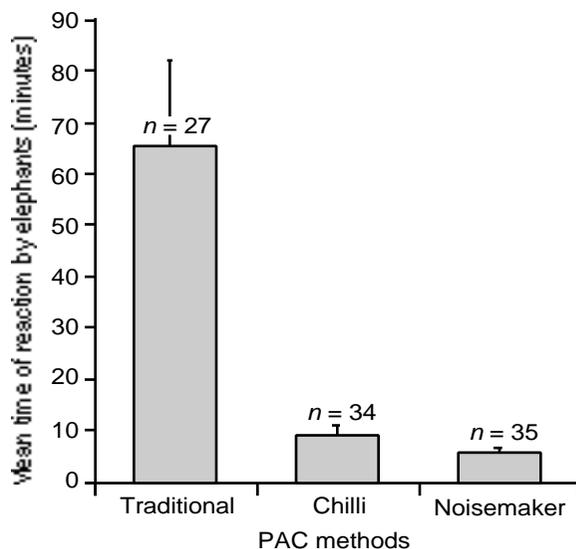


Figure 3. Mean reaction times of elephants to PAC methods. 'Traditional' refers to the methods outlined in table 1, 'chilli' refers to burning a mix of elephant dung and chillies.

villagers. This may, in part, be because elephants become accustomed to control methods to which they have been exposed for a long time, as noted in Kenya (Thouless 1994) and in Sumatra (Nyhus et al. 2000). To ensure long-term effectiveness, it is likely that farmers will need to continuously develop new deterrent methods to avoid eventual habituation. It seems more likely that elephants would ignore 'empty threats' such as fire and noise than the chilli-based methods, which inflict considerable short-term pain. This conclusion, however, is beyond the scope of this study.

The alarm systems clearly improved a farmer's ability to detect elephants, presenting the opportunity to deter them before they caused crop damage. This in part would explain the reduction in the number of incidents of crop damage and the overall area

of crop damage in the study villages where experimental PAC and alarm systems were employed.

In discussions with farmers MZEP found that warning systems also offered farmers a measure of security. They were more willing to spend the night in their fields if they knew they had sufficient forewarning of elephants approaching.

As an overall strategy the experimental PAC system was effective in limiting the area of crop damage. A combination of increased farmer vigilance and a new range of deterrents appeared to reduce the damage that crop-raiding elephants caused. Because of the limited replication of each treatment of PAC and the high level of variation in the data collected, the results from this study cannot be taken as conclusive evidence that experimental systems are more effective than traditional ones. Rather, the results indicate that this is likely to be the case. A complication of the experimental design was identifying villages with similar characteristics in which to work. In addition, when testing PAC methods, it was difficult to isolate the trials from external influences of noise and smell, and this in part may explain the high variation in results.

Identifying the methods that farmers found most effective was key to developing community PAC strategy. In evaluating potential methods farmers considered the effectiveness and practicality of each. Any methods developed need to be available and acceptable to the people using them. Crop defence is complicated and dangerous. Farmers may not sleep in their fields for a range of reasons, including fear for their lives, concern that their homesteads could be robbed while they were absent and risk of increased exposure to malaria (Hoare 2000; O'Connell-Rodwell et al. 2000).

Convincing farmers that they could take responsibility for their own crop protection was central to the success of this new approach for dealing with crop loss from elephants. Developing the tools that were inexpensive and easily maintained proved that it was not necessary to rely entirely on the central PAC units of the wildlife authority.

Methods need to be financially and technologically within the capacities of the people implementing them if they are to provide long-term solutions (Kangwana 1995). A village-based scheme not wholly dependent on outside intervention is seen as the option most likely to be sustainable in the long term, being both

cheaper than donor interventions and more reliable than centralized interventions.

Several conservation implications emerge from these results. If farmers are able to address their elephant conflict problems, the adverse effect of the elephants upon farmers' lives will be reduced. This may be the first step towards redressing the cost-benefit imbalance that currently exists. In many CBNRM initiatives it is recognized that the responsibility of wildlife management has not been devolved to the community. Community-based PAC potentially can enable farmers to deal with their own issues, and shift the responsibility and blame for crop damage away from the local wildlife authority. Generally, wildlife authorities expend a great deal of resources on PAC with little net result. Effective community-based PAC will make additional resources available to tackle other pressing wildlife management issues.

The methods described here are not presented as a panacea for resolving human-elephant conflict. Rather they form a component of the growing range of methods and approaches that are required to mitigate this complex management problem.

Conclusions

The most effective PAC strategy combines a number of methods that make it difficult for elephants to enter fields, alerts farmers to their approach and gives them the ability to chase the elephants from their fields. The methods presented are effective, cheap and can be implemented by rural communities. For the methods to continue to be effective they will need to undergo constant adaptation while adhering to the technological and financial capabilities of a community. Evaluating the effectiveness of PAC methods is complex, as many confounding variables exist. Indicators may be used to measure comparative success, but treatment replications should be extensive. Implementing an efficient and affordable community-based system of PAC not only allows farmers to protect their own crops, but it also reduces the management pressures upon the wildlife authorities.

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Do cattle determine elephant distribution in the Red Volta Valley of northern Ghana?

Moses Kofi Sam,¹ Charles A.K. Haizel¹ and R.F.W. Barnes²

¹ Wildlife Division, Forestry Commission, PO Box M239, Accra, Ghana

² Department of Biology 0116, University of California at San Diego, La Jolla, CA 92093-0116, USA

Corresponding author: Moses Kofi Sam, email: osmo288@yahoo.co.uk

Abstract

Elephants use the forest reserves along the Red Volta River as a refuge and raid fields in the nearby farmland. This study tested the null hypothesis that cattle have no effect on elephant distribution by measuring on transects the dung piles of both species. Having controlled for other variables, we show that increasing numbers of cattle reduce the probability of finding elephants outside the forest reserve. We suggest that cattle grazing could be manipulated to reduce the risk of crop raiding by elephants.

Résumé

Les éléphants utilisent les réserves forestières le long du Nazinon comme refuges et dévastent les champs des fermes voisines. Cette étude a testé l'hypothèse zéro selon laquelle le bétail n'aurait aucun effet sur la distribution des éléphants, en mesurant des crottes des deux espèces le long de transects. En tenant les autres variables sous contrôle, nous montrons que l'abondance croissante de bétail réduit la probabilité de trouver des éléphants en dehors de la réserve forestière. Nous suggérons qu'il est possible de gérer le bétail de façon à réduire les risques de dommages dus aux éléphants.

Introduction

Elephants (*Loxodonta africana*) are found in about a dozen ranges in Ghana (Wildlife Division 2000). The northernmost is the Red Volta Valley, which lies adjacent to the frontier with Burkina Faso. Elephants move along the valley between Ghana and Burkina Faso and raid crops on both sides of the border. On the Ghanaian side, the rural population lives in extreme poverty and elephants are the farmers' bane (Sam et al. 1997; Sam 1998). We have long suspected that elephants in the Red Volta Valley avoid places used by the other common large herbivore: cows.

In this paper, data collected in the 1999 planting season were used to test the hypothesis that elephant density was inversely proportional to cattle density. For each species, dung was used as a measure of abundance. Since many variables could influence elephant distribution, we developed a multivariate model to explain elephant distribution. If cattle dung made a

significant contribution to the model, then the null hypothesis (that cattle have no effect on elephant distribution) could be rejected.

Study area

The study area falls within White's (1983) Sudanian centre of endemism but the vegetation has been much modified by human activities (Boateng 1970). Rainfall is about 1000 mm per annum, falling in a single wet season, between May and November. A detailed description is given by Sam et al. (1996) and Sam (1998).

The Red Volta flows southwards from Burkina Faso (where it is called the Nazinon) into Ghana to its confluence with the White Volta (fig. 1). The river banks are protected by forest reserves that are up to 14 km wide. Thus if one walks due east from the river, one will pass first through the forest reserve, then successively a belt of bushland, cultivated land, and

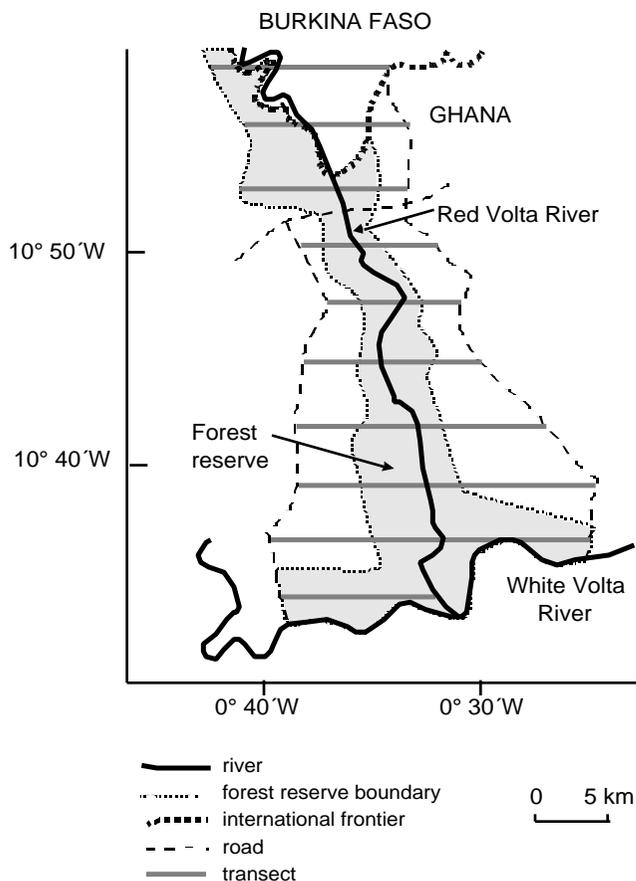


Figure 1. The Red Volta River flowing southwards from Burkina Faso to its confluence with the White Volta, the forest reserve that lines its banks, and the east–west transects spanning the Red Volta Valley. Villages lie along the roads, and farms are found between the roads and the forest reserve boundaries.

a village lying on a road that runs roughly north–south and parallel to the river (fig. 1). The same habitat types are encountered when one walks due west from the river.

Elephants move up and down the valley, taking advantage of the cover that the forest reserve provides. Farmers and Wildlife Division staff seldom know where the elephants are at any particular moment until they emerge from the forest to raid crops. After feeding in the fields, the elephants return to the forest reserve, and the next report of raiding may come from the other side of the valley and far to the north or south.

Farmers hand over their cattle to Fulani herdsmen, who graze them in large herds. Though Fulani families are known to possess firearms they do not usu-

ally carry them while herding. A typical herd may range widely, moving across the farmland of many villages. Sometimes herders will corral the cattle, especially when they are close to the family base. Otherwise they will camp out and continue foraging the next day.

Methods

Ten east–west transects crossed the valley from the road on one side to the road on the other (fig. 1). Since we could not ford the river in the wet season, we considered the east and west halves as separate transects, each running from the Red Volta River to the road.

The transects were walked in the 1999 planting season between May and July. Standard line-transect methodology was used (Buckland et al. 1993) and all elephant and cattle droppings were recorded. Habitat and features such as roads and water sources were noted.

The data were first analysed by complete transect (river to road). Next, only the segment that passed through the forest reserve was examined; finally, only the segment outside the forest reserve (that is, from the boundary of the forest reserve to the road).

We saw too few elephant droppings to enable us to estimate density, because the distance method requires a minimum of 60 sightings (Buckland et al. 1993). Instead, we assumed that the visibility profile was constant throughout, and we used the number of droppings seen on each transect as the index of elephant abundance.

Typical count data included integers, no negative numbers and a high proportion of zeroes; the counts were not normally distributed. Therefore, generalized linear models with Poisson errors were fitted with the GLIM package (Francis et al. 1993; Crawley 1994). The models were of the form

$$E = \exp(a + b.L + c.x_1 + d.x_2 + e.x_3 \dots m.x_n)$$

where E was the expected number of elephant droppings, L was the length of the transect in kilometres, $x_1 \dots x_n$ were independent variables, a was a constant,

and b , c , d , e and m were coefficients fitted by maximum likelihood.

For the complete transects, the following variables were entered into the model: length of transect passing through farmland, length of transect passing through fallow, length of transect passing through bush, length of transect segment within the forest reserve, number of water courses, and number of cattle dung piles.

Inside the forest reserve, independent variables were the number of water courses and of cattle dung piles.

Outside the forest reserve, independent variables were length of transect passing through farmland, length of transect passing through fallow, length of transect passing through bush, number of water courses, number of cattle dung piles, and distance from the mid-point of the transect to the river.

In each case the number of cattle dung piles was transformed to $C = \ln(1 + \text{number of cattle dung piles})$.

For each analysis, all the independent variables were entered into the model. Each variable was then examined in turn and its contribution to reducing model deviance evaluated by χ^2 (Crawley 1994). Then the variable that made the least contribution was dropped and the remaining variables were each examined in turn. This process was continued until only those variables remained that made a significant contribution to the reduction in deviance.

Results

Complete transects

Thirty-five elephant droppings were recorded on 19 transects. No droppings were seen on 7 transects. Three variables significantly reduced the deviance: length of transect in forest reserve, F ($P < 0.001$); cattle dung, C ($P < 0.01$); and water sources, W ($P < 0.01$). The final model was

$$E = \exp(2.05 + 0.08L + 0.25F - 0.50C - 0.43W)$$

Forest reserve

Twenty-four elephant droppings were recorded on 17 transect segments. No droppings were seen on 10 transect segments. Only length of transect segment, L , had a significant effect ($P < 0.001$):

$$E = \exp(-1.19 + 0.24L)$$

Outside forest reserve

On the 16 transect segments outside the forest reserve, 11 elephant droppings were recorded. No elephant droppings were seen on 12 transect segments. Three variables made a significant contribution to reducing the deviance: length of transect segment, L ($P < 0.05$); distance to the river, R ($P < 0.01$); and number of cattle dung piles, C ($P < 0.001$):

$$E = \exp(9.82 + 1.38L - 1.66R - 2.26C)$$

Varying the value of C while holding L and R constant at their median values shows that increasing cattle numbers will reduce the probability of spotting elephant dung piles (fig. 2).

Discussion

Transect length was significant both inside and outside the forest reserve. As one would expect, the longer the transect, the greater the probability of spotting droppings. This was the only significant variable inside the forest reserve. This means that either the variation between transects is random within the forest reserve or more likely, we failed to identify and measure the variable(s) that influence elephant distribution within the forest reserve.

Elephants must depend on water, but the presence of water sources reduced the probability of recording their droppings on the complete transects. It is likely that there is more human activity around water—for example, Sam (1998) recorded illegal gold-panning

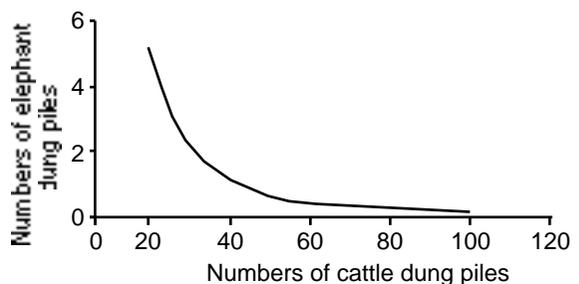


Figure 2. The predicted number of elephant dung piles that will be seen on the average transect outside the forest reserve in relation to cattle dung piles, according to the model when transect length and distance to the river are held constant at their median values.

activities (*galamsey*) along portions of the river. When habitat and water sources were taken into account, cattle had a marked effect in reducing the probability of spotting elephant droppings on the complete transects. Similarly, after accounting for distance to the river, cattle had a strong effect ($P < 0.001$) on reducing the probability of spotting elephant droppings outside the forest reserve (fig. 2). This is an especially important result because it is outside the forest reserve that elephants raid crops. Figure 2 shows that only a few cattle dung piles were needed to bring a rapid reduction in the expectation of finding elephant droppings. At present we do not know the actual numbers of cattle, or the number of cattle-days, that correspond to the observed numbers of cattle dung piles.

We have shown the inverse relationship between cattle and elephants, but we do not know whether elephants are avoiding the cattle or the herdsman, nor whether they are avoiding the noise, the smell of the cattle that lingers after they have passed through, or the grazing land itself, tainted by the smell of cattle. If elephants are avoiding noise, then the presence of cattle is not likely to deter them during the night, when they usually raid crops. But if they are avoiding the smell of cattle or the tainted grazing land, then the presence of cattle in an area during the day will deter elephants both by day and by night. Since elephants usually leave the forest reserve at night, and there is a strong inverse relationship between cattle and elephants outside the forest reserve (fig. 2), it seems likely that elephants are avoiding the smell.

This analysis suggests a possible method for mitigating the risk of crop raiding. We propose that cattle be managed to reduce crop raiding by elephants. If the presence of elephants is detected in a particular sector of the forest reserve, and if the Fulani herdsman can be persuaded to move their cattle into the area between the forest reserve and the farmland, elephants will be deterred from moving out of the forest and into the fields.

For this method to work well, one needs to be able to detect the north–south movements of elephants in the long forest reserve. Recently the Cornell Laboratory of Ornithology, Conservation International and the Wildlife Division of Ghana have been experimenting on elephant infrasound detection in Kakum National Park in southern Ghana. This technique could

lead to a method for remote detection of elephants in different sectors of the forest reserve.

It is possible, however, that elephants that avoid one area tainted by cattle may simply head towards farmland where no cattle have recently grazed. In that case, one is simply displacing the problem rather than mitigating it.

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Rate of decay of elephant dung in the central sector of Parc National des Virunga, Democratic Republic of Congo

Leonard Mubalama^{1,2} and Claude Sikubwabo²

¹Wildlife Conservation Society, Bukavu, Democratic Republic of Congo

²Institut Congolais pour la Conservation de la Nature, BP 852, Bukavu, Democratic Republic of Congo

Corresponding author: Leonard Mubalama, email: mikedrce@yahoo.co.uk

Abstract

Because of the spread of thickets and the massive regeneration of *Acacia* species that followed the drastic reduction in elephant numbers in the Lilimbi sector of Parc National des Virunga, the faecal census method is increasingly being used to determine abundance and relative densities of savannah elephant populations. A sample of 75 fresh elephant dung piles was monitored at 14-day intervals from April to July 1998 and then from January to April 1999 in the central sector of the park from the time they were fresh until they decomposed and disappeared. Decomposition of elephant droppings is principally brought about by three factors: dung beetles, termites, and mechanical disturbances such as heavy rain, fire, trampling, and foraging for insects by birds.

Additional key words: dry and wet seasons

Résumé

A cause de l'envahissement de taillis et de la régénération massive des espèces d'*Acacia* qui a suivi la réduction drastique du nombre d'éléphants dans le secteur Lulimbi, la méthode de recensement basée sur les crottes est de plus en plus utilisée afin de déterminer l'abondance ainsi que les densités relatives de population d'éléphant de savane. Un échantillonnage de 75 crottes fraîches a été suivi dans l'intervalle régulier de 14 jours jusqu'à la disparition d'avril à juillet 1998 et de janvier à avril 1999 dans le secteur centre du parc Virunga. La décomposition de crottes d'éléphant est effectuée par trois facteurs principaux, y compris les scarabées, termites et les facteurs mécaniques telles que la pluie torrentielle, le piétinement, le fourrage d'insectes par les oiseaux et le feu.

Introduction

When the elephant population in Parc National des Virunga (PNVi) was cut drastically to one-sixth of its former number, *Acacia* species regenerated massively and thickets spread into neighbouring grasslands (Aveling 1990; Delvingt et al. 1990). This brushland makes it very difficult to make a direct count of the animals that are believed to be under cover at the time of a survey (Wing and Buss 1970; Jachmann and Bell 1984; Barnes et al. 1991; Dudley et al. 1992). Therefore, the faecal census method was used to determine abundance and relative densities of elephant populations in the savannah habitat of the central PNVi sector (Mubalama 2000).

Using the decay rate of dung piles to determine the density of an elephant population is a method that is little documented but one that is obviously more comprehensive for conducting a census in most of PNVi (fig. 1), which is now more than ever covered by trees and shrub savannah, changing into a woodland dominated by stands of *Acacia* spp. and *Capparis tomentosa*. Given the pronounced trend towards forest invasion of the grassland areas in recent years (Olivier 1990), we believe a comprehensive study of the rate of decay of elephant dung is needed. Our ignorance is epitomized by the lack of information available on frequency of droppings in protected areas of the Democratic Republic of Congo. To use dung density to determine elephant

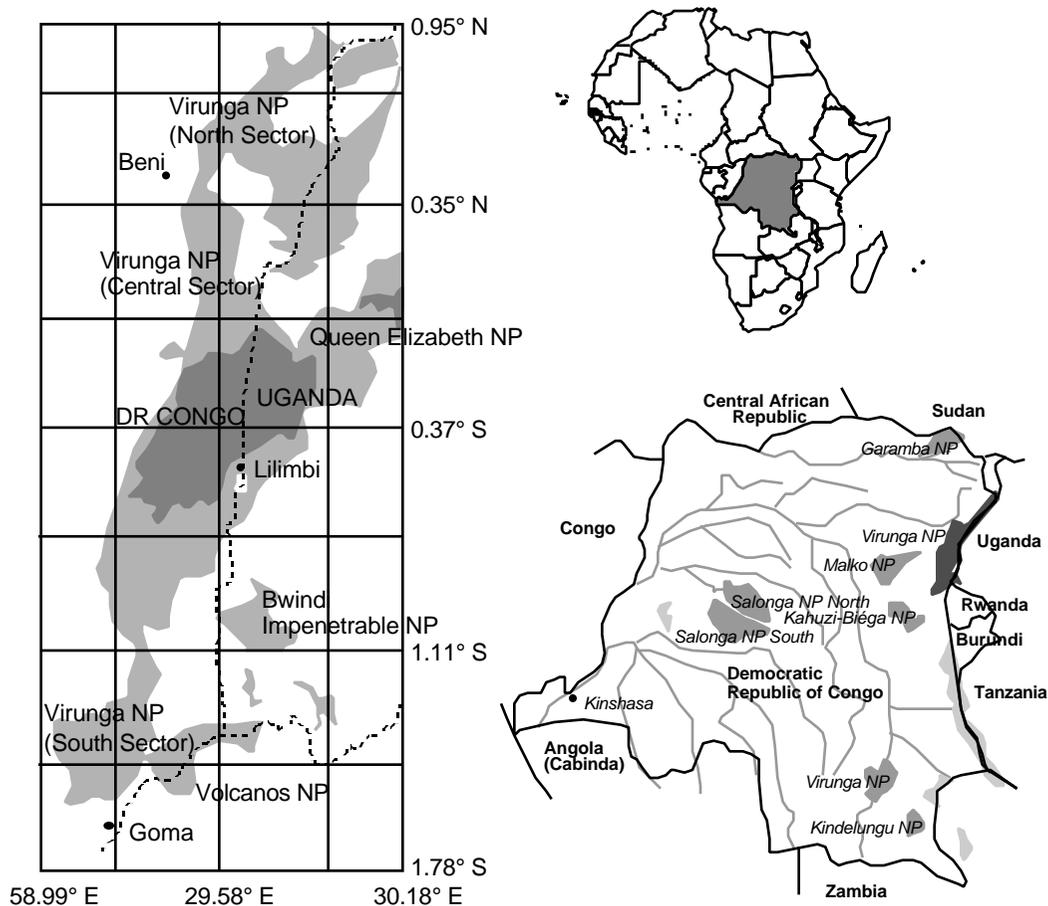


Figure 1. Location of the central sector of the Virunga National Park in DRC.

density, one must know the defecation rate and the mean dung-pile survival time or decay rate (Barnes and Jensen 1987). This often poses a major problem as there are rarely the time and enough personnel available to monitor elephant dung decay and at the same time undertake dung counts. Here we report our efforts to determine the rate of decay of elephant dung in the central sector of PNVi and the most important factors affecting dung duration.

Materials and methods

During a three-month study (April–July 1998) of the status and distribution of the African elephant (*Loxodonta africana africana*) in the central sector

of PNVi (Mubalama 2000), elephant dung piles were marked and data on them collected. In a line-transect sampling cut through the area on a predetermined compass bearing, observers followed a straight line of 2.5 km and monitored dung piles. Further assessment of dung-pile decay was carried out from January to May 1999. A 100-m string, a 50-m measuring tape, a compass, numbered tags and survey forms were used (fig. 2). When a dung pile was found, the perpendicular distance from the transect line to the centre of the dung pile was measured, the position of the fresh pile of bolus or dropping was recorded, and the pile was tagged with a ribbon to facilitate locating it again. The dung pile was fortnightly revisited until it disintegrated and disappeared.



Figure 2. Field research team assessing decay of elephant dung at Kinyonzo.

Two key factors were chosen to assess the dung decay rate: the general shape and the odour. The dung was judged for freshness as follows. If the dung was still warm, with fresh oil, very strong odour and few or no insects, it was considered to have been deposited within the previous 24 hours (0 days old). Dung with strong odour, stale oil and some insects was considered to have been deposited within the previous 24 to 48 hours (1 day old). Dung with fairly strong odour, no oil, many insects and some tiny white fungi present was considered to have been deposited within the previous 48 to 72 hours (2 days old). No dung first seen that was too old to fit into one of these three categories was monitored for decay.

Five stages of the general shape of the dung pile were considered: A – dense; B – $\frac{1}{4}$ decomposed; C – $\frac{1}{2}$ decomposed; D – $\frac{3}{4}$ decomposed; E – completely decomposed (the dung was deemed to have ‘died’). This rating system follows the dung morphological categories defined by Barnes and Jensen (1987).

Odour was rated in four categories: 1 – very strong; 2 – strong; 3 – slight; 4 – none.

At every visit we noted the stage of dung decay. The duration of each dung pile was the number of days from date of deposition to date dung was last observed in stage D plus a random number between 0 and 14 (observation interval), following Barnes et al. (1997). The date of death of the dung pile was defined as the last day when the pile was recorded in stage E.

Surveys were restricted to one a year, owing to the expense and the limited availability of research funds. The survey form recorded the number of the fresh dung pile, its location on a map, the date of observation, and habitat (taking into account whether the soil was bare or covered). A dung pile was defined as a fresh pile of boluses produced at one time by one elephant (Barnes and Jensen 1987). As observers gained experience, whenever they saw an elephant drop dung, they noted the sex and identified individuals when possible, based on body and head size.

Test controls were performed by a team of five observers every two weeks except on three rare occasions when rains were heavy. In fact, when the rain poured after a day of test control, observers were advised to record the decay rate data again the following day to keep a close eye on the decomposition rate. During each visit notes were made for each dung pile of any animals engaged in opportunistic activities, flood and water runoff, baking of dung by the sun, and seedling and herbaceous growth on or around the dung pile that might have affected elephant dung decay (fig. 3).

Additional records made for dung piles selected for monitoring were number of boluses (noted as diarrhoea if dung was not deposited in boluses); mean diameter of the boluses; dung contents (grass fragments, leaf fragments, fruit fibre and pulp, hard seeds, wood cellulose and other fibres), and making visual estimates of the proportion. Dung piles in which any of these constituents were dominant (> 70%) were specially noted and were sorted together as a cohort for mean duration calculations.

Results and discussion

Decay rate was assessed during both the dry and the wet season. It was based on the observations of 35 and 40 cohorts of known-age dung observed during the course of the surveys. The data set collected during the study period 1998 showed the following results:

Average 54.78667 days

Variance 151.8458

Standard deviation 12.32257

Standard error 1.42288

Confidence limit 2.7888

Upper confidence limit 57.57547

Lower confidence limit 51.99787

Coefficient of variation 22.49%

These results mean that in 95% of confidence limits the values 57.57547–51.99787 bracket the true mean days.

During the dry season an elephant dung pile lasted at least 14.4 weeks before it reached stage D then E, according to both shape and odour key criteria. However, the decomposition rate speeded up during the wet



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Figure 3. Dung pile invaded by tender shoots regenerating from *Coccinia grandis* and *Citrullus lanatus* seeds defecated by an elephant.

season when sometimes the sampled dung piles reached stage D and then E in less than 12.99 weeks.

The difference was significant between the dung piles of adults and yearlings in the time they took to decompose completely. Dung piles of yearlings decomposed twice as fast as those of adults. Differences were particularly marked in the rains. Grass and browsed stems seemed very fibrous and this may have contributed to yearlings avoiding them.

On account of limited time and budget, no figures for the nutrient content of either green browse (leaves and shoots) or woody browse (twigs and branches) are mentioned to explain the correlation between the variation in plant parts eaten and the elephant dung decay rate.

The data presented in this paper suggest that the decay rate of elephant dung is a complex process, which can be conditioned by seasonality with a pile of boluses lasting much longer in the dry season than in the wet. Dung piles deposited on stream banks or gulleys can be washed away by rain, but dung that remains moist, because it is in contact with marshy ground, can remain apparently fresh for longer periods. In addition, dung exposed to direct sunshine can be baked dry, hence becoming 'fossilized' and maintaining its form longer (White 1995).

Many animals, including insects, also depend on elephants. Elephants digest less than half of what they eat. The rest passes through them to nourish others, from micro-organisms of the soil to primates and other large mammals. Dung beetles (Scarabaeidae), termites (Termitidae) and other insects are important decomposers of dung piles. They in their turn are eaten by such birds as common ringed plover (*Charadrius hiaticula*), yellow-necked spurfowl (*Francolinus sephaena*), spur-winged lapwing (*Vanellus spinosus*), and Forbes's plover (*Charadrius forbesi*), which are believed to feed largely on beetles and other insects, usually taken at water-edge dung piles. Although there was no strong statistical evidence to support this, observations indicated that the decomposers of dung piles acted in seasonal patterns in central PNVI, being less common in the major dry season (pers. obs.). Dung-beetle activity was confined to the wet season. This is consistent with findings by Jachmann and Bell (1984) in Kasungu National Park, Malawi.

Moreover, field teams noted on three occasions that elephant dung was scattered by baboon (*Papio cynocephalus doguera*), red river hog (*Potamochoerus*

porcus) and African civet (*Viverra civetta*), who broke and dispersed the boluses as they foraged in elephant dung piles for seeds and insects (pers obs.).

Several contributing factors may have played a key role in prolonging the duration of elephant dung piles, including sun baking and the roots of fast-growing seedlings holding boluses intact.

The droppings of elephants provided an exceptionally good source for identifying food materials use, since the bolus contains a relatively large percentage of undigested material (Benedict 1936). Freshly browsed food plants with tracks and droppings nearby were used occasionally as indicators of foods eaten. The inflorescences of certain grasses were selected during the rains and their bases in the dry season (Field 1971). Browse leaves have little silica but are rich in other minerals, and this may have contributed to their greater palatability. Elephants preferred grasses in the wet season, as observed from their defecation. They turn to browse only in the dry season when the grasses have withered (Buss 1961; Bax and Sheldrick 1963; Hanks 1969; Field 1971; Wyatt and Eltringham 1974; Laws et al. 1975; Williamson 1975; Guy 1976; Olivier 1978).

In addition, the anatomy of the elephant digestive system makes the elephant more sensitive than the ruminant to toxic plant secondary compounds. This would then force elephants to diversify their supplementary foods. Thus in the wet season the bulk of the elephants' diet would be provided by grasses, containing low concentrations of toxins, and would be supplemented by small amounts from a range of other species (Olivier 1978).

Elephants were sometimes very selective, preferring to feed on thatching grass (fig. 4) more frequently and in larger quantities than any other grass, including rush grass (*Sporobolus consimilis*), speargrass (*Heteropogon contortus*) and palisade grass (*Bracharia brizantha*). In woodlands near grasslands, they also ate *Acacia sieberiana*, *Aeschynomene elaphroxylon*, *Azima tetracantha*, *Capparis tomentosa*, *Carissa edulis*, *Citrullus lanatus*, *Coccinia grandis*, *Cyperus articulatus*, *Maerua mildbraedii*, *Panicum maximum* and *Securinega virosa*. For lack of time, we did not perform a more robust sampling on grazing and browsing patterns during the course of the survey. Thus there is a critical need to undertake such a study in the near future, to understand any relationship in the savannah elephant population between food preference and duration of their dung.



Figure 4. An adult elephant feeding on succulent and nutritious *Cynodon dactylon* grasses fringing the marsh near Lulimbi headquarters.

Obtaining the precise age of elephant dung by its decay rate can be difficult. The difficulty of doing so, however, is not sufficient reason to abandon logic in analysing the data. In the past 10 years, many publications have dealt with age-estimation techniques. However, many of these papers are of questionable value for future workers, not because of the techniques themselves, but because authors did not provide useful estimates of the accuracy of their techniques. The problem of the present paper is that it omits statistical treatment, thus hindering efforts to evaluate age-estimation accuracy and limiting its worth in analysing collected data.

Further study on dung decay and environmental variables should investigate this to see whether a gen-

erally applicable relationship can be found to relate weather, food availability and elephant dung decay rate. This would enable researchers undertaking similar surveys to apply decay rates and factors affecting the duration of elephant dung piles in either rain forest or savannah from other sites with more confidence.

Conclusion and recommendations

Nearly all papers on this subject of decay rate refer to the technical difficulty of estimating the decay rate of elephant dung. They especially refer to the inadequacy of the statistical treatment used to assess the accuracy and confidence limits of the techniques and to do regression analysis. Recently several papers have called attention to inaccuracies in the procedures. To improve the quality of the age-estimation literature, future reports dealing with elephant dung decay rate should include estimates of accuracy, mean duration (days), rainfall (mm), mean humidity (%) and regression of mean square-root transformed duration of elephant dung piles and environmental variables.

It may be a useful method for comparing the use of different areas within one major vegetation type or for comparing the use of the same vegetation type between years as long as the dropping counts are done at the same time each year.

From that prospect, elephant feeding behaviour in PNVi should be a worthy study in the near future, to elucidate fully the savannah elephant defecation rate per day as a key step towards obtaining elephant population estimates. This study blazes a trail for future research on elephant dung piles, food preference and dung duration, and more so because these savannah elephants seem to show seasonal variation in defecation rate. Estimating the rate of dung decay remains a time-consuming process. But it can be used in regular monitoring of a cohort to keep information up to date and to identify in environmental correlates any differences observed between different surveys that may get under way in the future.

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Elephant-induced change in woody vegetation and its impact on elephant movements out of a protected area in Zimbabwe

Ferrel V. Osborn

Mid Zambezi Elephant Project
37 Lewisam Avenue, Chisipite, Harare, Zimbabwe
mzep@africaonline.co.zw; www.elephantpepper.org

Abstract

In Zimbabwe, changes in woodlands caused by elephants and other factors motivate elephants to leave refuges to forage on wild tree species still abundant outside these areas. A vegetation survey was conducted using transects and aerial photo interpretation to test the hypothesis that the vegetation structure and relative abundance of certain plants in remnant forest fragments differ from forests found within protected areas. Tree species that elephants browse on outside the protected area were monitored over a three-year period. The results suggest that historically, high densities of elephants have altered forest structures, and elephants are now moving into areas occupied by humans to feed on certain woody plant species now uncommon in protected areas. This may be a factor in understanding conflict between elephants and people.

Additional key words: elephant–habitat interaction, human–elephant conflict, vegetation change

Résumé

Au Zimbabwe, les changements causés aux forêts par les éléphants, et par d'autres facteurs, poussent ces animaux à quitter leurs refuges pour se nourrir des espèces d'arbres sauvages qui sont encore abondantes en dehors de ces zones. On a mené une étude de la végétation en se servant de transects et d'interprétations de photos aériennes pour tester l'hypothèse selon laquelle la structure de la végétation et l'abondance relative de certaines plantes dans les derniers petits morceaux de forêt seraient différentes de celles des forêts que l'on trouve à l'intérieur des aires protégées. Pendant trois ans, on a contrôlé de façon continue les espèces d'arbres dont les éléphants se nourrissent hors de l'aire protégée. Les résultats suggèrent que, depuis toujours, les fortes densités d'éléphants ont altéré la structure des forêts et que les éléphants se déplacent maintenant vers des zones occupées par les hommes pour se nourrir d'espèces végétales qui sont devenues rares dans les aires protégées. Ceci peut constituer un facteur de meilleure compréhension dans les conflits qui opposent les hommes et les pachydermes.

Introduction

Changes in woodlands in regions with elephants have been extensively documented in Africa (for example, Afolayan 1975; Laws et al. 1975; Malpas 1977; Coetzee et al. 1979; Jachmann and Bell 1979; Barnes 1983; Conybeare 1991). In the 1960s, wildlife managers of newly gazetted protected areas noted substantial changes in woody vegetation caused by the destructive nature of elephant feeding. Although considered generalist feeders, elephants can be very selective and are able to eliminate preferred woody species locally (Wing and Buss 1970; Anderson 1973; Barnes 1983).

An elephant's preference for certain species appears to be an important factor dictating its movements in some habitats. Elephants consume the bark of woody plants that can result in the death of these trees (Thomson 1975). There is evidence to suggest that this selective elimination of trees has occurred within protected areas in Zimbabwe and that tree species that elephants favour have declined in number, while some mature individual trees that elephants prefer have remained intact in areas now inhabited by people (Guy 1989).

The goal of this study was to determine if changes in woodlands caused by elephants and other factors

motivate elephants to leave a protected area to forage on tree species still abundant outside these areas. If this is the case, management of elephants to control the effect they have on woodlands may be important in controlling elephant incursions into areas inhabited by humans.

Study area

The study area is situated in the Sebungwe region of Zimbabwe, in and around the Sengwa Wildlife Research Area (SWRA) and the surrounding communal lands (CLs) (fig. 1). During the mid-1970s, the elephant population within SWRA was estimated to be over 1000 animals. Damage to the woodlands was deemed unacceptable and a series of culls were carried out in an effort to keep the density under 3 animals per km². (Martin and Conybeare 1995).

The vegetation is generally deciduous and dry deciduous savannah woodland. The main vegetation associations are *Brachystegia/Julbernardia* woodland, *Colophospermum* mopane woodland, *Acacia* spp. riparian woodland, riverine grasslands and *Combretum* spp. thickets. A single rainy season usually occurs between November and April, but it is highly variable in timing and quantity. The mean annual rainfall is 668 mm ($n = 30$) (DNPW 1997).

Between 1940 and 1960, there was an attempt to eliminate all large game in CLs as part of a tsetse fly control scheme. A wire fence 2.5-metre high with eight strands was erected in 1968 along the southern and eastern boundary to prevent game from moving south into CLs. The fence line does not follow ecozonal boundaries and the woodlands inside and out were identical in 1966 (D. Cumming, pers comm.). Effectively, large game animals did not use the vegetation in CLs for 30 years (Guy 1989). This fence fell into disrepair during the late 1980s and was removed in 1990.

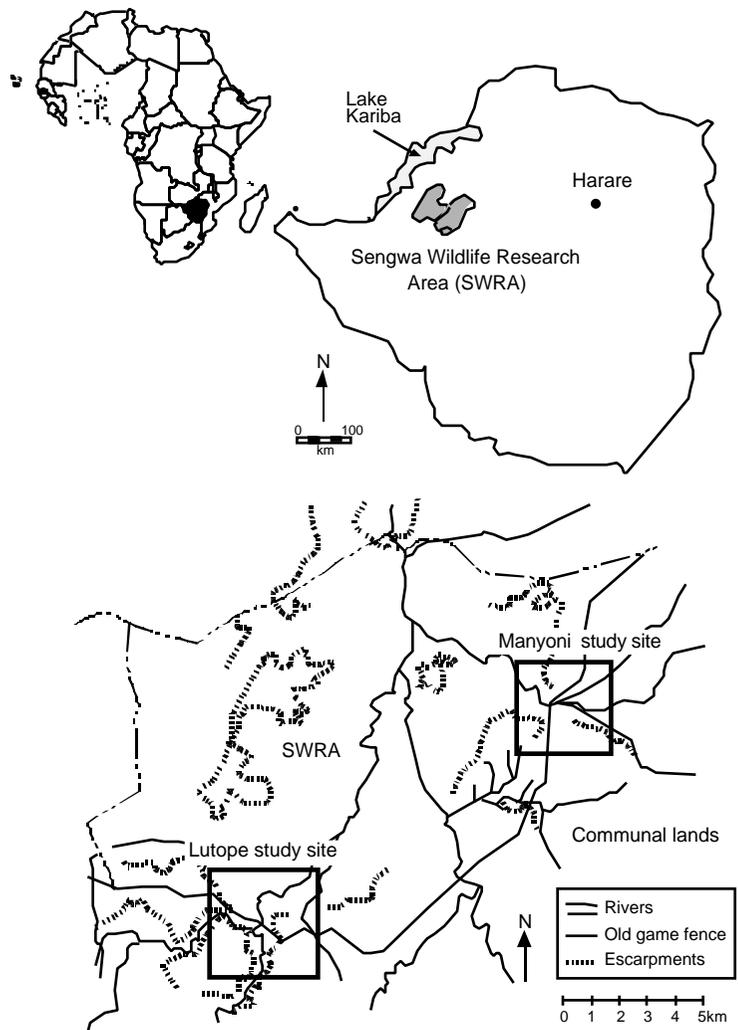


Figure 1. Location of the study area in Zimbabwe (Sengwa Wildlife Research Area—SWRA) and sites where study was conducted.

Materials and methods

Guy (1989) noted that exclosures had been useful for examining changes that occur in woodlands isolated from the effects of fire or grazers, or both. When exclosures are constructed, an area is cordoned off to ensure that fires do not occur and animals do not enter the plots.

When a reserve is fenced, a different situation occurs: wild animals are enclosed, keeping them from the woodlands outside the reserve. A comparison can be

made between the woodlands inside and outside the fence. This technique has been used by Penzhorn et al. (1974) in Addo National Park in South Africa and by Murindagomo (1984), and Ford (1987) and Guy (1989) in the miombo woodlands around SWRA to study elephant impact on vegetation.

Two assumptions were made about the history of the riverine woodlands examined in this study. The first is that there was no difference in the woodland structure and composition of vegetation before the boundary fence was erected. The second is that changes to the vegetation in SWRA were caused by elephants and fire, and changes in CLs were due to human cultivation, domestic livestock and fire.

Three types of data were collected. First, vegetation transects were conducted to identify differences in woodland structure and composition. Second, aerial photographs taken between 1966 and 1993 were used to plot trends in woody vegetation cover in the riverine woodlands inside and outside the park. Finally, indirect observations of trees consumed by elephants in CLs were recorded.

From a survey of aerial photographs and vegetation and soil maps, two regions of riverine vegetation with similar physical features were identified for sampling. After experimenting with permanent plots and transects of different sizes, a 50 m x 10 m non-permanent belt transect (Brower and Zar 1977) was determined to be the most efficient sampling system. Transects were sited in SWRA and CLs in the Lutope and Manyoni riverine woodlands within 2 km of the boundary fence (fig. 1). In CLs, transects were sited in riverine fragments greater than 0.5 ha and selected from 1993 aerial photographs.

Anderson and Walker (1974) defined trees as woody plants taller than 3 m with a stem diameter greater than 6 cm (measured above the buttress swelling). Damaged by elephants, the shapes of many trees were distorted. For this study, a woody plant with a stem diameter greater than 5 cm was considered to be a 'tree'. Plants were either identified in the field or a sample was collected for later identification at the SWRA herbarium. Multi-stem or coppicing plants were measured from ground level if the original stem was greater than 5 cm. The height was measured to the nearest half metre using a graduated pole. Dead trees were excluded. Damage was estimated using four categories: old elephant, old unknown, new elephant, and new unknown. Obvious fire or human dam-

age was also noted. Data were recorded on data sheets designed by Anderson and Walker (1974). No recent fires had passed through the four transect areas, two of which are in CLs and two in SWRA.

Aerial photographs of the Lutope study area used in this analysis were taken five times over a 30-year period: 1966, 1971, 1977, 1983 and 1993. All photographs were taken in the mid- to late dry season when many of the deciduous trees in the miombo and mopane woodlands had lost their leaves. Most trees in the riverine woodlands are evergreen, making interpretation less susceptible to seasonal effects.

Research assistants tracked elephants from the SWRA boundary into CLs in the Lutope study area from June 1993 to June 1996. The fence line was patrolled six days a week and all elephants entering CLs were tracked. The location where elephants left SWRA was identified and the route taken by these elephants the previous night was followed. Assistants were trained to identify plants consumed by elephants, and each time a plant that an elephant had browsed on the previous night was encountered, the plant part consumed was recorded and was scored as one 'browse event'. No effort was made to distinguish the amount of plant material removed.

Each browse event involved an interaction between elephants and an individual tree. Even if more than one elephant fed on a tree, the interaction was scored as one incident. However, as the group size of the study elephants in CLs varied from day to day, a bias exists in the browse event as an index. A group of 10 elephants moving through a woodland are more likely to feed on the same species of trees than a group of unassociated animals. Assistants patrolled the fence line six days a week so the number of days the elephants were tracked is an accurate measure of the number of times the elephants entered CLs.

Analysis

Although 33 transects were conducted in the study area, 4 were not used in the analysis because they crossed from one vegetation type to another. Two-tailed *t*-tests were used to compare the differences between tree height, species composition, and damage classes as the data appeared to be normally distributed. To compare the height of the trees, data were partitioned into three categories. An *A* classification was assigned to trees measuring 0.5–2.5 m in height,

B was given to trees 2.6–10 m, and *C* to trees over 10 m. Two-tailed *t*-tests were used to compare the differences between tree heights and the number of species, as the data appeared to be normally distributed. Simpson's diversity index was used to compare the CL and the SWRA riverine forest. This index takes into account both the abundance (biomass) patterns and the species richness. It is calculated by determining, for each species, the proportion of individuals that it contributes to the total in the sample (Begon et al. 1990).

If two individuals are taken at random from a sample the probability that the two will belong to the same species is

$$l = \frac{\sum n_i (n_i - 1)}{N(N - 1)}$$

where n_i is the total number of species i in the sample and N is the total number of individuals in the sample.

The quantity l is, therefore, a measure of dominance. A large l implies an aggregation of individuals in only a few species, whereas a small value of l denotes a more uniform distribution of individuals among species (Brower and Zar 1977). A collection of species with high diversity will show low dominance, and, $D_s = 1 - l$:

$$\text{Simpson's index } D_s = 1 - \frac{\sum n_i (n_i - 1)}{N(N - 1)}$$

Brower and Zar (1977) state that if the data comprise an entire sub-community, then the result of the above analysis may be compared by inspection instead of statistically.

Photographs of the Lutupe study area were selected from the five samples taken over the 30 years. The scale of the photographs varied from 1:10,000 to 1:70,000. To make a comparison between years, the scale of all the photographs was adjusted to 1:10,000 with the use of a Grant light table. This light table projected the image onto a piece of glass on which a 100 x 100 grid of squares measuring 1 cm² was positioned. Another grid of the same dimensions was placed on the photograph and by adjusting the height of projected image, the scale of all the images was standardized.

Each 1-cm² square cell was the equivalent of 20 x 20 m on the ground at the 1:10,000 scale used for analysis. The contents of each cell were examined

and coded with either a percentage of the vegetation filling the cell or given a value of *F* for field or *R* for river. If a cell contained both wild vegetation and either 'field' or 'river', the cell was allocated to whichever type covered more than 50% of the cell. Wild cover classes were as follows:

- 0 = areas in CLs that had been cleared and not cultivated, or were bare ground in SWRA
- 1 = 5–24% cover
- 2 = 25–49% cover
- 3 = 50–75% cover
- 4 = 76–100% cover

Results

The difference between the number of individual trees in CLs and SWRA in the Lutupe woodland was not significant ($t = 0.09$, $df = 14$, $p = 0.931$). The difference between the number of species was also not significant ($t = 1.05$, $df = 14$, $p = 0.310$) nor was the difference between the stem diameters ($t = 0.85$, $df = 14$, $p = 0.408$).

There was a significant difference between the percentage of trees in height class *A* ($t = -2.86$, $df = 14$, $p = 0.013$). Figure 2a shows that 72% of the trees in SWRA measured below 2.5 m whereas only 48% of the trees in CLs were below this height (fig. 2b). There was also a significant difference between the percentage of trees in height class *B* ($t = 3.03$, $df = 14$, $p = 0.009$). Figure 2a shows that in SWRA only 19% of the trees were in the 2.5–5-m class whereas 39% were in this category in CLs. The difference in the percentage of trees greater than 10 m was not significant, with 9% in SWRA and 13% in CLs ($t = 0.74$, $df = 14$, $p = 0.474$).

The difference between the number of individual trees in CLs and SWRA in the Manyoni riverine was not significant ($t = 1.9$, $df = 13$, $p = 0.8$). The difference between the number of species was significant ($t = 5.03$, $df = 13$, $p = 0.0001$) as was the difference between the stem diameters ($t = 2.22$, $df = 13$, $p = 0.045$).

There was a significant difference between the percentage of trees in height class *A* ($t = -5.41$, $df = 13$, $p = 0.0001$). Figure 3a shows that in SWRA 86% of the trees measured were below 2.5 m whereas only 58% of the trees in CLs were below this height. There was also a significant difference between the percentage of trees in height class *B* ($t = 3.87$, $df = 13$, $p =$

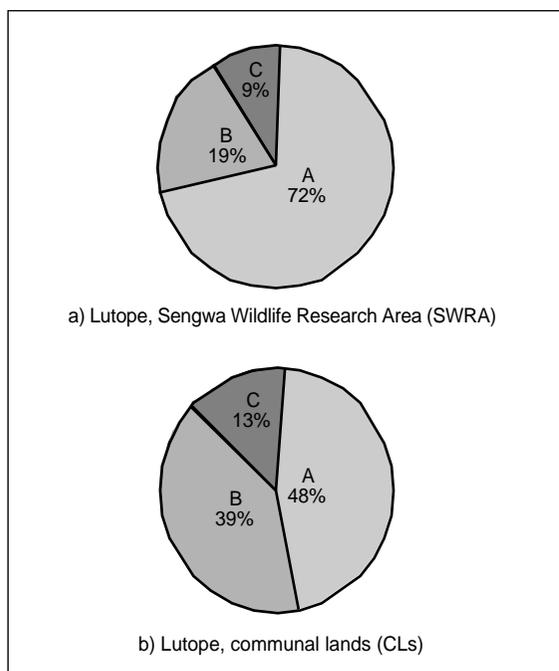


Figure 2. The percentage of trees in the Lutope study site in height classes A (0.5–2.5 m), B (2.6–10 m) or C (> 10 m).

0.002). In SWRA 13% of the trees were in the *B* class whereas 30% of the trees were in this category in CLs (fig. 3b). The difference in the percentage of trees in the > 10-m class was also significant with 1% in SWRA and 12% in CLs ($t = 4.62$, $df = 13$, $p = 0.001$).

Figure 4 shows the results of the aerial photo analysis for the five years sampled. The 1966 photos show little difference between the percentage of cover in the riverine vegetation inside and outside of SWRA. In the 1971 photos, the first few fields in CLs appear and there is a decline in category 4 and an increase in 1, which could be due to clearance of land in preparation for cultivation. The shift in the number of cells inside SWRA classified as 4 between 1966 and 1977 is due mostly to elephants and, to a lesser degree, fire (Anderson and Walker 1974). The shift is not as marked in CLs but there is a slow erosion of the number 4 class in favour of the other categories during the period between 1966 and 1977. This decline could be caused by cover variation at the time the photo was taken. The 1983 photos show a substantial shift from the 4 and the 1 cells to fields.

The routes elephants travelled in CLs were tracked

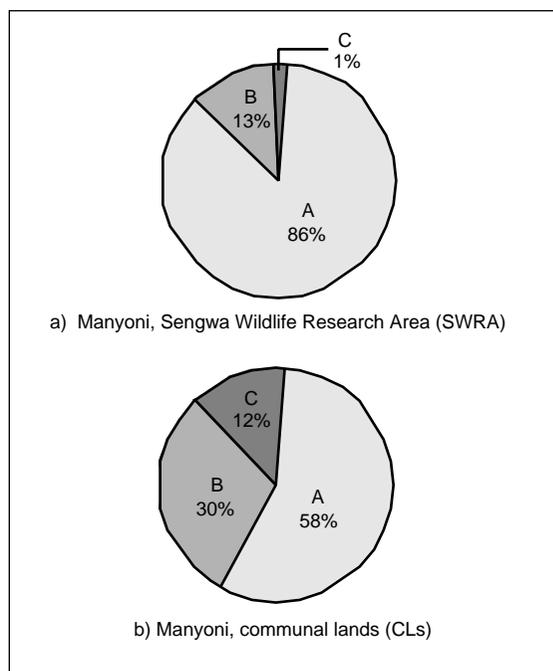


Figure 3. The percentage of trees in the Manyoni study site in height class A (0.5–2.5 m), B (2.5–10 m) or C (> 10 m).

on 784 occasions in the Lutope study area. Table 1 rates the 12 species most commonly browsed by elephants in CLs. As noted earlier, this method gives only a rough estimation of browse selection and is biased. The species they most heavily selected was *Combretum fragrans*, which is reported to be highly preferred by elephants within SWRA (Anderson and Walker 1974; Guy 1989).

Both *Combretum fragrans* and *Colophospermum mopane* are common in SWRA, and the fact that they are selected outside the park is not surprising. However, species such as *Bauhinia inscines* and *Grewia monticola* are no longer common in SWRA.

Discussion

The main difference between the woodlands in CLs and in SWRA is in the size of the trees. The woodlands in SWRA are younger and generally more homogeneous. It does not appear from these data that there are fewer preferred species in SWRA. In fact, in the Manyoni riverine woodland inside the park, some of the transects were sited in nearly pure stands of species

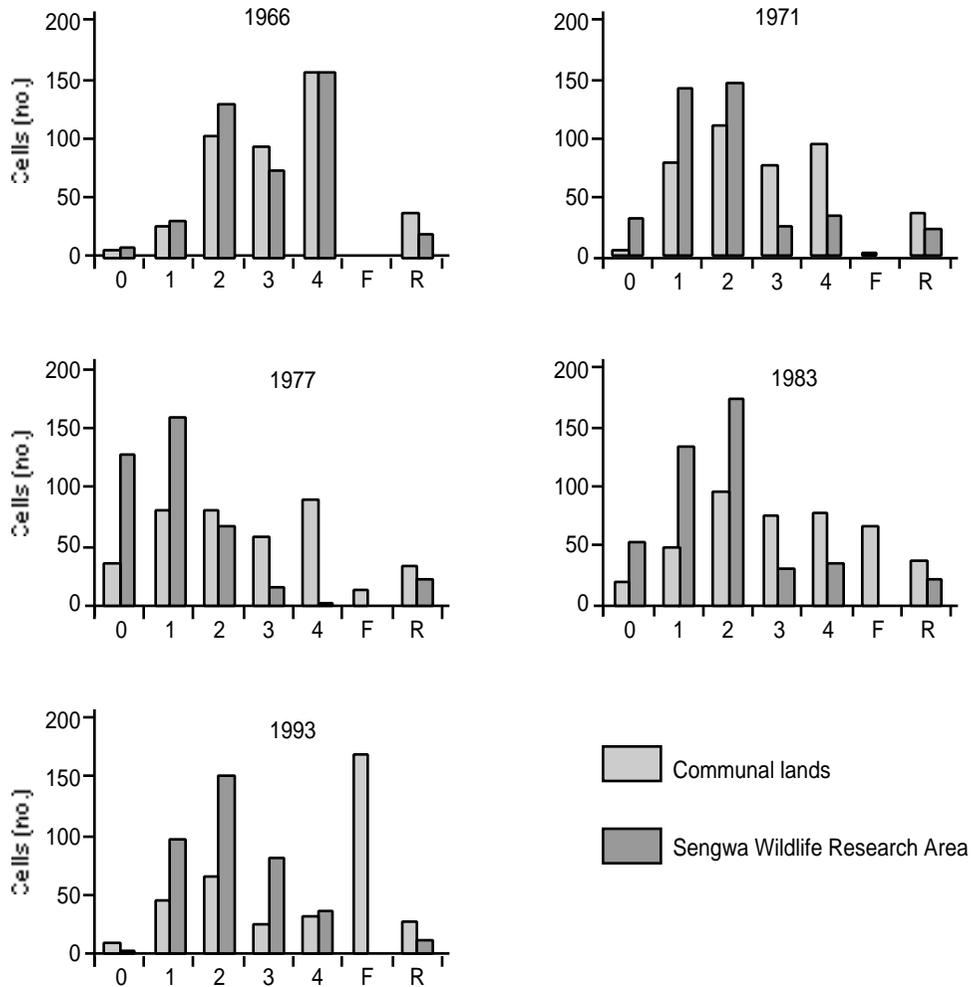


Figure 4. Aerial photo analysis of the vegetation. The 1-cm² cells in the photos indicated on the Y axis each cover an area 20 x 20 m on the ground. 0 = areas that had been either cleared and not cultivated or were bare ground, 1 = 5–24% woody cover, 2 = 25–49% woody cover, 3 = 50–75% woody cover, 4 = 76–100% woody cover, F = field and R = riverine.

that elephants seem to prefer. However, if elephants need to eat a small portion of many different trees to minimize the effect of any one secondary defence chemical, then the elephants may not find these pure stands of 'preferred' species particularly attractive. The relationship between secondary chemicals and elephant selection of food plants was beyond the scope of this study but does need to be investigated.

The results of the air photo interpretation suggests that before the fence was erected the woodlands inside and outside the park had approximately the same canopy cover. The shift in the number of cells classified as 4

from 1966 to 1977 is due mostly to elephants and fire. The shift is not as pronounced in CLs until 1983, when the photos show large areas cleared for farming. The shift from category 0 and 1 to 3 and 4 in SWRA suggests that there was substantial regeneration of the woodland after the culling in the late 1970s and early 1980s.

The browse selection analysis for CLs indicates that the two species selected most frequently there are very common in SWRA—*Combretum fragrans* and *Colophospermum mopane*. Elephants and fire have severely denuded the rest of the species in

Table 1. The order of importance of tree species selected in CLs by elephants using Simpson's index D

Rank	Species
1	<i>Combretum fragrans</i>
2	<i>Colophospermum mopane</i>
3	<i>Diplorhynchus condylocarpon</i>
4	<i>Bauhinia inscines</i>
5	<i>Terminalia sericea</i>
6	<i>Pseudolachnostylis maprouneifolia</i>
7	<i>Grewia monticola</i>
8	<i>Acacia tortilis</i>
9	<i>Bauhinia petersiana</i>
10	<i>Diospyros lycioides</i>
11	<i>Acacia polyacantha</i>
12	<i>Dichrostachys cinerea</i>

SWRA that were selected in CLs, with the exception of *Acacia tortilis*. This suggests that one reason why elephants move into CLs is to feed on those species that are now uncommon in SWRA.

The contrast between the vegetation inside SWRA and in CLs was already noticeable four years after the game fence along the southern boundary was erected. Guy (1989) noted that the difference between the density of canopy trees in CLs and SWRA was pronounced and attributed this to a decline in woody biomass in the major vegetation types within SWRA, especially the miombo woodlands. Ford (1987) concluded that the woody plant cover in CLs was significantly higher than in SWRA and attributed the differences to the selective feeding habits of elephants. Observations from this study suggest that elephants feed primarily, but not exclusively, in the riverine woodlands in CLs. Some typical miombo tree species, such as *Brachystegia boehmii* and *Azelia quanzensis* were, however, also heavily browsed by elephant in CLs. Both of these species are now rare in the SWRA (Guy 1989).

The elephants' motivation to leave SWRA appears to be influenced by a variety of factors. The data presented suggest that the woodlands in CLs are different from those in SWRA, and this is probably the result of elephant feeding in SWRA. Although not demonstrated by this study, past vegetation studies in SWRA suggest that its vegetation may be considerably less diverse than that in the relatively unbrowsed CLs because of the high density of elephants in the 1970s and 1980s.

The high densities of elephants in many national parks are due to a combination of factors. In East Africa, human habitation and poaching have restricted elephants to relatively small areas. Compression or immigration of elephants from outside a protected area is an important factor contributing to over-population of elephants in many national parks (Eltringham 1979). In southern Africa, elephants were hunted to near extinction around the turn of the century and the currently high densities in protected areas are mostly due to natural reproductive increase. Lewis (1986) notes that human pressures have disrupted, or in some cases eliminated, patterns of dispersal for elephants and altered their use of food resources. Historically elephants regulated their effect on woodlands by moving from over-used areas. It therefore seems reasonable to view the movement of elephants into CLs to feed on wild browse as a normal reaction to over-used habitat within the protected areas.

Conclusion

In this paper, some of the causes behind the apparent attractiveness to elephants of the wild browse in forests outside protected areas have been examined. Elephants may be feeding on browse in CLs because of lower secondary chemicals or because of the abundance of favoured plants in CLs that are now uncommon in SWRA. In the past, elephants would have dispersed as the food resources became depleted in an area. This may be, in effect, what these elephants are doing when they move into the remnant forest mosaics outside of protected areas. While this study has not established a causal link between elephants and degraded woodlands, allowing elephants to degrade them may exacerbate conflict between elephants and farmers. Policies allowing elephant populations to increase unchecked, thereby removing preferred tree species, may motivate elephants to move into areas where crops are grown to find wild plants. Management of protected areas where elephants occur in abundance is, therefore, necessary if conflict with humans is to be reduced.

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Dedication leads to reduced rhino poaching in Assam in recent years

Bibhab Kumar Talukdar

Aaranyak, Samanwoy Path (survey)
PO Beltola, Guwahati – 781 028, Assam, India
e-mail: bibhab1@sancharnet.in

Abstract

Assam has a proud legacy of successfully conserving the great Indian one-horned rhino (*Rhinoceros unicornis*) and presently holds two-thirds (66.9%) of the world's wild population of about 2500. The gradual shrinking and fragmenting of habitat are ominous threats for this species' struggle for survival. Of particular importance is the threat posed by poachers. In the past few years, however, anti-poaching staff of the Forest Department in Assam's rhino areas have renewed their dedication and courage, which have minimized rhino poaching. Better coordination among the various conservation agencies and positive support extended by non-governmental organizations has paid dividends in rhino protection in Assam.

Additional key words: threats, strategy, conservation

Résumé

L'Assam est fier d'avoir su depuis toujours conserver le fameux rhinocéros unicolore de l'Inde (*Rhinoceros unicornis*) et il détient actuellement les deux tiers (66,9%) de la population totale vivant en liberté dans le monde (2.500 animaux). Le rétrécissement et l'émiettement progressifs de l'habitat constituent des menaces inquiétantes pour la lutte que mène cette espèce pour sa survie. La menace posée par les braconniers est particulièrement grave. Ces dernières années pourtant, le personnel du département des forêts chargé de la lutte contre le braconnage dans les régions de l'Assam où il y a des rhinos a renforcé son dévouement et son courage et a réussi à réduire le braconnage des rhinos. Une meilleure coordination entre les différents organismes de conservation et le soutien positif accru des organisations non gouvernementales ont eu un effet très bénéfique sur la protection des rhinos en Assam.

Mots clef supplémentaires : menaces, stratégie, conservation

Introduction

Assam occupies a special place in its conservation of the great Indian one-horned rhino *Rhinoceros unicornis* (AsRSG 1999; Talukdar 2000). Of the total estimated world population of Indian rhino in the wild of around 2500, Assam conserves an estimated 1672 according to a census carried out in 1999. The conservation movement in Assam started protecting rhinos at the beginning of the 20th century. With a combination of success and failures, rhino conservation initiatives in Assam have begun the 21st century giving renewed hope to environmentalists keen to see the Indian rhino alive in the wild. This paper describes current successes in curb-

ing rhino poaching in Assam and shows how dedicated field staff are largely responsible for protecting the rhino from poaching. It is based on the study conducted by the author for the Wildlife Crime Monitoring Centre of Aaranyak of Assam, which is a society for biodiversity conservation in north-east India.

Areas conserved for rhino and basic requirements

The number of rhinos found in Assam is 1672; the area available for rhino conservation where rhinos still exist is only around 1100 km², covering areas like Kaziranga National Park (NP), Manas NP, Or-

ang NP, Pobitora Wildlife Sanctuary (WLS) and Laokhowa WLS. Among these sites, rhino conservation efforts in Manas and Laokhowa took a severe blow from poaching, particularly during periods of social unrest around these two rhino areas. During the social unrest of 1983, almost 54 rhinos were killed in Laokhowa WLS, marking the beginning of the disappearance of rhinos from this protected area. Currently, no rhinos are resident in Laokhowa WLS, but occasionally a few rhinos from Kaziranga, Pobitora and Orang wander into the area. The habitat at Laokhowa can still hold a sizeable rhino population, but before any major translocation exercise to re-establish a founder group of rhinos is planned and executed, infrastructural needs such as more personnel and equipment must be met and sound planning undertaken to protect the rhinos from poachers.

Recently I analysed the conservation status, threats and success of rhinos in Pobitora WLS (Talukdar 1999, 2000). Pobitora WLS is one of the smallest rhino areas, being only 16 km², but at 4.75 rhinos per km² its rhino density is high. Although the area was extended up to 38 km², lack of political and administrative will by the district administration has meant that the additional area of about 22 km² has not been officially handed over to Pobitora WLS. This delay will hamper rhino conservation, because as the human population continues to increase yearly the harder it will be to hand over the additional area. If the area is handed over to the manager of Pobitora, infrastructure for it will need further boosting. In addition to the assistance for infrastructure development the government provides, Aaranyak and the David Shepherd Wildlife Foundation (DSWF) have donated a wireless base station, handsets and solar panels. They have also repaired a few of the old handsets in the past two years. Since 1995, the Rhino Foundation based at Guwahati has donated motorcycles, wireless main sets, handsets, solar panels and battery chargers. This in-kind assistance has greatly increased the morale of the forest staff in their efforts to protect rhinos and their habitat.

The current proposal is to extend Kaziranga National Park, holding around 1552 rhino according to the 1999 census, with the addition of six areas that will add another 400 sq km² to the existing area of 430 km². This will provide rhinos with ample area in which to move and will contribute further towards population build-up of the species in Kaziranga. However, with this expansion, the Forest Department will need to ensure that

infrastructure and resources are adequate to manage these additional areas. The manager of Kaziranga NP will need to prepare a long-term plan, keeping in mind the current financial constraints of the state government and future uncertainty, which together with the assistance of NGOs (non-governmental organizations) will help him fulfil his management duties.

This plan, which would include requirements for infrastructure, will help NGOs assist Kaziranga NP and will minimize duplication of effort with regard to in-kind assistance.

Orang NP has been getting infrastructure assistance from Aaranyak, DSWF, and the Rhino Foundation. Recently the Wildlife Trust of India in collaboration with Aaranyak and DSWF have donated around 100 anti-poaching kits to the forest staff of Orang NP (fig. 1). To assist in anti-poaching efforts in Orang NP, Aaranyak and DSWF have donated wireless handsets, base stations, a speedboat and a number of solar panels; the Rhino Foundation has also donated handsets, base stations, solar panels and battery chargers over the past five years.

Threats

Periodic assessment of threat is an important component of site as well as species' conservation planning. The threats include the following.

Poaching

Poaching is the major threat facing rhino conservation (Vigne and Martin 1998; Martin 1999) and whenever more poaching takes place the morale of the forest staff is lowered. However, whenever morale of the forest staff is high, poaching is reduced. This situation has fluctuated at times, based on the situation on the ground and on issues such as the degree of social instability, political and administrative support, and quality of intelligence. Details of rhinos poached during 2000 until August are summarized in table 1.

Covering only 16 km², Pobitora WLS is another interesting site for rhino conservation in Assam. My study revealed that an average of 20–30 rhinos stray out of the sanctuary every night, mainly to graze and migrate and to mate. Although many wildlife activists and zoologists claim in the media that Pobitora WLS is overpopulated with rhino, valid conclusions cannot be drawn as no scientific study on the carrying capacity of the



Figure 1. Anti-poaching kits distributed to forest staff in rhino areas include raincoats, jackets, sleeping bags, caps, rucksacks, water containers, a tarpaulin sheet, torch lights and hunting boots.

sanctuary has been conducted. During this field study, I observed that rhinos from Pobitora tended to migrate from November until early March.

Pobitora WLS is proud that during 2001 no rhinos were poached although poachers made numerous attempts.

Table 1. Rhino poaching in three rhino protected areas in Assam, 2000–2002

Protected area	Poached in 2000 (no.)	Poached in 2001 (no.)	Poached Jan–Sep. 2002 (no.)
Pobitora WLS	2	0	1
Orang NP	5	2	0
Kaziranga NP	4	8	3

WLS – wildlife sanctuary; NP – national park

A strong intelligence network and follow-through activities of the range officer and forest staff paid dividends. Poachers shot and killed one adult female and her calf in June 2000. On 2 January 2002, a group of poachers electrocuted and killed a rhino. While doing so, two of the poachers were also electrocuted. In investigations the forest range officer, Mrigen Barua, and the officer in charge of Mayong Police Station, Pradeep Nath, and I carried out, we found that more than 900 m of electric line was used to kill the rhino. These investigations further revealed that the poachers had been engaged by a vested interest group to kill as many rhinos as possible that night. The group’s intent had been to use their established media network to criticize local conservationists and so create chaos, which they hoped would lead to these two dedicated officers being removed. Expert poachers would know how to avoid electrocution while fixing the elec-

tric line. The poachers killed in this incident were novices with no previous experience in this type of activity. In a raid the two officers carried out within 24 hours of the incident, they recovered the horn from a house in the nearby village. This particular incident reveals the deep-rooted conspiracy involved to demoralize the forest and police staff.

Orang NP went through a difficult time from 1995 to 2000, when poachers killed more than 50 rhinos, reducing the rhino population from 97 in 1993 to only 46 by 1999. However, dedicated forest staff continued their struggle and in recent times they have successfully reduced the amount of rhino poaching in the park. Between May 2001 and September 2002, no rhinos were poached in Orang, an achievement of which the dedicated field staff are proud. During the period from 2000 to August 2002, anti-poaching staff shot dead two poachers attempting to poach rhino inside Orang NP. This incident has further boosted the morale of the staff, and the casualties the poachers have suffered have created a fear psychosis that deters others who might otherwise attempt to poach rhino in the park.

Kaziranga NP (KNP) has also been successful in controlling rhino poaching from 2000 through September 2002. Compared with earlier average annual rhino-poaching rates of around 40 animals per year in KNP (Vigne and Martin 1998), poaching was reduced by an estimated 90% in 2000 and 80% in 2001. This does not mean that patrolling has been cut back or that detection of carcasses is low. In places like KNP, patrolling cannot be taken lightly and it takes place regularly. As more than 70% of the KNP area is open canopy, detecting carcasses is not a problem, and observing birds of prey helps.

From 2000 through September 2002, more than six rhino poachers, including one Bhutanese, were killed in encounters with KNP forest staff. Two of the four rhinos poached in KNP during 2000 were shot and two were killed in pit traps. In 2001 six

more rhinos were killed in pit traps and two were shot. During 2000, Kaziranga lost 44 rhinos from natural deaths that included old age, tiger predation and disease. In 2001, 35 rhinos died from causes other than poaching. During that period three rhino horns were recovered from a poachers' den, two of which are shown in figure 2. On 17 March 2002, a poacher killed a rhino that had strayed out of the park into the Gohpur Jaroni area in Sonitpur District. One person was arrested in connection with this incident and a court trial is still in progress. All three rhino-poaching incidents shown in table 1 took place outside the KNP boundary, where definitely the rhinos had strayed.

Trade

Illegal rhino horn trade has been the main problem facing managers of the rhino-protected areas of Assam. Assam and north-east states border other countries where endangered species (including rhinos) are more vulnerable to being poached to supply the illegal wildlife trade. Lucrative prices offered by rhino horn traders have increased the financial gains of the illegal trade resulting in a large number of mafia-like operations, which the current forest staff with their limited organizational set-up find difficult to counter. So far, the judiciary and the police have shown little sensitivity towards quick apprehension and timely prosecution of rhino-poaching offences.

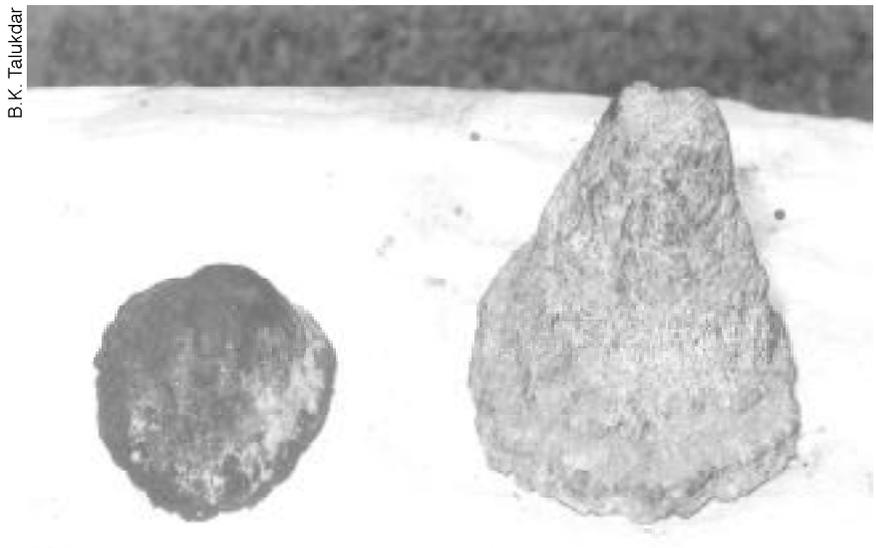


Figure 2. Rhino horn recovered near Kaziranga.

The Subramanian Committee and the High Court Committee have made certain relevant recommendations in this regard, which need quick implementation by both central and state governments.

The current price for a rhino horn varies anywhere from USD 300 up to USD 38,000. The chronology of rhino horn transportation, with prices, is shown in figure 3.

The poacher who shoots the rhino generally gets a negligible amount compared with the national and international smugglers and traders. Efforts the forest department takes to curb rhino poaching will de-

pend on how it deals with the poachers. In addition to implementing various laws, we need to initiate awareness and motivation programmes for family members of known poachers so that they can try to influence the poachers to stop this illegal means of livelihood. Clearly no children would want to introduce their fathers or family members to their friends as rhino poachers. Further, environmental education campaigns should focus on how traders and smugglers exploit the poor poachers for a few thousand rupees. Non-governmental organizations should also help in education campaigns.

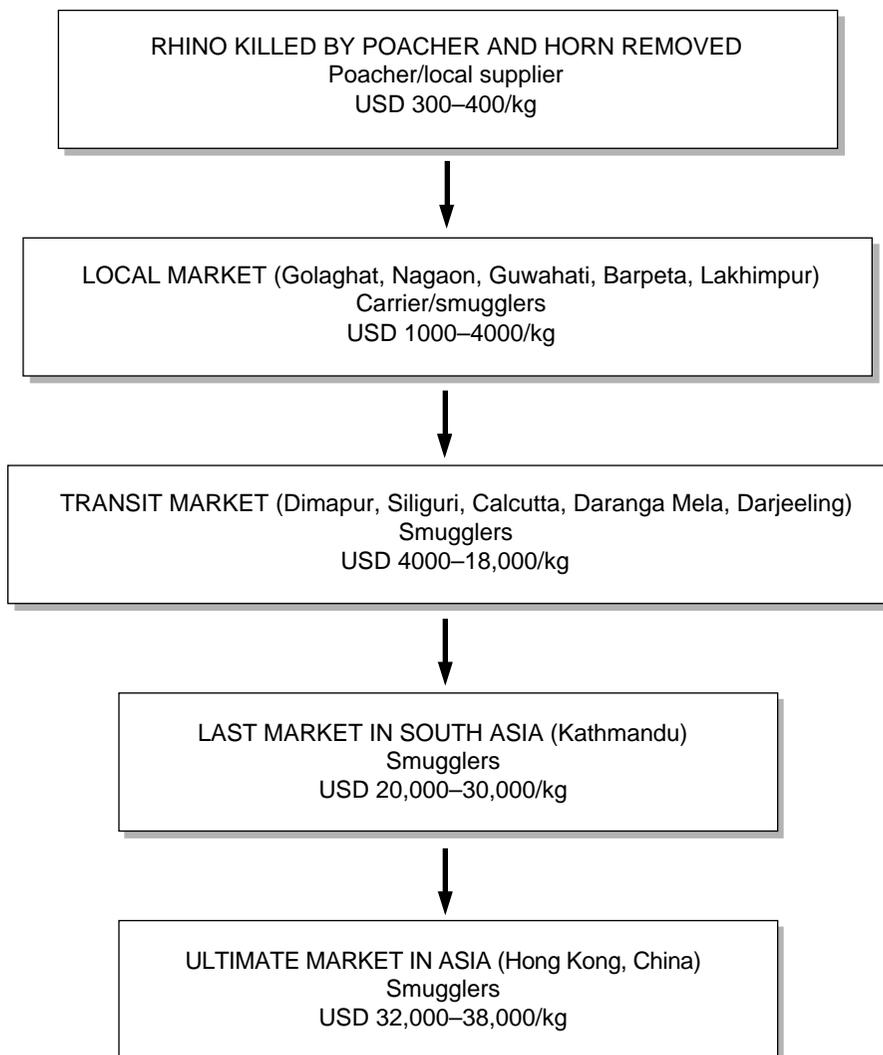


Figure 3. Movement of rhino horn from place of poaching to ultimate trading centre, showing price escalation.

Other causes for worry

Potentially, regulated, low-impact tourism can be an important conservation tool. It helps win public support for rhino conservation and offers opportunities to generate additional revenue to fund essential conservation activities. In recent times, however, the number of tourist visits to Kaziranga NP has mushroomed. The concern is that in future tourist numbers could create management problems if their impact is not studied and analysed properly. More than 100 vehicles enter the park every day during the tourist season, often putting animals under stress. In case of any conflict between tourism and the conservation interests of protected areas, it must be stressed that the interests of the park take precedence over tourism, because tourism exists for the parks and not the other way round. The demands of tourism must be subservient to and in harmony with the conservation interests of protected areas and all wildlife (MOEF 2002).

Eco-tourism in Assam should inculcate in the visitors empathy for nature and provide a communion with nature, rather than merely ensure sightings of maximum numbers of rhinos. Eco-tourism should involve and benefit villagers living at the fringes of the park, and the first benefits of tourism activities should flow to the local people at the park boundaries.

It is time to enhance the efforts made to win the support of politicians, legislators, judges, planners, bureaucrats and technocrats who manage the state to effectively implement rhino conservation measures in Assam. Broad-based public support should be elicited from different sections of the society, particularly communities neighbouring the rhino habitats of Assam. NGOs in particular need to convey a sense of urgency to young people and win their support to protect the rhino—the legacy of Assam.

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Les éléphants *Loxodonta africana* dans la Réserve de Biosphère de la Pendjari, nord-est République du Bénin : abondance, densité et répartition spatiale

C. Aristide Tehou

Ir. chercheur des Eaux et Forêts, Chef service écologie du Parc National de la Pendjari /CENAGREF
08BP 0227 Cotonou / 02 BP 527 Cotonou, Bénin
email : houte@avu.org

Résumé

Le présent article rend compte du statut des éléphants de la Réserve de Biosphère de la Pendjari, situé à l'extrême pointe nord-ouest de la République du Bénin. Ce manuscrit décrit la densité, l'abondance et la répartition spatiale des éléphants de la réserve dans le temps et dans l'espace. Il apparaît clairement que selon la méthode d'estimation, la période et le statut de la Réserve (une gestion avec ou sans projet) leur effectif varie en prenant la forme d'une courbe sinusoïdale. Pour preuve les résultats des travaux de dénombrement donnent les estimations suivantes: Pour une meilleure analyse nous avons considéré seulement les résultats des dénombrements terrestres des trois dernières années au niveau du noyau central (2660,4 km²) de la Réserve. Mais avec la création du Centre National de gestion des Réserves de Faune, la diversité biologique en général et les éléphants en particulier font objet d'un suivi écologique régulier.

Mots clef supplémentaires : dénombrement aérien, terrestre, écologie, individus, noyau central, diversité biologique

Abstract

This article gives an account of the status of elephants in the Pendjari Biosphere Reserve, located in the extreme north-west of the Republic of Benin. It describes the density, abundance and distribution of the elephants in time and space. It is clear that according to the method used for counting, the period and the status of the reserve (it lacks a coordinated management programme), their numbers vary, taking the form of a sine curve. For better analysis only the results of terrestrial counts for three previous years in the central area (2660.4 km²) of the reserve have been considered. But with the creation of a national centre for the management of faunal reserves, biological diversity in general, and elephants in particular, will be the subjects of regular ecological follow-up.

Additional key words: aerial count, land, ecology, animals, central area, biological diversity

Introduction

La Réserve de la Pendjari est située à l'extrême pointe nord-ouest de la République du Bénin. Ses limites géographiques sont comprises entre 10°30' et 11°30' latitude Nord et 0°50' et 2°00' longitude Est, avec une superficie de 4711,4 km² dont 2660,4 km² pour le parc national de la Pendjari, 1800 km² pour la zone cynégétique de la Pendjari et 251 km² pour la zone de Konkombri. Dans le cadre du suivi de sa diversité

biologique elle a bénéficié de plusieurs opérations de recensement des grands mammifères.

La population des éléphants de la Réserve de Biosphère de la Pendjari est la plus importante de toutes les aires protégées du Bénin. Le problème éternel d'absence d'un programme cohérent de suivi continu de la faune de nos réserves de faune reste également valable pour cette réserve qui n'a jamais eu un plan d'aménagement. Les données qui seront analysées dans le présent article ont été les résultats

des différentes estimations de la population des éléphants. Malheureusement les auteurs n'ont pas utilisé la même méthode d'estimation faute d'un suivi écologique continu de la faune en général et de l'éléphant en particulier.

Le présent article vient rendre compte de l'évolution de la population des éléphants de 1987 à 2002.

Méthode

La méthode de dénombrement adoptée est celle du « line transect » très indiquée pour le dénombrement terrestre de la faune sauvage dans les formations végétales ouvertes. Cette méthode a été appliquée pour le dénombrement dans la Réserve de la Pendjari à partir de 1996 par Laboratoire d'Ecologie Appliquée/FSA.

La méthode de dénombrement aérien choisie pour la réalisation de l'inventaire a été celle de

l'échantillonnage systématique de bandes de largeurs constantes mais de longueur inégale. Chaque bande échantillonnée est une unité de sondage au sens statistique du terme. De ce fait, on réalise un échantillonnage systématique composé d'unités de tailles inégales. Le plan d'échantillonnage a été conçu à partir d'une carte topographique au 1/500 000.

L'avion utilisé est un Cessna 172 FR de l'aéroclub de Bobo-Dioulasso. La bande de comptage a été fixée à 250 m. L'espacement des transects a été de 5 km. Deux observateurs étaient installés à l'arrière, l'un du côté gauche, l'autre du côté droit. L'altitude de vol a varié entre 136 et 368 m selon le relief du terrain. La vitesse de survol a varié entre 126 et 256 km/h avec toutefois une moyenne de 140 km/h.

Les données ont été traitées suivant l'analyse « d'estimation par le quotient » employé par Jolly en 1969 (loi de Jolly n°2) au Laboratoire d'Ecologie appliqué de la Faculté des Sciences agronomiques de l'Université d'Abomey Calavi au Bénin.



Abondance spécifique des éléphants

La réserve de la Pendjari a connu une série de dénombrements de 1987 à 2002. Les différents résultats de cette série de dénombrements terrestres et aériens se présente comme suit.

Avec le Projet d'aménagement des Parcs Nationaux (PAPN) en 1987 l'abondance spécifique est de 850 individus (CENAGREF 1999) ; E. Mahe et A. Touré en 1990 nous donne une estimation de 400 individus ; le Projet de Gestion des Ressources naturelles avec la collaboration du Laboratoire d'Ecologie Appliquée (Sinsin et al. 1996) n'a eu aucun contact avec les éléphants au cours de l'opération qui s'était limité à la zone cynégétique de la Pendjari ; le Projet Pendjari avec la collaboration du Laboratoire d'Ecologie Appliquée, Sinsin et al. en 2000 a eu une abondance de 433 individus ; Sinsin et al. en 2001 une abondance de 428 individus ; Sinsin et al. en 2002 ont estimé l'abondance de l'espèce à 2915 individus pour l'ensemble de la réserve et à 2607 individus pour le noyau centrale (dénombrement terrestre) [tableau 1].

Par contre pour le dénombrement aérien l'abondance est de 1450 individus (noyau central) et 2110 individus pour l'ensemble de la réserve (Sinsin et al. dénombrement aérien 2001); en 2002 on note

une abondance de 1130 individus au niveau de noyau centrale (rapport du dénombrement aérien conjointe avec le Complexe W, 2002).

Le résultat du dernier recensement terrestre montre qu'il y a eu un grand mouvement migratoire des aires protégées qui jouxtent la Réserve de biosphère de la Pendjari. Cette situation vient clairement confirmer l'problème éternel des couloirs migratoires trans-frontaliers. D'où la nécessité de la mise en application rapide de la stratégie sous-régionale pour la conservation et la gestion de l'éléphant de l'Afrique de l'ouest (Groupe de Spécialistes de l'éléphant d'Afrique 2001).

La discussion par rapport à l'abondance se limitera à la zone de réserve où nous avons eu des données avec la même méthode entre 2000 et 2002. Dans la situation actuelle seul la zone du parc peut fait objet d'une analyse. L'abondance spécifique en 2000 est de 433 individus, en 2001 nous sommes passé à 428 et en 2002 on observe abondance spectaculaire de 2607 individus. Les chiffres de l'année 2002 est un indicateur qui explique une fois l'impact de la quiétude que l'on observe de plus en plus au niveau de la Réserve de Biosphère de la Pendjari. Quand on rapproche les évènements de tentative de translocation des éléphants de la Réserve de Arly au Burkina Faso pour le Sénégal et la lutte anti-transhumance dans

Tableau 1. Comparaison des densités (ind /km²) des populations d'éléphants dans des réserves différentes de faune en Afrique de l'Ouest (dénombrement aérien)

Réserve	Superficie (km ²)	Eléphant /km ²	
		1999	2000
Parc National d'Arly, Burkina Faso	1088	0,38 / 0,29	0,38
Pama Centre Nord, Burkina Faso	652	0,76 / 0,26	0,10
Pama Centre Sud, Burkina Faso	565	1,10 / 0,06	0,03
Pama Nord, Burkina Faso	789	0,28 / 0,25	0,12
Parc National Comoé, Côte d'Ivoire	2890		0,13
Borgu, Nigeria	—		0,21
Parc National de 'W', Bénin	2290		0,15
Réserve de Biosphère de la Pendjari, Bénin	4711		0,47
Parc National de la Pendjari, Bénin	2660		0,54

le Parc du W du Niger qui sont des aires qui jouxtent la Réserve de Biosphère de la Pendjari, on comprend qu'il y a eu un grand mouvement migratoire vers la Pendjari. Cette situation explique clairement le phénomène observé cette année par rapport à l'abondance spectaculaire des éléphants dans notre Réserve (fig. 1).

Densité

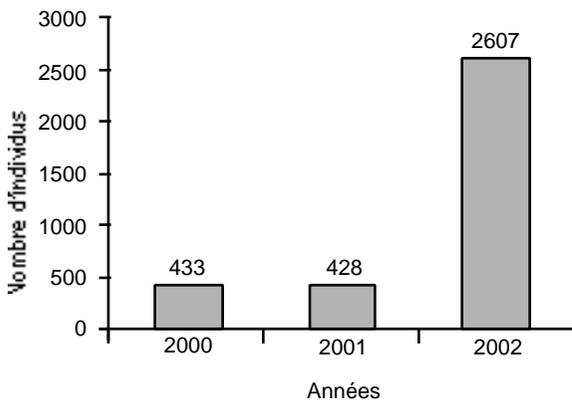


Figure 1. Abondance des éléphants dans le Parc National de la Pendjari.

Au niveau des résultats des différents dénombrements terrestres la densité moyenne est de $0,16 / \text{km}^2$ en 2000 avec un intervalle de confiance de 95 % = $[0,036 ; 0,74]$ et une taille des groupes $E(s) = 5,75$; de $0,16 / \text{km}^2$ en 2001 avec un intervalle de confiance de 95 % = $[0,20 ; 0,45]$ et une taille des groupes $E(s) = 8,10$ puis de $0,9 / \text{km}^2$ en 2002 avec un intervalle de confiance de 95 % = $[0,38 ; 2,49]$ et une taille des groupes $E(s) = 7,69$ si l'on considère uniquement le noyau central avec une superficie de $2660,4 \text{ km}^2$.

Par contre la densité moyenne des éléphants après le recensement aérien au niveau du noyau central en 2001 est de $0,54 / \text{km}^2$ avec une taille moyenne des groupes $E(s) = 7$ et de $0,42 / \text{km}^2$ en 2002 avec une taille moyenne des groupes $E(s) = 6,65$. Les résultats de 2002 pour le dénombrement aérien sont à prendre avec réserve.

Répartition spatiale

Les points de contact avec les pachydermes dans la Réserve au cours de la surveillance continue ont été

relevés à l'aide des GPS en 2001 et en 2002 et projetés sur carte avec le logiciel ARC-View 3.5 (fig. 2).

Conclusion

La population des éléphants de la Réserve de Biosphère de la Pendjari est la plus importante de toutes les aires protégées du Bénin. La diversité des auteurs et des méthodes utilisées et la longue période qui sépare les recensements ne permettent pas pour le moment d'avoir une idée précise quant aux tendances évolutives des populations d'éléphants. Les variations observées au niveau d'abondances et des densités moyennes montrent combien est délicat le suivi de la des animaux sauvage. On note également que les éléphants sont concentrer au niveau du parc national (noyau centrale) pendant les périodes de dénombrement et cela à cause des ressources en eau qui ne sont que disponible au niveau du noyau centrale pendant la saison sèche. Tous ces éléments réunis montrent une fois encore qu'il faut mettre en place un système de suivi continu de la faune en générale et des éléphants en particulier pour une gestion durable. Mais l'effort qui a été fait depuis le démarrage du CENAGREF/PCGPN à travers le Projet Pendjari (un projet de gestion d'aménagement de la faune) doit être poursuivi et surtout dans le cadre du suivi écologique continu des pachydermes de la sous-région en général et du Bénin en particulier à cause de la particularité que présente aujourd'hui les éléphants de l'Afrique de l'Ouest.

L'absence d'un programme cohérent de suivi écoéthologique continu de la faune sauvage en général et des éléphants en particulier constitue un problème majeur pour la sauvegarde des groupes de petites tailles de la sous-région.

Cette situation exige un soutien permanent à la recherche scientifique pour que les meilleures mesures de conservation et de gestion de l'espèce soient prise sur la base des scientifiques actuelles et fiables.

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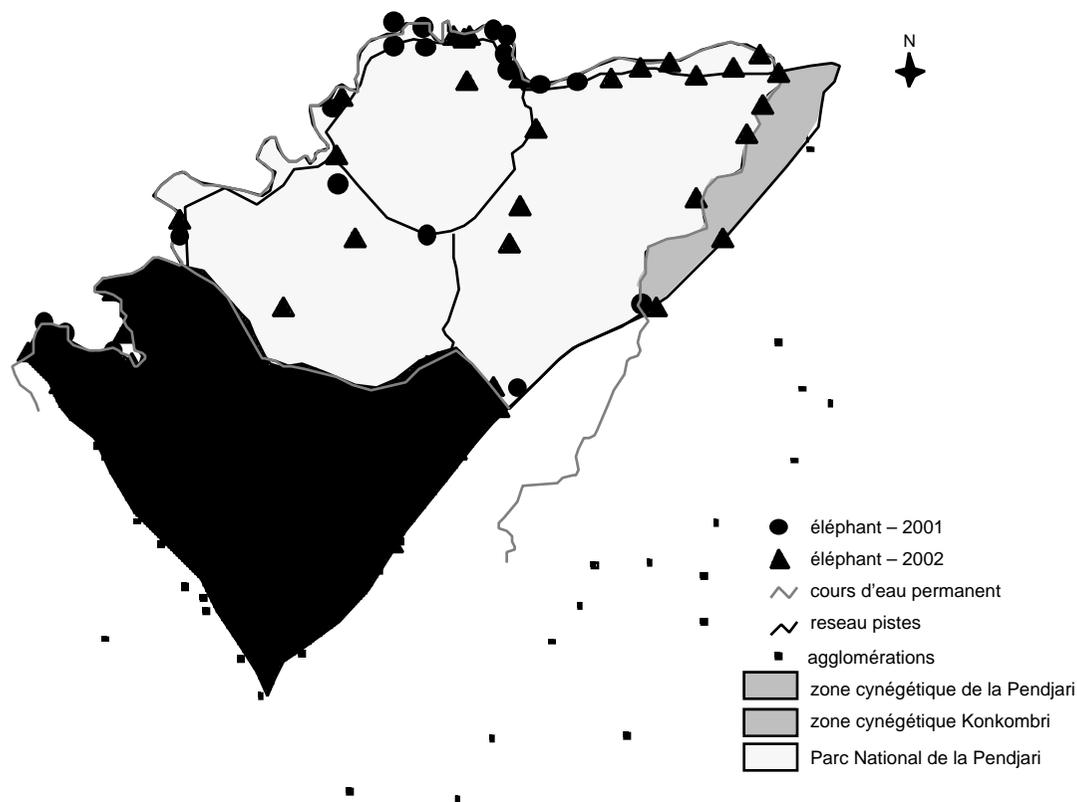


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Decline of elephants and other wildlife in the Nasolot–South Turkana and Kerio Valley–Kamnarok conservation areas, Kenya

P. Omondi, E. Bitok and R. Mayianda

Kenya Wildlife Service, PO Box 40241, Nairobi, Kenya
email: elephant@kws.org

Abstract

The 2002 total aerial count of elephants for Nasolot, South Turkana, Kerio Valley and Kamnarok National Reserves and surrounding dispersal areas was conducted between 4 and 8 August. Two aircraft fitted with global positioning system (GPS) were used in navigation, recording survey paths and waypoints. Total counts of elephants and other wildlife species were done and livestock numbers estimated. Elephants counted were 490, many in the northern parts of their range. This count is a decline of 362 individuals or 42.4% since 1997 and 302 or 38.1% since 1999. This drastic decrease since 1997 suggests that this elephant population is severely threatened. The distribution pattern of elephants during all the counts (1997, 1999 and 2002) is similar, with most elephants distributed in the northern and southern parts of the ecosystem. The number of carcasses recorded was 62, compared with 45 in 1999 and 13 in 1997. The carcass ratio was 11.2% contrasted with 5.4% in 1999. This ratio is much higher than that of other elephant ranges in the country. If it is a relative index of poaching levels, the situation in the ecosystem is alarming. About 29,000 head of livestock were estimated in the study area, signifying a high level of human activity in the area, thus carrying a high potential for human–wildlife conflict.

Résumé

Du 4 au 8 août 2002, on a procédé au recensement aérien total des éléphants des Réserves Nationales de Nasolot, du Turkana-sud, du Kerio Valley et de Kamnarok et des aires de dispersion environnantes. Deux avions équipés d'un système de positionnement global (GPS) ont servi à la navigation pour relever les sentiers étudiés et les points de repère. On a procédé au comptage total des éléphants et des autres espèces sauvages et à une estimation du bétail. Les éléphants dénombrés étaient au nombre de 490, plus nombreux dans les parties nord de leur aire de répartition. Ce chiffre représente une baisse de 362 individus, ou de 42,4 % depuis 1997, et de 302, ou 38,1 % depuis 1999. Cette chute dramatique constatée depuis 1997 suggère que cette population d'éléphants est gravement menacée. Le schéma de distribution des éléphants est resté semblable pendant tous les comptages (1997, 1999 et 2002), et la plupart des éléphants se répartissaient dans les portions nord et sud de l'écosystème. Le nombre de carcasses rapportées était de 62, alors qu'il était de 45 en 1999 et de 13 en 1997. Le pourcentage des carcasses représente 11,2 %, contre 5,4 % en 1999. Ce pourcentage est beaucoup plus élevé que celui des autres aires de répartition des éléphants dans la région. Si on peut le considérer comme un indice relatif du taux de braconnage, la situation est alarmante dans l'écosystème en question. On a évalué le nombre de têtes de bétail à environ 29.000 dans la zone étudiée, ce qui signifie un taux élevé d'activité humaine et, par conséquent, un risque considérable de conflits hommes-animaux sauvages.

Introduction

The 2002 aerial count was undertaken as part of a Kenya Wildlife Service (KWS) initiative to determine the current status of Kenya's elephant population. Nasolot and

South Turkana reserves hold the largest elephant population in western Kenya and some of its security patrols are administered from Mt Elgon National Park (90 km away), which is one of the four Monitoring of Illegal Killing of Elephants (MIKE) sites in Kenya.

Historical information on elephants in this area is scant. In 1973 the estimate for Turkana District was 1500 elephants, but no figures were given for the other districts (Jarman 1973). The Department of Resource Surveys and Remote Sensing (DRSRS) carried out a small number of surveys during the 1970s and 1980s. These generally gave low estimates—a few hundred animals across the whole area—with the exception of one count in Turkana in 1981 that gave an estimate of over 800 elephants outside the reserves.

In 1990 local KWS staff estimated that there were 400 elephants in Nasolot and South Turkana game reserves at the northern end of the range, with another 100 in Kerio Valley and Kamnarok to the south. DRSRS sample counts in the same year gave estimates of 535 for West Pokot (including Nasolot), 0 for Turkana and 596 for Baringo. However, the confidence limits were high. No survey was carried out in Elgeyo Marakwet. A sample aerial count of the area was carried out in June 1992 (Mbugua 1992). Very few elephants were seen inside the sample strips, so the count was treated as a low-intensity total count. This provided a similar figure of 580 elephants, of which 525 were in Nasolot and South Turkana. Because this was carried out at low intensity, it was estimated that the total population could have consisted of over 900 elephants.

Total aerial counts of the Nasolot and South Turkana elephants were carried out in June 1997 (Muriuki et al. 1997) and July 1999 (Omondi et al. 1999). Elephants counted were 852 in 1997 and 792 in 1999. In both counts most of the elephants were found in the northern block of Nasolot–South Turkana, with smaller numbers seen in the southern Kerio Valley and Kamnarok Reserves. Pastoralism remains the major economic activity in the dispersal areas.

Kamnarok National Reserves and the surrounding areas (fig. 1). The surrounding dispersal areas east and west of the study area are moderately settled by people who have restricted wildlife movements. The Nasolot North Reserve covers about 92 km².

Topography and rainfall determine vegetation types. The study area is characterized by light bushland with significant areas of dwarf shrubland and grassland. Moisture and elevation gradients influence vegetation, with higher elevations having more woody cover than the lowlands.

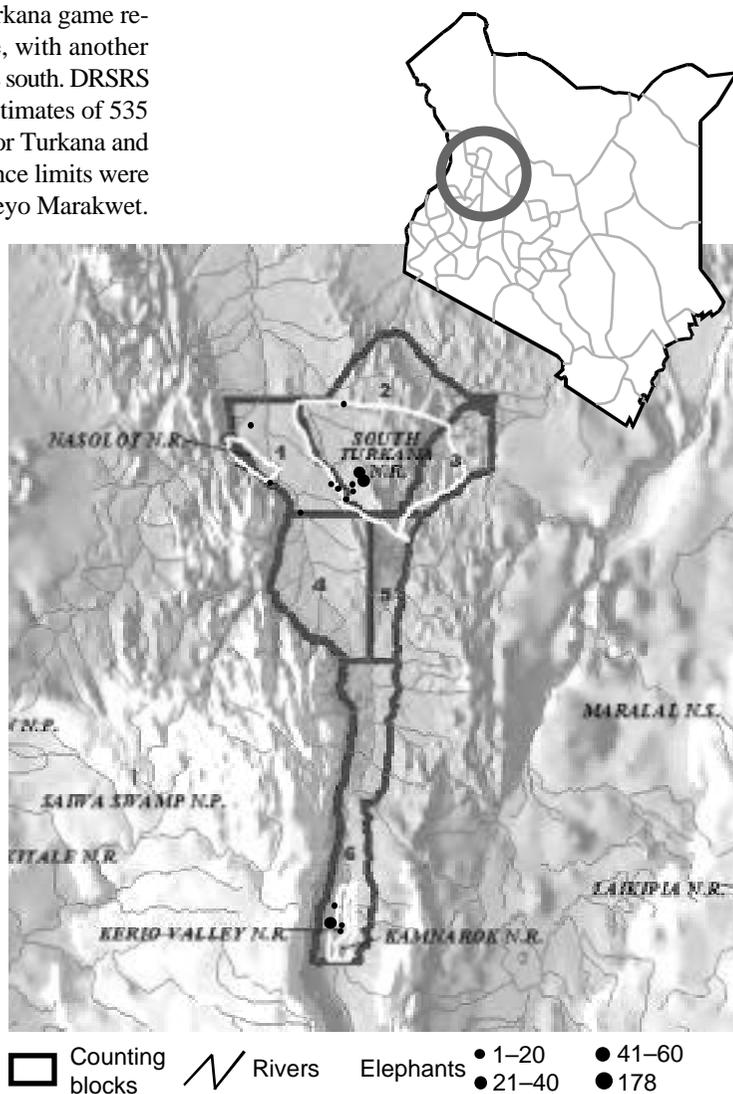


Figure 1. Elephant distribution as observed in the August 2002 aerial count in the Nasolot–South Turkana and Kerio Valley–Kamnarok study area. (GPS map produced by R. Mayienda, GIS Section, IT Dept. KWS.)

Study area

The study area covered the Nasolot, South Turkana, Kerio Valley and

The main watercourses support evergreen or semi-deciduous riverine vegetation, which form dense forests with a dominance of various tree species such as *Acacia tortilis*, *Acacia seyal*, *Balanites aegyptiaca*, *Dichrostachys cinerea* and *Salvadora persica*. Away from the watercourses, the common species vary somewhat with region and soil type. Cover is sparse, often less than 5%, bushes being typically thorny and rather widely spaced.

The climate is arid and hot. Temperatures are high throughout the year with an average daily level of about 24° C to 38° C. Rainfall is low with an annual average of about 180 mm. The survey was carried out during the dry season, which falls around August to December.

Methods

The method adopted for the 2002 total aerial count for wildlife and livestock was that used in the 1999 census (see methods of Douglas-Hamilton et al. 1994 and Douglas-Hamilton 1997). The count therefore employed the global positioning system (GPS) technique with ArcView software used for plotting species distribution maps (for example, figs. 1 and 2).

Two aircraft were used in the count. The survey crews consisted of one observer and a pilot for a two-seater aircraft; a pilot, a front-seat observer and two rear-seat observers for the four-seater aircraft. Each used GPS in navigation, recording the survey path and waypoints. The exercise started every morning at 0730 and ended late in the evening. Breaks were taken during refuelling of the aircraft and at lunch. All observations were saved in GPS as waypoints with the geographical location referenced and used to produce species distribution maps. Unless the view was obstructed by thick vegetation, photographs were used to establish the correct count of large herds (Douglas-Hamilton 1997). All waypoints were downloaded onto a computer at the operation base each evening and the front-seat observers did a summary table of each block. Any double counts in neighbouring blocks were also worked out and eliminated during these sessions.

Results

Total flying time was 33 hr 32 min, total count time 21 hr 12 min. Like in the previous count of 1999, all species of animals seen were recorded to get a good

picture of species numbers, diversity and distribution. Eight wildlife species were counted: 12 baboons, 5 Cape buffaloes, 3 dikdik, 490 elephants, 1 gazelle, 2 lesser kudus, 1 oryx, 11 warthogs. Most of these animals were found in the southern parts of Sigor–Kolosia (blocks 4 and 5) and Kerio Valley (block 6). In 1999, most of the species were found in the northern blocks of Nasolot–South Turkana (blocks 1–3).

Elephants

The number of elephants counted was 490. This is a major decline from previous counts. Blocks 1 and 2 (Nasolot and South Turkana) had the highest number (285 or 58% of total elephants counted). Like in the previous count of 1999, no elephants were counted inside Nasolot Game Reserve. Most were found farther south-east towards South Turkana Reserve and the rest in Kerio Valley Game Reserve in the farthest south area of the Kerio Valley (fig.1). This Kerio Valley block had 42% (205 elephants) of the total number of elephants counted. No elephants were counted in blocks 4 and 5 (Sigor and Kolossia).

Carcasses

Observed during the count were 62 carcasses, compared with 13 in 1997 and 45 in 1999 (table 1). Most were in blocks 1 and 2 (50%); the rest were spread over the other blocks (fig. 2).

Livestock

Livestock were concentrated in the southern blocks with none or very few recorded in the northern blocks. The number of livestock estimated during the count was 28,700 (almost the same number estimated in the last count of 1999); 39% were cattle and 61% sheep and goats (table 2).

Discussion

Elephant and carcass trends

Elephant trends in this ecosystem have continued to decline since 1997 (Muriuki et al.). Compared with the 1999 count (Omondi et al.), the 2002 count indicated a major decline (38.1%) in elephant numbers. Between 1997 and 1999, the decline had been 7%. The carcass ratios have also continued to increase between 1997 and 2002 (1.5% for 1997, 5.4% for 1999

Table 1. Carcass trends in Nasolot–South Turkana ecosystem between 1997 and 2002

Year of count	Live elephants (no.)	Carcasses (no.)		Carcasses (%)	Recent (%)
		Old	Recent		
1997	852	10	3	1.5	23
1999	792	36	9	5.4	20
2002	490	52	10	11.2	16.1

Most of the recent or fresh carcasses were found in the Nasolot–South Turkana blocks (mainly in block 1) while most of the old were in block 4 (see fig. 2).

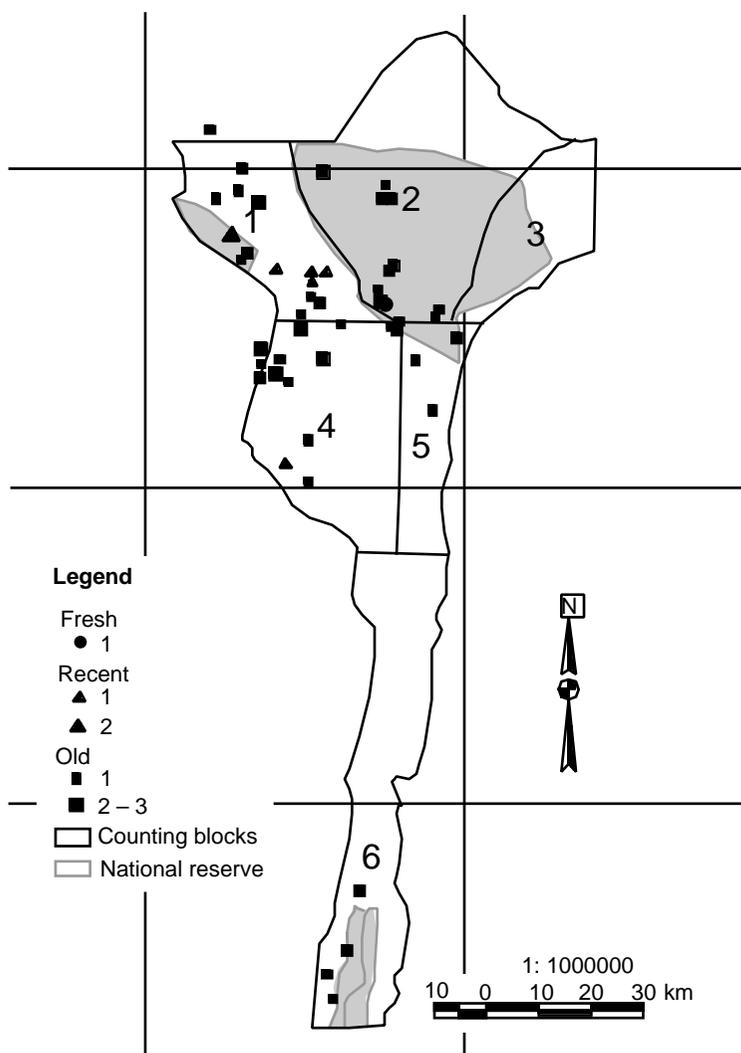


Figure 2. Elephant carcasses as spotted in the August 2002 aerial count, Nasolot–South Turkana and Kerio Valley–Kamnarok. (Modified from the GPS map produced by R. Mayienda, GIS Section, IT Dept., KWS.)

and 11.2% for 2002). This clearly reflects the trend in the dwindling numbers of live elephants as portrayed by count results (fig. 1). It is therefore clear that this population is highly threatened compared with populations in other Kenyan ranges, which have registered increases.

Livestock

The large number of livestock in the Nasolot–South Turkana ecosystem presents a big change from the results of the last count. It signifies a high level of human activity in the area. As in other ranges, increased human–elephant interactions are a potential threat to the survival of the elephant population. These interactions are likely to lead to conflict and increased vulnerability of elephants to various causes of death. The interactions involve competition for limited resources such as water and grazing areas. With the presence of so many illegal firearms in the hands of local people, who are often seen carrying them while grazing or herding their livestock, incidents of elephant mortality will continue to increase. It is also important to note that the encroachment into Kerio Valley and Kamnarok in the south has led to intense human–elephant conflict. This conflict has been attributed to increased human population that has forced people to move into the reserve in search of pasture for livestock, firewood and honey (Kerio Valley warden, pers. comm., August 2002). These human–elephant interactions have led to four human deaths in two years. The Nasolot–South Turkana area is insecure, with very little tourist activity; cattle rustling has become a serious problem in the last few years and KWS often encounters large parties of armed men. The seizure of 28 tusks in South Turkana in 1999 suggests that the com-

Table 2. Livestock estimates in Nasolot–South Turkana ecosystem

Blocks	Cattle	Camels	Sheep & goats	Total
1	–	–	800	800
2	100	60	470	630
3	50	–	–	50
4	5,118	10	7,162	12,290
5	2,160	20	1,405	3,585
6	3,273	–	–	3,273
Outside	540	25	7,485	8,050
Total	11,241	115	17,322	28,678

mercial ivory trade was active in this area. Intelligence reports indicate that elephants are often killed if raiding gangs encounter them; they eat the meat and take the tusks. It is likely that only a very small percentage of the overall elephant mortality is actually reported, many of the carcasses being in inaccessible areas.

Conclusion

These observations make it evident that wildlife species have continued to decline in this ecosystem. In 1999 total wildlife numbers were 1031; during this count, only 525 animals were counted. The decline (49%) calls for immediate action to find and control the causes, to save some wildlife populations from local extinction.

The Nasolot–Kamnarok elephant population is severely threatened by the influx of firearms from neighbouring countries. The presence of sophisticated weapons has led to escalated violence through banditry and cattle rustling. The elephants have not been spared in battles between local communities. They have been killed either for ivory and meat or as an outcome of human conflict.

Because of the threats faced, more resources should be set aside for wildlife protection in this ecosystem. Intensive air and ground patrols should be carried out continuously to monitor the status of all species, especially the elephants. With so many firearms concentrated within a small area and the general lack of security, the future of these elephants is bleak unless far more stringent law enforcement is put in place.

Acknowledgements

We would like to acknowledge all the participants and organizations for their financial, material and moral

support from the time of preparation through to the actual count. We are grateful to MIKE through its director, Nigel Hunter; the European Commission through the African Elephant Specialist Group's (AfESG) programme officer Leo Niskanen for funding the exercise; and KWS director Joseph Kioko for committing two KWS aircraft towards this exercise and giving his encouragement, both of which ensured the success of this count.

We appreciate the efforts and dedication shown by KWS pilots Bongo Woodley and Anthony Kiroken, who flew tirelessly to ensure that all blocks were covered within schedule.

We would also like to thank the wardens for Kerio Valley and Nasolot National Reserves, Dickson Korir and David Muthui respectively, and their staff for their support on the ground. We applaud the dedication of the drivers, rangers and aircraft attendants, without whom the count would not have been smooth. Finally, to all those who participated in any way but have not been mentioned, we thank you for your contribution towards making the Nasolot count a success.

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The trade in African and Asian ivory in South and South East Asia

*Daniel Stiles*¹ and *Esmond Martin*²

¹ PO Box 5159, Diani Beach, Kenya; email: kenyan@wananchi.com

² PO Box 15510, Mbagathi, Nairobi, Kenya; email: rhino@wananchi.com

Abstract

Elephant poaching continues in Africa and Asia, largely as a result of the ivory markets. If the ivory markets were reduced through law enforcement and education, the price of raw ivory would fall and the incentive to poach elephants would also drop. The authors completed a study of the ivory markets in Africa in 1999, but baseline data to pinpoint the problem areas in Asia were urgently required because the two regions are linked. The authors therefore undertook a study in South and South East Asia in late 2000 and early 2001. It is more cost efficient to investigate, understand and thus be able to control the ivory markets than to stop elephant poaching by conventional means. The eight key countries visited and covered in this article were Cambodia, Laos, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam. Data were collected on the numbers of craftsmen, workshops, retail outlets, ivory items, and prices for raw and worked ivory. Thailand, by far the largest market, is fuelled mainly by illegal imports of African raw ivory plus some tusks from Myanmar. The ivory trade has declined since 1990 in all the countries surveyed because the demand for ivory has been reduced, except for Thailand, where trade has probably remained the same, and Myanmar, where it has increased. Although all the countries studied except Laos are members of CITES and also have domestic laws on ivory, law enforcement is weak. It is important to stop illegal ivory sales to tourists and businessmen in the two regions reported in order to reduce elephant poaching in Africa and Asia, especially in Cambodia, Laos and Vietnam where wild elephant numbers have declined by over 75% since 1988.

Résumé

Le braconnage des éléphants se poursuit en Afrique et en Asie, en grande partie à cause de l'existence d'un marché pour ce produit. Si on pouvait diminuer le marché de l'ivoire par un renforcement des lois et par l'éducation, le prix de l'ivoire brut chuterait et les incitants du braconnage diminueraient aussi. Les auteurs ont terminé une étude sur le marché de l'ivoire en Afrique en 1999, mais on avait besoin des données de base pour localiser avec précision les zones qui posent problème en Asie parce que les deux régions sont liées. Les auteurs ont donc entrepris une étude en Asie du Sud et du Sud-Est fin 2000 – début 2001. Il est en effet plus rentable de faire des enquêtes, de comprendre et puis de pouvoir contrôler le marché de l'ivoire que de stopper le braconnage des éléphants par des moyens traditionnels. Les huit pays clés visités et couverts par cet article sont le Cambodge, le Laos, le Myanmar, le Népal, Singapour, le Sri Lanka, la Thaïlande et le Vietnam. Nous avons récolté des données sur le nombre d'artisans, d'ateliers, de points de vente, sur les objets en ivoire et sur les prix de l'ivoire brut ou travaillé. La Thaïlande, qui est de loin le marché le plus important, est principalement approvisionnée par des importations illégales d'ivoire africain brut auquel s'ajoutent quelques défenses venues du Myanmar. Le commerce de l'ivoire a diminué depuis 1990 dans tous les pays étudiés parce que la demande a baissé, sauf en Thaïlande où le commerce est probablement resté stable, et au Myanmar où il a augmenté. Bien que tous les pays étudiés, sauf le Laos, soient membres de la CITES et qu'ils aient une législation locale sur l'ivoire, le respect des lois laisse à désirer. Il est important de stopper les ventes illégales d'ivoire aux touristes et aux hommes d'affaires dans les deux régions citées pour pouvoir réduire le braconnage des éléphants en Afrique et en Asie, et spécialement au Cambodge, au Laos et au Vietnam où le nombre d'éléphants sauvages a chuté de plus de 75 % depuis 1988.

Introduction

In 1999 we investigated the ivory markets of Africa, finding out that raw African ivory was still being smuggled from certain countries into Asia in significant quantities (Martin and Stiles 2000; Stiles and Martin 2001). The subsequent work in South and South East Asia was partly to find out where African ivory was going in the two regions and who was buying it (Martin and Stiles 2002). There are fewer than 50,000 wild Asian elephants remaining, about 10% of the African elephant population (WWF 2002; Kemf and Santiapillai 2000). The Asian elephant population cannot supply the ivory demand in some parts of South and South East Asia, a situation that has encouraged smuggling ivory from Africa.

This recent study focused on internal trade in raw and worked ivory in the key towns and cities with ivory markets in two regions of Asia. We also gathered information related to cross-border trade. We visited eight countries in the region—Cambodia, Laos, Myanmar, Nepal, Singapore, Sri Lanka, Thailand, and Vietnam. Even though all except Laos have ratified CITES, international trade in ivory still occurs, particularly with Thailand.

A main question to answer is whether the ivory trade is increasing or decreasing or is stable. The level of poaching should be correlated with the magnitude of retail ivory being sold, both of which are in most cases illegal and thus hidden. We believe that monitoring and evaluating ivory markets can be a cost-effective method of assessing threats to elephant populations. Here we provide baseline data to help understand the scale of the ivory trade, and in some instances where past data are available, trends.

Methods

Fieldwork was carried out from early November 2000 to late March 2001 by two investigators working in close coordination to keep data-collecting techniques as similar as possible for consistency and comparisons. Martin worked in Cambodia, Nepal and Thailand, while Stiles worked in Laos, Myanmar, Singapore, Sri Lanka, and Vietnam. Ivory traders, craftsmen, vendors, customers, government officers and conservationists were interviewed. Almost every retail ivory item on display was counted individually. Indicators used were the

prices of raw and worked ivory, the number of outlets selling ivory items, the number of ivory workshops and craftsmen, and the number of ivory items seen for sale. Prices for raw tusks were confirmed by using several informants.

Results

Legal position of the ivory trade

CAMBODIA

Cambodia joined CITES in 1997. All hunting of wildlife and the internal trade in new ivory were banned in 1994. The domestic trade in pre-1994 elephant products is not prohibited. In 1996 the sale, trade, harvest and transport of live wildlife was prohibited, but not the sale of dead animal products. Thus trade in elephant products in Cambodia was legal for 'old' items, but not for new ones at the time of this survey.

LAOS

Although Laos has not joined CITES, ample national legislation since 1986 prohibits elephant killing and trade in products of elephants and other protected wildlife species. Ivory and other wildlife products can be imported and exported, but since 1989 government authorization plus a certificate of origin are needed.

MYANMAR (BURMA)

Myanmar joined CITES in 1997. Wild elephants have been protected since 1935. In 1994 a new law was enacted protecting wild animals and plants outside forest and wildlife protected areas, and later that year a list was published of species that cannot be hunted or their products exploited, which includes the Asian elephant. It is legal to buy whole tusks and ivory tusk-ends from privately owned domesticated elephants and to transport these with the proper permit. It is also legal to sell carved ivory.

NEPAL

Nepal joined CITES in 1975; thus imports and exports of elephant ivory are illegal. Domestic trade without a permit has been illegal since 1973, and no permit has ever been given.

SINGAPORE

Singapore joined CITES in 1987. Internal sales of raw and carved ivory were banned in 1989, except for ivory stocks that had been registered before November 1986. A permit is needed to import, export, re-export, transport by sea, possess, sell or display CITES-scheduled species; otherwise the offender may be fined up to 5000 Singapore dollars (USD 2900 in 2001) and spend up to a year in jail. When asked, vendors say they are selling old stocks of worked ivory.

Daniel Stiles



A Chinese visitor shops for ivory in a Bangkok luxury hotel.

SRI LANKA

Sri Lanka joined CITES in 1979. In 1981, all elephant tusks and carvings had to be registered with the Wildlife Department. Only registered ivory can be sold domestically. Since 1993, anyone caught with unregistered ivory is subject to two years in prison and a fine of 30,000 Sri Lankan rupees (USD 400 in 2000). Individuals can still own elephants and ivory deriving from these elephants and have it carved and willed to descendants, but no ivory can be legally exported or sold. All elephant hunting was banned in 1937.

THAILAND

Thailand joined CITES in 1983. The internal trade in all wild elephant products has been illegal since 1960, but the internal sale of raw and worked ivory from domesticated Thai elephants is legal. If an official tries to arrest a trader or shopkeeper, the latter will state that his ivory came from domesticated Thai elephants. This is a major loophole in the law.

VIETNAM

Vietnam joined CITES in 1994. A series of government laws and decrees prohibit the hunting of ele-

phants and other listed wild species and the use, trade and transport of products derived from them. In 1993 the exploitation and trade of species on the government's list of threatened species was prohibited.

Sources and raw ivory prices

CAMBODIA

The most important source of raw ivory within Cambodia is from illegally killed Cambodian elephants. Cambodians and also Vietnamese, often in organized gangs, are poaching the remaining elephants, whose numbers have fallen sharply to a few hundred (Heffernan et al. 2001). The second source for carvers is from the 144 domesticated elephants that still remained by 2000, mostly their tusk tips (Weiler and Chheang Dany 2001).

After the fall of the Khmer Rouge government the price of wildlife products, including ivory, rose through the 1980s and early 1990s as the economy grew. Tusks over 10 kg were USD 227/kg, average-

sized ones USD 182/kg and those less than 3 kg 114/kg in 2001.

LAOS

Virtually all raw ivory carved in the country comes from the southern provinces of Laos from poached elephants. Elephant numbers have fallen significantly, from about 2500 in 1989 to an estimated 1000 in 2000 (Santiapillai and Jackson 1990; WWF 2002), while domesticated elephants are thought to be over 1000.

Larger pieces and tusks were sold for USD 250–300/kg in 2001. Several raw tusks less than 10 cm in length were seen for sale. Prices have risen over the decade, probably more because ivory is scarce than from an increase in demand (table 1).

MYANMAR

Most ivory comes from the forested areas of Kachin and Shan States in the north and north-east of the country, with a little from the central Pegu Yoma Mountains. Myanmar still has the largest population of both wild and domesticated elephants in South East Asia. Most elephant poaching is by soldiers in the Myanmar army and in the ethnic minority armies. Chin tribes on the border with India sell Indian tusks to middlemen who resell them in Mandalay. Tusk tips and tusks from dead domesticated elephants are sold to carving workshops and shop owners.

Buyers said they could get permits from the Forestry Department to transport legal raw ivory and also that officials at the military check points could be bribed if undocumented ivory were found.

Table 1. Past and present ivory trade indicators for South and South East Asia

Country	Year	Price of raw ivory, 1–5 kg (USD)	Retail outlets (no.)	Workshops (no.)	Craftsmen (no.)	Minimum no. items
Cambodia	1991	150	–	–	–	–
	1992	340	–	–	–	–
	1994	400	–	–	–	–
	2001	338	59	–	~ 30	1,773
Laos	1998	100	–	–	–	–
	1990	200	–	–	10+	–
	2001	250–300	63	4	5	1,424
Myanmar	1981	26	–	–	–	–
	1995	239	–	–	> 60	–
	2001	142	53	~ 11	~ 40	5,801
Nepal	1979	140	–	–	30–50	–
	1982	92–115	–	–	8+	–
	1991	187	–	–	–	–
	1998	242	71	–	–	1,454
	2001	166–207	57	2	4	1,546
Singapore	1979	140	–	–	30–50	–
	2001	–	23	0	0	2,700
Sri Lanka	1979	170	–	–	107	–
	1987	110	–	–	–	–
	2001	300?	22	6	~ 14	620
Thailand	1979	99	–	–	–	–
	2001	159	194	–	~ 70	88,179
Vietnam	1989	150	–	–	–	–
	1990/1	100–200	> 80	–	63–83+	–
	2001	350–500	50	> 7	> 22	3,039

– no data

In Yangon a tusk tip weighing between 1.5 and 5 kg cost USD 142/kg. It would cost the same or slightly less in Mandalay. A tusk weighing more than 15 kg was USD 355–497/kg. Small pieces ranged from USD 42.50–85/kg.

NEPAL

Tusks can be obtained when wild elephants in Nepal die. The population, however, is very small, found mostly in and around Bardia National Park in the west of the country. More frequently, ivory comes from cutting off tusk tips from domesticated elephants; females do not have tusks but only very small tushes, which cannot be pruned. Nepal's domesticated elephant population is also small, and as in all these countries, most are females, so the supply of ivory is limited. Rich Nepalis sell some tusks to traders from old private stocks. Nepal also receives a few tusks smuggled in from north and north-east India.

The price of good-quality raw tusks as offered by a trader to a shop owner or carver in the Kathmandu area was USD 187/kg in early 2001, a decline from 1998 when it reached an all-time high of USD 242/kg, implying a decrease in demand.

SINGAPORE

All ivory entering Singapore for the domestic market is worked. Most of it comes from China with origins in Africa. In 1979 Martin found that most of the raw ivory carved then was from Africa and sold wholesale in Singapore for USD 140/kg.

SRI LANKA

Those dealing in ivory would not say where tusks came from nor their price, except to say they were priced not by weight but individually by quality. Most come from dead or poached elephants around the town

Daniel Stiles



Most of Vietnam's carved ivory items are of Chinese subjects, reflecting the taste of the principal buyers. The ivory industry in Vietnam is dying as the government is now enforcing its wildlife laws more effectively.

of Polonnaruwa, from Wilpattu National Park or occasionally from those killed by land mines in the north. It is unlikely that raw ivory is smuggled into Sri Lanka as the risk is too great compared with the pay-off. In 1999, however, the Fauna and Flora Protection Task Force of the Customs Department seized several carved ivory pieces in Colombo port from a ship coming from Ghana (Kambe 2000). A little worked ivory still comes in from India.

One pair of 25-cm tusks was seen for retail sale priced at USD 556/kg, but it could have been bought for up to 50% less after bargaining.

Esmond Martin



One of the sources of raw ivory in South and South East Asia is tusk tips, which are cut from live domesticated elephants.

THAILAND

Most ivory sold in the country is not from Thai elephants. Strong evidence based on data from carvers and shop owners and on shipments of raw ivory that were intercepted by the Thai authorities from 1995 to 2000 (Associated Press 2000; Srikrachang and Jaisomkom 2001) suggests that most ivory is smuggled in from Africa. Ivory is also smuggled in from Myanmar's border town of Tachilek across to Mae Sai in Thailand, a major route for ivory smuggling for at least a decade. Poaching of Thai elephants has not been common in the 1990s. Numbers of domesticated elephants at around 2500 with an estimated 600 being adult males with tusks (R. Lair, pers. comm. 2000) are probably greater than those in the wild, so tusk tips are frequently used by the carvers.

The wholesale price for an average African or Asian tusk of 5 kg was USD 159/kg; small tusks were USD 68/kg and tiny pieces cost USD 23/kg in 2000.

VIETNAM

Several informants in both Ho Chi Minh City and Hanoi named Dak Lak Province, and specifically the town of Ban Ma Thuot, as the source of their raw

ivory. Even more than in Cambodia, the once-large elephant population has been virtually wiped out in recent years, falling from 1750 in 1989 to an estimated 135 in 2000 (Kemf and Santiapillai 2000). Raw ivory is thus smuggled in from Cambodia and Laos. Perhaps 200 or so domesticated elephants in Vietnam in 1996 (Lair 1997) supplied a little ivory.

Tusk tips were USD 350-500/kg while poor-quality tusks sold for USD 171-233/kg in 2001. A major workshop owner was buying African ivory smuggled in from Angola by a Vietnamese for USD 300/kg in 2001. He said he would telephone a contact in Angola when he needed ivory. Prices rose from earlier years because of economic liberalization and the increase in tourism.

Ivory workshops

CAMBODIA

Most ivory craftsmen live in and around Phnom Penh. In 1994 there were about 30 (Martin and Phipps 1996), and in 2001 the figure was about the same. Older carvers are still teaching young men to carve. A little carving is still sometimes done in Pursat, Battambang and Siem Reap if ivory is available. Local ivory is enough to satisfy demand as Cambodians, who are the main



These African pieces were found for sale in Ho Chi Minh City, Vietnam.

buyers, cannot afford large pieces. Very small (2–3 cm) Buddha amulets are the main items produced.

LAOS

Three woodcarving teachers at the National School of Fine Arts in Vientiane carve ivory Buddha amulets and other small items when commissioned. An antique shop in the Morning Market employs two carvers. These are the only five carvers now working on ivory in Laos because demand is low. In 1990 there were 10 carvers in Vientiane and a few in Luang Prabang (Martin 1992a).

MYANMAR

In Yangon, some workshops are in people's homes in the suburbs, where carvers still work with hand tools and vices. One ivory workshop is near the Shwedagon Pagoda along with wood carving workshops. Five workshops with about 10 craftsmen were found. They are provided with ivory (usually less than 1-kg pieces) and work on commission for dealers,

who sell ivory items to shops and embassies. Some carvers are moving to Mandalay where there is more raw ivory. In Mandalay, about 32 ivory carvers work in three main workshops, fewer than in 1989 (Luxmoore 1989) and 1995 (Martin 1997), some working part-time for more than one workshop.

NEPAL

In 1982 there were eight ivory craftsmen, all using hand tools, but by 1991 only three were left because of difficulties in obtaining tusks. By 1998 only one carver was still active, and he was earning less in 2000 than he had two years earlier, now earning on a par with a skilled worker such as a carpenter rather than as an artisan. An artistic tradition practised for hundreds of years in Nepal had virtually stopped.

SINGAPORE

In 1979 Martin counted 30 to 50 ivory carvers in Singapore, but ivory carving had stopped by 1990 because of government bans.

SRI LANKA

Although in 1979 about 100 ivory carvers were working (Martin and Martin 1990), now there are only about 10 in Polonnaruwa and perhaps 4 in Kandy, working from their homes. Most of the workshops, especially the larger ones in Galle and Kandy, have stopped ivory carving because of government crackdowns.



Daniel Stiles

Quite large carved tusks can still be found in Myanmar. This elephant bridge was for sale in the entrance to the Shwedagon Pagoda in Yangon.

THAILAND

The main ivory-carving centre is Phayuha Kiri, a traditional small town with 12 shops selling mainly wholesale ivory items. At least 50 ivory craftsmen work freelance, mostly from their homes, and some are attached to the shops. The carvers obtain tusks from dealers and sell worked items to shop owners. Over 85% is jewellery that can be made quickly with electric-powered drills. About 20 ivory carvers work in the second main ivory carving centre, in and around Bangkok. Most Bangkok shopkeepers obtain their ivory items from Phayuha Kiri. Chiang Mai is no longer an important ivory carving centre, and dealers usually obtain ivory items from Phayuha Kiri to sell to the two main ivory shops in the town.

VIETNAM

Traditionally, the skill of ivory carving was passed down from father to son, but the practice is dying out, as educated boys do not want to do what they now perceive as manual labour. There are about four carvers in Hanoi and three or four families are involved in carving in small villages around Th'u'ong Tin, just south of Hanoi, but most of these are carving in wood and bone as there is little market for ivory. Ho Chi Minh City shopkeepers said their ivory was carved in Ban Ma Thuot, Hué and a village 70 km from the capital. The number of carvers is dropping as ivory prices rise and demand falls.

Retail outlets and prices for worked ivory

CAMBODIA

Some 54 souvenir and jewellery shops plus one antique shop offered 1683 ivory items for sale in Phnom Penh with 78 more items on display in a souvenir shop in Siem Reap next to the Angkor Wat ruins. Most of the items were Buddha amulets (82%) locally carved in Phnom Penh and flower buds worn as jewellery (9%) costing around USD 5 each. Most were bought by Cambodians, although some Thais and French also buy the Buddhas.

LAOS

Out of 182 shops, 63 were selling small amounts of ivory items, totalling 1424 pieces. Most were 3–4-cm Buddha amulets and pendants. These items were also carved from bone and deer antler, which were hard to distinguish from ivory. The bigger items were antiques, as there was little demand for new large pieces. Mounted and carved tusks could be as small as 6 cm because of the shortage of ivory.

Vendors said that the sale of ivory items had remained stable and slow over the past five years. Mostly Laotians bought the amulets, but Chinese from

China, Hong Kong and Thailand and some Japanese bought other items in Vientiane. Europeans bought antiques in Luang Prabang.

MYANMAR

A total of 53 shops carried 5801 ivory items in Mandalay and Yangon. None was seen in Bago. Shops must be registered with the government to sell worked ivory, gems, gold and antiques.

The increased price of raw ivory was forcing up prices of worked ivory a little, but vendors said that the retail ivory trade was good and had been growing over the past three years. Some Burmese-worked ivory goes to China and Thailand.

In Yangon the main buyers in order of importance were ethnic Chinese from Thailand, Hong Kong, Singapore, Malaysia and China; Japanese and Indians; and occasionally wealthy local officials. In

Mandalay, some vendors said that Germans, Italians and Spanish also bought worked ivory. Because of the CITES export ban a vendor will, if asked, write on the receipt that the item is bone, or the customs officer is simply bribed.

NEPAL

Ivory items were found in 57 of the 200 curio and jewellery shops in Kathmandu. In 1998, 71 out of 184 shops were selling ivory (Martin 1998). In 1998, 1454 ivory items were counted, and in 2001, 1546. Only 38% of the items were made in Nepal compared with 53% in 1998. China followed with 33%, India with 22%, Tibet with 6%, and Japan, Hong Kong and Europe 1%. Indians and Tibetans smuggle worked ivory into Nepal by road while some shop owners order items from China, Hong Kong and Japan or go there to purchase them.

Daniel Stiles



Selling of ivory in Sri Lanka is strictly prohibited. These pieces in Colombo were brought out of a hiding place to show the investigator, posing as a prospective buyer.

Retail prices in US dollars have remained about the same from 1998 to 2001; shop owners are starting to phase out ivory as it is not profitable enough. The main retail buyers were French, Germans, Italians and Japanese. Despite an increase in tourism from 1990 to 1997 (Shrestha 2000) ivory sales have fallen by 90% since 1990.

Daniel Stiles



SINGAPORE

Some 23 shops out of 158 were selling 2700 ivory items, mostly smuggled in from Beijing and Guangzhou in China and from Hong Kong. Retail prices were higher in 2001 than before 1990, as Chinese source prices had increased. The lowest prices were in Chinatown, as perhaps they were actually pre-1986 stocks. Other vendors said they had stopped selling ivory after it was made illegal. Overall, Singapore prices were the highest seen in the study. The most common item was the name seal, bought by East Asians, as were Chinese figurines. Singaporean Chinese preferred larger items.

SRI LANKA

Out of 113 antique and craft outlets, 22 were selling 620 ivory items in the towns surveyed. Kandy, Polonnaruwa and Colombo sold the most, followed by Negombo, Beruwala and then Hikkaduwa. Dambulla, Galle, Ratnapura and Sigiriya had no ivory. In Colombo, unlike elsewhere, nearly all the items were kept in cupboards or closed safes as the vendors feared government inspectors.

Nearly all items were carved in Sri Lanka, with a few from India and China. One bust was carved on a tusk from central Africa. Prices were highest in Colombo, then in Kandy, then in the coast towns, and finally in Polonnaruwa, near where elephants are currently poached.

Singapore sells a wide variety of illegally imported ivory items from China and Hong Kong. The hippo tusks on the right carved in Hong Kong probably originated in Uganda.

Shopkeepers are willing to issue false receipts for the ivory items stating they are cow or water buffalo bone to enable export and destination import. Sales were quite slow, the vendors said, with prices lower than five years ago. Many vendors said they had stopped buying ivory, but this was not so in the tourist centres, mainly Kandy.

Mainly Portuguese and Dutch collectors buy the ivory antiques while British, Dutch, French and Portuguese tourists buy newer, cheaper items. The Japanese were the main buyers until the mid-1990s, when the civil war with the Tamil Tigers discouraged their visits.

THAILAND

In Thailand, 88,179 ivory items, the great majority trinkets, were counted in about 194 shops in the three main centres. Bangkok sold 38,510 items in 164 antique and curio shops, with the main buyers being Americans, Europeans and Japanese; next were Taiwanese. In Chiang Mai, 9 shops offered 80% of the 10,020 ivory items for sale with the main clients being Hong Kong Chinese, Malaysian Chinese, Singaporeans and Taiwanese. In Phayuha Kiri, 12 shops offered 39,649 items, most offered wholesale

but some sold retail to Chinese, Japanese and Taiwanese.

Daniel Stiles

VIETNAM

In all, 3039 ivory items were found in 50 outlets out of the 276 visited, mostly in Ho Chi Minh City but also in Hanoi. All tusks seen for retail sale were at least 30 cm in length, unlike in Laos. There were 10 African items in three shops in Ho Chi Minh City, including three busts for USD 700–1000 that had been there for five years.

Vendors reported that retail sales of ivory had dropped since 1995 after Vietnam joined CITES. Prices of larger items had stayed the same over the past five years because demand for them had declined despite their scarcity, but smaller pieces had increased considerably in price since 1990/1 (Martin 1992b) as they are more popular, being easier to smuggle. In Ho Chi Minh City the main buyers were ethnic Chinese from East Asia, with Taiwanese preferring the larger items. In Hanoi, Chinese, Japanese and Vietnamese buy ivory, as well as Americans and French.

Discussion

The number of ivory items in Thailand greatly exceeds that in any country in Africa (Martin and Stiles 2000). The Ivory Coast and Egypt, the African countries with the most ivory for sale, together only had a little over 40,000 items compared with over double that amount for Thailand. The weight of ivory items displayed for sale in Thailand also exceeded that in any African nation. The rankings of countries in South and South East Asia based on estimated weight of worked ivory for sale were, in descending order, Thailand, Myanmar, Singapore, Vietnam, Nepal, Sri Lanka, Cambodia and Laos. The total number of ivory



Buddhas are common ivory objects in Bangkok, Thailand.

items seen in these 8 countries was about 105,000 (table 2) compared with 110,000 counted in the 15 countries surveyed in Africa in 1999, but in terms of weight, African countries had more ivory for retail sale than South and South East Asia.

Retail prices for ivory items were highest in Singapore; next were those in Vietnam, where raw ivory was the most expensive because it was scarce; items were cheapest in Myanmar, where raw ivory was the least expensive. Thailand's raw ivory and worked ivory prices were also fairly low, as Asian ivory has to compete with the lower price of imported African ivory, with comparable tusks costing the same within Thailand.

Some data are available from past studies to compare the ivory trade today with that of previous years (table 1). The data show that raw ivory prices in dollars were higher in 2000–2001 than for any of the years before 1990. But mid-1990s prices in Cambodia, Myanmar and Nepal were higher than those in 2001. The number of ivory carvers has decreased notably in Laos, Nepal, Singapore, Sri Lanka and

Table 2. Ivory trade indicators for South and South East Asia in 2000–2001

Country, town	Retail outlets	Work-shops	Craftsmen	Price/kg raw ivory (USD)			Minimum no. items
				< 2 kg	2–5 kg	> 10 kg	
Cambodia							
Phnom Penh	55	–	~ 30	150	350	450	1,683
Siem Reap	4	–	–	–	–	–	90
Laos							
Luang Prabang	10	0	0	–	–	–	78
Vientiane	53	4	5	–	250–300	–	1,346
Myanmar							
Mandalay	19	~ 6	~ 30	–	142	> 350	2,363
Yangon	34	5	10	43–85	142	–	3,438
Nepal							
Kathmandu	57	2	4	–	166–207	–	1,546
Sri Lanka							
Colombo	6	0	0	–	–	–	102
Kandy	7	~ 3	~ 4	–	–	–	355
Negombo	3	0	0	–	–	–	19
Polonnaruwa	3	3	~ 10	–	–	–	116
SW coast	3	0	0	–	~ 300	–	27
Singapore	23	0	0	–	–	–	2,700
Thailand							
Bangkok	164	–	~ 20	23–68	91–182	–	38,510
Chiang Mai	18	–	6?	–	–	–	10,020
Phayuha Kiri	12	–	> 50	23–68	91–182	–	39,649
Vietnam							
Hanoi	13	5*	~ 20*	–	350–500	–	777
HCMC	37	> 1	> 2	–	350–500	–	2,262
TOTAL	521	~ 30	~ 200	–	–	–	105,081

– no data

* including Th'u'ong Tin village 20 km south of Hanoi

Vietnam, and the number of ivory retail outlets has decreased in Nepal, Singapore and Vietnam. The minimum number of ivory items seen in Nepal in 1998 and 2001 was about the same.

Why were pre-1990 South East Asian prices for tusks lower than in 2001 while those in Africa were higher before 1990 than in 1999 (Martin and Stiles 2000)? Immediately after the 1990 CITES ban, raw ivory prices rose in Asia and fell in Africa as exports from Africa dropped, increasing the supply in Africa and reducing it in Asia. Illegal trade routes have since been developed to send ivory from Africa to Asia, so the price rises in raw ivory seen since 1990 in a few African countries may be related to this. But demand for raw ivory is greater in nearly all of Asia than in

Africa today, with local supplies of Asian ivory dwindling, with constricted imports of African ivory in the 1990s, and with a booming tourist economy in the Asian region, resulting in higher prices there. The Asian ivory market has suffered since the 1997 economic crisis. Recent reductions in raw ivory prices reflect this and perhaps also come about as a result of increased imports of illegal African ivory to Thailand.

Ivory demand has probably declined in Cambodia, Laos, Singapore and Vietnam since the mid-1990s. The number of shops selling ivory items has declined in Singapore because of the decrease in customers. The raw ivory price in Cambodia and the number of ivory craftsmen in Laos have definitely declined, suggesting decreased demand, as the sup

ply is available. Informants said that business was slower in Vietnam than in the past, in spite of price rises for both raw and worked ivory, which are due to ivory scarcity and not to increased demand.

In the mid-1980s, Thailand exported 200,000 (plus or minus 50,000) pieces of worked ivory a year and many Bangkok shops displayed large quantities of ivory (Luxmoore 1989). Although the number of tourists has increased significantly in Thailand from 1990, the CITES ivory ban has probably kept the Thai ivory market at roughly the same level as it was in the 1980s, although almost all sales are now internal rather than wholesale exports. Work carried out by TRAFFIC in Thailand in 1997 supports this view for the 1990s (Nash 1997).

Myanmar's raw ivory prices have been rising steadily since 1981 as measured in local currency, but because of the depreciation of the kyat, the USD price has fluctuated. In 1981 the price was USD 26/kg. By 1995 prices had skyrocketed to USD 239/kg but in early 2001 had fallen to USD 142/kg for medium-sized tusks. The kyat price was 45,000/kg in 1995 and 100,000/kg in 2001, an increase of more than 100% in Burmese terms. Vendors said that business had been increasing since the early 1990s, explaining the kyat price increase. Although the number of craftsmen has decreased since 1995 as old carvers retire, the remaining craftsmen may have increased their productivity to keep up with the demand.

Ivory demand in South Asia has declined over the years in response to rising prices and increased risk related to selling ivory, as evidenced by the decline in the number of ivory retail outlets and craftsmen in Nepal and Sri Lanka. Virtually no worked ivory has been displayed in India since the CITES ban, and the number of ivory craftsmen has declined significantly since 1989 (Vigne 1991).

Unlike in Africa, no shop owner or vendor in South or South East Asia mentioned the 1999 approved auctions of government ivory stocks in southern Africa to Japan. This was either because they did not find them significant or more likely had never heard of them. Some ivory craftsmen had heard of the auctions but did not think them relevant to their business. The auctions thus did not cause the ivory trade to increase in these two regions as had been feared and as had occurred in a few African markets.

Views in general of the future of the ivory trade were pessimistic. Craftsmen are not encouraging

younger members of their families to learn the art. In Nepal, they doubt that any market will remain for their carvings in another 10 years. In Vietnam, many have given up ivory carving and in Sri Lanka, where the government has cracked down on the ivory trade, it is a dying profession. Even in Thailand the craftsmen in Phayuha Kiri fear dwindling supplies of tusks in the future. Only in Myanmar, where there is currently a healthy ivory market, is there any optimism.

Conclusions

Although the ivory trade has declined from 1990 in Cambodia, Laos, Nepal, Sri Lanka and Vietnam, the trade seriously threatens their small and dwindling wild and domesticated elephant populations. Although Singapore's ivory trade has also declined significantly since 1990, the country puts pressure on both Asian and African elephants as newly carved ivory from China is still imported. In Myanmar, the ivory trade increased from 1990 to 1995, when it peaked, but since then it has remained stable or has slightly declined. The number of wild and domesticated elephants in Myanmar can sustainably support the current level of trade within the country. Myanmar's exports of tusks and worked pieces to Thailand and China, however, may exceed sustainability. Thailand's ivory trade has remained stable and large since the late 1980s. The country's elephant population is thought to have remained stable since then as it illegally imports large amounts of raw ivory from Africa, and secondarily from Myanmar.

The wholesale price of raw ivory was higher in 2001 than in the late 1980s in the countries surveyed. In 2001 the average tusk price was over five times higher than in Africa (USD 250 versus USD 45). This high price has put severe pressure on Asian elephants, and if this demand continues, the poverty-stricken rural people will risk poaching even more, as the economic returns are high.

None of the governments for the countries surveyed has control over the ivory trade. Although the number of craftsmen has decreased in the 1990s in general, Chinese businessmen continued to smuggle ivory items to many Asian countries, and even some Western tourists, despite the negative publicity in their countries, have continued buying ivory trinkets. The number of foreign tourists and businessmen visiting South and South East Asia, more than 20 million a year, has been

increasing at a rate of over a million a year, ensuring that the demand for ivory will continue.

The governments of these countries need to improve their domestic legislation and increase enforcement, as India has done. Laos must join CITES, and all countries in the region need to enforce CITES regulations to stop the import and export of raw and worked ivory.

It is far more economical to control the marketing side of the ivory business than to prevent elephant poaching. If there is a significant decline in the ivory market, ivory prices should fall and elephant poaching decrease dramatically. A high demand for ivory in only a few countries can affect elephant populations in many others. If CITES and the national governments of the countries involved do not improve and enforce their laws and decrees, the ivory markets and buyers will continue to claim the lives of many African and Asian elephants.

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FIELD NOTES

Wild forest elephants shake down fruit and leaves from trees

Fiona Maisels,^{1,2} Stephen Blake^{1,2} and Andrea K. Turkalo³

¹ Wildlife Conservation Society/New York Zoological Society, BP 14537, Brazzaville, Congo

² Institute for Cell, Animal and Population Biology, Edinburgh University, UK

³ Wildlife Conservation Society, BP 1053, Bangui, Central African Republic

corresponding author: Fiona Maisels, fax: +871 762 134145; email: bomassa@uuplus.com

Fruit is known to be an important item in the diet of the forest elephants *Loxodonta africana cyclotis* living in central African forests (Short 1981; White et al. 1993, 1995; Powell 1997; Blake 2002) but little is known of the way in which they collect these fruits. Fruiting trees in the forest attract elephants, and the ground underneath fruiting trees is often completely clear of vegetation because of intensive elephant activity. Thus it is assumed that elephants visit fruiting trees and collect fallen fruit, but not whether they actively play a part in making fruit fall. Similarly, elephants feed on leaves of many tree species, using their trunks to gain access to low branches. The use of different techniques by elephants to collect food has mostly focused on how they collect fruit and foliage within their reach or by actually knocking down trees (Feer 1995; Powell 1997). However, a captive forest elephant female in Abidjan Zoo was observed to throw sticks to knock down foliage from branches beyond her reach (Powell 1997). Savannah elephants have also been known to knock fruit out of trees (Douglas-Hamilton 1972).

The area spanning north-east Gabon to south-east Cameroon to north Congo to south-west Central African Republic is a large area of African lowland forests that are among the last to remain partially intact. Within this zone, three neighbouring protected areas span the Sangha River–Lac Lobeke Reserve in Cameroon, Nouabale–Ndoki National Park in the Republic of Congo, and the Dzanga–Sangha–Ndoki complex of Central African Republic. Transboundary

movements of these elephants have been demonstrated (Blake et al. 2001), and the area is considered the single most important zone for African forest elephants (Barnes et al. 1995).

Two extensive elephant studies are under way in the region, one ongoing since 1990 at the Dzanga clearing in Central African Republic focusing on forest elephant demography and social behaviour, and another since 1998 throughout the Ndoki forests of northern Congo, where behavioural and ecological data are collected on elephants and their spatial and temporal movements. In the study in northern Congo, phenological data were collected on individual trees of species that elephants favoured.

The headquarters of Nouabale–Ndoki National Park, Congo, is sited in a band of secondary forest near the village of Bomassa on the Sangha River in northern Congo. In the last two years, forest elephants have started to frequent the area of riverine vegetation and secondary forest around the village, and this has allowed more detailed data to be taken on their movements and behaviour. A number of these elephants have become relatively habituated to human presence, and they now allow observers to approach to within a few metres.

Observations

In July 2000, a number of trees were fruiting at the project headquarters, and elephants were known to be visiting during the hours of darkness. It was some

times difficult to see what they were actually eating as they were hidden in vegetation, but examination the following morning of the places they had been usually revealed that they had been eating fallen fruit or leaves and stems of various herbs or trees.

On 2 and 4 July 2000, an adult male elephant who was often seen in the Bomassa area was observed between 2000 and 2130 at a well-lit area within park headquarters. The elephant was seen to stand at the base of fruiting trees and push hard with its head until fruit fell. The elephant then picked up most of the freshly fallen fruit on the ground. Shaken in this way were three trees of three separate species, *Pseudospondias microcarpa* (Anacardiaceae), *Myrianthus arboreus* (Moraceae) and *Tetrapleura tetraptera* (Mimosaceae).

During field surveys, elephants were heard knocking fruit down from two additional tree species: *Omphalocarpum elatum* and *Chrysophyllum lacourteanum* (both Sapotaceae). The fruit of *O. elatum* is very large and heavy, and it is eaten only by elephants. One of the individual *O. elatum* trees that was under observation in the phenology study was found to have been repeatedly pushed by elephants (from evidence both on the trunk itself and around the base of the tree where it had been loosened from the surrounding earth) when the tree bore ripe fruit.

Also during the field surveys, elephants were seen to shake young *Nesogordonia papavifera* (Sterculiaceae) trees so much that the top whipped back and forth and eventually snapped off. They then ate the leaves. Young *Petersianthus macrocarpum* (Lecythidaceae) trees were found with the top snapped off and elephant sign around the base of the trees, indicating that elephants had pushed the tree and eaten the leaves from the snapped-off top. In and near Dzanga clearing in neighbouring Central African Republic, elephants have been heard and observed knocking fruit from several tree species, including *Allanblackia floribunda*, *Celtis adolfi friderici*, *Desplatsia dewevrei*, *Myrianthus arboreus*, *O. elatum*, *Panda oleosa*, *Polyalthia suaveolens* and *Treculia africana*. Baaka pygmies, native to the area, claim that elephants wait for ripe fruits of certain species of fruiting trees to fall rather than shake them out of the trees.

Finally, in an educational film WWF made in Gamba, a protected area on the coast of neighbouring Gabon, elephants were seen to knock their heads against borassus palm trees, *Borassus aethiopicum*, and

cause fruit to fall, which they then consumed (Baconnet 1996). Borassus fruits are large and heavy and high in oil content.

Conclusion

It is possible that forest elephants frequently manipulate both objects and inedible parts of food plants to obtain food as part of their behavioural repertoire, but because these animals are rarely seen, the literature has little data on the subject. Savannah elephants, more easily observed in their environment, have been documented knocking fruit out of trees (Douglas-Hamilton 1972). The data reported on here are the first from the wild to show that forest elephants deliberately knock fruit and leaves down from trees. It is interesting that observations include both northern Congo and the coast of Gabon, more than 1000 kilometres away. It would be interesting to determine if this is widespread behaviour in forest elephants. If so, it highlights the adaptability of this mega herbivore.

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Update on the study and management of human–elephant conflict in Africa

Mise en courant de l'étude et la gestion du conflit hommes–éléphants en Afrique

Richard Hoare

PO Box A222, Avondale, Harare, Zimbabwe
email: rhoare@mango.zw

The IUCN African Elephant Specialist Group (AfESG) has had a Human–Elephant Conflict Working Group since 1996. To begin investigating HEC, carefully specified topics initially were identified and studied. Later, management-related outputs were produced in the form of guides to help mitigate the problem, culminating in the production in 2001 of a 'decision support system' for managing conflicts, available in both English and French (see www.iucn.org/afesg). A network of AfESG collaborators working on conservation projects in Africa and Asia continues to contribute to a growing understanding of the HEC phenomenon. HEC manifests itself in complex social and spatial dynamics across many bio-geographical landscapes in Africa, but common characteristics and themes allow certain management principles to be recommended to address it. These ideas are often transferable to human–wildlife conflict involving other species such as carnivores, crocodiles, hippopotamuses and primates. Frequently, elephants are simultaneously the 'flagship' of both the problem aspects and the charismatic qualities of the large fauna in Africa. Increasingly, therefore, HEC has become not a problem in isolation but a topic strongly linked to many fundamental conservation issues, especially in community conservation initiatives. Coexistence between elephants and humans is possible but it requires solid policy support from wildlife authorities, strong commitment on the part of conservation interests and a climate of trust among the diversity of negotiating parties. A summary of HEC knowledge is as follows.

Human–elephant conflict:

- is widespread in Africa and often becomes politically important locally
- involves agricultural loss and a large social dimension among people

Le Groupe de Spécialistes de l'Eléphant d'Afrique de L'UICN a un Groupe de Travail sur les Conflits Hommes-Eléphants depuis 1996. Au début, quelques questions ont été identifiées et étudiées afin de comprendre le CHE ; là-dessous, des documents en forme de guides ont été produits pour avancer la gestion de ce problème et l'atténuation de celui-ci sur le terrain, se couronnant par la production en 2001 d'un « Système de Soutien aux Décisions » pour la gestion de CHE, disponible en anglais et en français (voir www.iucn.org/afesg). Un réseau de collaborateurs du GSEAf, qui travaillent sur les projets de conservation en Afrique et Asie, contribuent à une croissance continue de la compréhension du phénomène CHE. Le CHE montre une dynamique sociale et spatiale complexe à travers plusieurs paysages bio-géographiques en Afrique mais quelques traits communs permettent la recommandation de certains principes et thèmes d'aménagement. Ces idées se prêtent souvent aux conflits impliquant d'autres espèces d'animaux sauvages comme les carnassiers, crocodiles, hippopotames et primates. L'éléphant est souvent en même temps un 'vaisseau-amiral' pour les espèces nuisibles et les espèces charismatiques de la grande faune sauvage d'Afrique. Ainsi, le CHE est devenu de plus en plus pas un problème isolé mais un sujet fortement enchaîné à quelques questions fondamentales de conservation, surtout dans le domaine d'initiatives qui traite de la conservation par les communautés locales. La coexistence entre les éléphants et les humains est possible mais il faut un solide appui politique de la part des autorités de la faune, un fort engagement des intérêts de conservation et un climat de confiance entre la diversité des parties impliquées sur le terrain. Un résumé des connaissances du CHE en forme de points brefs suit ci-dessous.

- has complex spatial dynamics across the landscape
- involves a problem perceived by a community that may be quite different from the actual problem revealed by systematic gathering of information

Other key points to keep in mind:

- Quantification of direct elephant damage is relatively straightforward but gauging the intangible costs of living near the threat of elephants is not.
- Behaviour of individual elephants may be important.
- One should aim to reduce the problem to tolerable levels rather than expect to eliminate it altogether.
- Mitigation involves using many apparently unrelated measures in a 'package' and working with both people and elephants.
- Different mitigation methods produce synergy when used together in defence against problem elephants.
- Managing problem elephants must have strong local participation and preferably be integrated with other elephant management activities; it may thus serve as a good entry point for conservation initiatives.

For more detail see:

[AfESG] African Elephant Specialist Group. 2001. *A decision support system for managing human–elephant conflict situations in Africa*, by R.E. Hoare. IUCN AfESG, PO Box 68200, 00100 GPO, Nairobi, Kenya. 104 p. Also www.iucn.org/afesg

Conflit hommes–éléphants :

- est très répandu en Afrique et devient souvent une affaire de politique locale
- s'agit des pertes agricoles et implique aussi une grande dimension sociale auprès des gens
- montre une dynamique spatiale complexe à travers le paysage
- s'agit d'un problème aperçu par une communauté d'une façon très différente de la réalité démontrée par le rassemblement systématique d'information.

Autres points importants :

- Quantification des dégâts causés par les éléphants est une tâche relativement simple mais le jugement des coûts humains de demeurer près de la menace des éléphants est plus difficile.
- Le comportement des éléphants individuels serait important.
- Le but de la gestion de CHE serait de réduire le problème jusqu'à des niveaux tolérables auprès des gens, plutôt que d'espérer d'éliminer le problème entier.
- Atténuation du problème implique d'usage d'un colis de mesures apparemment sans rapport et de travailler dans le domaine des gens et des éléphants.
- Plusieurs méthodes d'atténuation différents produisent une 'synergie' lorsqu'on les utilise ensemble contre les éléphants nuisibles.
- La gestion des éléphants nuisibles doit avoir la participation forte des gens locaux et de préférence doit être intégré parmi les autres activités de la gestion des éléphants ; engagement à ce problème serait parfois un « point d'entrée » productif pour les efforts de conservation.

Pour avoir plus de détail voir :

[AfESG] African Elephant Specialist Group. 2001. *Un système de soutien aux décisions pour la gestion des situations de conflit hommes–éléphants en Afrique*, par R.E. Hoare. IUCN AfESG, PO Box 68200, 00100 GPO, Nairobi, Kenya. 104 p. Et www.iucn.org/afesg

African elephant genetics: request for samples

Alfred L. Roca,¹ Nicholas Georgiadis² and Stephen J. O'Brien¹

¹Laboratory of Genomic Diversity, National Cancer Institute, Frederick, Maryland, USA

²Director, Mpala Research Centre, Nanyuki, Kenya
email: roca@mail.ncifcrf.gov and njg@mpala.org

The Laboratory of Genomic Diversity and the Mpala Research Centre have been conducting a continent-wide genetic survey of African elephants. We found evidence supporting species-level genetic distinctions between forest and savannah elephant populations in Africa (Roca et al. 2001). We would like to expand this survey by using additional genetic markers and by sampling populations from additional regions of Africa as well as additional individuals from sites previously undersampled. A broader sampling of elephant populations, would provide much additional information on the evolution, natural history, biogeography and taxonomy of African elephants—particularly hybridization, which will be useful for conservation efforts on their behalf. We request the assistance of AfESG members, researchers, conservationists and others who may be able to collect elephant samples from anywhere in Africa.

Summary of our published findings

In a recent publication (Roca et al. 2001), we examined DNA sequence variation in four nuclear gene introns (a total of 1732 base pair) in African elephants from 21 populations across Africa, using DNA extracted primarily from dart-biopsy tissue samples (Karesh et al. 1989). The genetic distance between African forest elephant and savannah elephant populations was large, corresponding to 58% of the difference in the same genes between elephant genera *Loxodonta* (African) and *Elephas* (Asian). There were multiple fixed nucleotide site differences between forest and savannah African elephants. Genetic evidence for hybridization between the two was limited to Garamba (Democratic Republic of Congo), which was the only intermediate forest–savannah habitat zone sampled. Analysis of individual gene haplotypes (alleles) indicated that, outside the hybrid zone, gene flow across the forest–savannah boundary was not detected. Along with previously established morpho-

logical and habitat distinctions, the genetic evidence supported the recognition and conservation management of two distinct African species: *Loxodonta africana* and *Loxodonta cyclotis*.

Sampling locations

We hope to expand and build upon this work by adding more populations of elephants and by using additional genetic markers. We have adequate sampling from the following locations: Dzanga–Sangha Forest Reserve, most of Botswana, Kruger National Park, south-western Zimbabwe, northern Namibia, north-eastmost Tanzania, Amboseli and most of central Kenya.

We welcome additional samples from the other locations in our study as well as from any locations that we have not previously sampled. Our top priorities are for samples from Zambia, Congo (especially south of the Congo River), and all nations in Africa west of Cameroon. We are also looking for samples from Malawi, Mozambique (especially northern), and central and southern Tanzania; from Ethiopia, Sudan and Chad; from any additional forest location; and from intermediate habitat regions or putative hybrid zones. In summary, we are looking for samples from all but the locales listed in the previous paragraph.

Types of samples preferred

In general, we have extracted DNA of excellent quality from all of the following: skin samples collected by biopsy darts of the type designed by Karesh et al. (1989); blood or tissue from planned culls or immobilizations; and samples of tissue, even dried tissue, from elephant carcasses resulting from natural death or from hunting.

However, if it is not feasible to collect tissue of any kind in your area, we welcome dung samples, from which we have also been able to extract DNA. Note that from almost any tissue source the quantity and

quality of DNA extracted is much better than from dung. But dung samples are nevertheless useful where tissue is not available.

All tissue and dung samples should be collected as fresh as possible. When feasible, the samples should derive from an unambiguously identified individual. Any available information should be recorded regarding the individual elephant from which the sample is taken, such as name or identification number, sex, age, herd, location, date collected, storage medium. However, if individual identification is not possible, then record the location, date collected, storage medium and any other known information.

In locations with large elephant populations, and where feasible, collect one individual sample per herd, to give us an overall view of the population. However, if the population of elephants in a location is very small, then collect more than one individual sample per herd, but make sure that this information is recorded along with other available information.

Samples from individuals of uncertain geographic origin, such as those sold in bushmeat markets, are not as useful for biogeographical studies.

Samples of tissue (muscle, organs, skin)

Samples of muscle, organs, skin or other soft tissue should be placed in ethanol. Having successfully extracted DNA from samples stored in alcohol, we prefer the use of 90–100% ethanol. While soft tissue can also be preserved in buffers, such as the TES buffer that is used to store blood (detailed below), we have had better success in extracting DNA from samples in ethanol, and it is our preferred storage medium. However, the shipment of ethanol is highly regulated; therefore, allowing the ethanol to evaporate before shipping or storing in other media may be appropriate in some cases.

Tissue that is metabolically active, such as from muscle or organs, is best, although almost any tissue, including skin, will be adequate. Avoid surface tissue directly exposed to sunlight, air or soil. Even a small amount of tissue sample, 1 cm³ or even smaller, can provide sufficient DNA, although several cubic centimetres is preferred. The volume of 90–100% ethanol should be at least four times greater than that of the sample, and the tube should be filled to the top or close to it with the ethanol.

Regardless of storage medium, it is helpful to cut slits in the tissue to allow for better penetration of the fluid. It is also important to minimize cross-contamination of samples by using different blades or thoroughly cleaning blades between samples.

Any sturdy leakproof screw-cap tubes can be used to store the samples, which if possible should be kept cold or preferably frozen until shipped.

Samples of blood

Blood can be collected from live animals in blood collection tubes or other tubes containing anticoagulants such as EDTA (preferred) or ACD. If mixed only with anticoagulant, the blood must be kept refrigerated and shipped as soon as possible. It can also be mixed with an equal volume of TES buffer ('Easy Blood'), in which case it can be stored for longer periods and even kept at room temperature; TES buffer is 100 mM Tris, 100 mM EDTA, 2% SDS (sodium dodecyl sulphate).

This buffer, when mixed in equal part with fresh blood in anticoagulant, will lyse the red and white blood cells but will protect the DNA and inhibit nuclease activity and microbial growth. This solution is used in field situations where no centrifugation or refrigeration is available. Once the samples are back in the lab, refrigeration or freezing is recommended for long-term storage.

Appropriate quantities of TES can be dispensed into vials for transport to the study site. Use a large enough vial to allow space for an equal volume of blood. Alternatively, the dry components can be weighed into plastic vials for transport and later mixed with the appropriate amount of sterile distilled water at the study site. However, this requires weighing out microgram amounts of each chemical.

TES buffer

From stock solution (in ml) for . . .	100 ml	500 ml
Sterile distilled water	50	250
0.5 M Tris HCl pH 7.5	20	100
0.5 M Na ₂ EDTA (pH must be adjusted to 8 to dissolve EDTA)	20	100
20% SDS (sodium dodecyl sulphate)	10	50

From dry chemicals, g per 100 cc (sterile distilled water to final volume of 100 ml, pH adjusted to 8)

Tris base (MW = 121.2)	1.2 g
EDTA Na ₂ (MW = 372.2)	3.7 g
2% SDS	2.0 g

Samples of dung

A sterile tongue depressor (a new one for each different sample, to avoid cross-contamination) or any similar sterile item can be used to collect a dung sample at least several grams or cubic centimetres in size. Ideally a fragment concentrating on the surface of the dung can be collected, so that it contains a higher proportion of sloughed-off intestinal cells, thereby yielding more DNA. If this is not feasible, or if the outside has had long exposure to sunlight, an internal portion can be used.

Different ways of storing the sample are possible. One possibility is for the dung, especially if fresh or wet, to be placed into a sturdy, leakproof screw-cap tube, with the tube then filled to the top with 90–100% ethanol (ethanol volume at least 4 times the sample volume), capped and briefly shaken to allow the ethanol to penetrate. However, shipping samples in ethanol may be problematic (see above). An alternative is to place the dry dung in a screw-cap tube with silica-gel beads at the bottom, separated from the dung by filter paper (there is no problem if some silica-gel beads are in contact with the dung). We can supply the tubes with silica-gel beads.

Other details

Appropriate permits should always be obtained before collecting. If possible, please contact the Laboratory of Genomic Diversity before collecting the samples, especially if ethanol will be used as the storage medium. We can provide you with the necessary materials for sample collection and with information on required documentation and permits, and we will pay for shipping costs.

A broad sampling of elephant populations will allow the tools of molecular genetics to uncover the evolution, natural history, biogeography and taxonomy of African elephants, providing much information useful for their conservation. We thank those who have provided samples previously, and those who are willing to assist in the future.

Contact information

Alfred L. Roca, PhD
 Stephen J. O'Brien, PhD
 Laboratory of Genomic Diversity
 National Cancer Institute – FCRDC
 Building 560, Room 11-10A
 Frederick, MD 21702-1201, USA
 tel: +1 301 846 1299
 fax: +1 301 846 6327 or 1909
 email: roca@mail.ncifcrf.gov

Nicholas Georgiadis, PhD
 Director, Mpala Research Centre
 PO Box 555, Nanyuki, Kenya
 tel: +254 176 32752
 fax: +254 176 32750
 email: njg@mpala.org

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OPINION

Treating crop-raiding elephants with aspirin

R.F.W. Barnes

Africa Program, Conservation International, Ecology, Behavior and Evolution Section
Division of Biological Sciences 0116, University of California at San Diego
La Jolla, CA 92093-0116, USA
email: rfbarnes@ucsd.edu

Introduction

A man goes to his doctor. ‘Doctor, I suffer from regular daily headaches.’

‘Take two aspirin. That will do the job.’

The next day the patient returns. ‘The aspirin worked. Yesterday afternoon I was fine, but this morning my head aches again.’

‘Take two aspirin, you’ll be just fine.’

A farmer goes to the park warden. ‘Every night elephants come out of your park and into my fields.’

‘I’ll send some game guards to fire a few shots in the air and scare the elephants back into the park.’

The next week the farmer returns. ‘Your men frightened the elephants back into the park, but now they are back again.’

‘Don’t worry, I’ll send some more men to scare them away.’

When the patient returns to complain again about his headaches, the doctor may suggest something stronger: acetaminophen or ibuprofen. But these pills are not curing the problem; they are simply treating the symptoms. Eventually the doctor will realize that he must tackle the causes of the persistent headaches. Perhaps the patient is over-stressed at work, or suffering eyestrain while reading, or maybe he has a brain tumour. After seeking the cause of the headaches the doctor is more likely to cure the patient by changing his work patterns, giving him new glasses or sending him for surgery to excise the tumour.

When the farmer comes again to complain, the warden may prescribe some further measure such as banging drums, burning tyres or installing a fancy alarm system. But these are analogous to the doctor prescribing stronger pills. The temptation is always to throw aspirin at elephants because such palliatives are cheap, they give the farmer the impression of action, and they may indeed scare the elephants away. Well, at least for today. Most attempts to tackle cases of elephant crop raiding are searches for an effective palliative—an aspirin for that particular situation. But the elephants will always return unless a long-term solution is found by addressing the underlying causes of the problem. In the Upper Guinea forest zone the most likely root causes of crop-raiding problems are insufficient habitat within the park and the modified landscape outside.

Carrying capacity for elephants

When elephants forage regularly outside their protected area managers wonder whether resources within the park are sufficient to support the elephant population. Does the current elephant density exceed the carrying capacity of the park? Unfortunately, this is a difficult issue to address, not least because of the question of defining ‘carrying capacity’ (Macnab 1985). For savannah parks one can use equations from Coe et al. (1976) or Fritz and Duncan (1994), but such estimates may have wide confidence limits. At present

we do not have enough data to estimate the carrying capacity of forest habitats for elephants. The mammalian biomass that humid forests can support is much lower than that of savannahs (Barnes and Lahm 1997) and elephants make up a large proportion of that biomass.

It is certainly quite likely that elephants in fragmented forest parks are at greater densities than previously. For example, as the forests north of Cape Coast in southern Ghana were felled during the 20th century, elephants were killed or fled to the largest remaining forest block, which is now Kakum National Park (Barnes et al. 1995). Today crop raiding is a huge problem for the warden of the park.

It is possible that many forest fragments are simply too small for a species that has evolved a large body size that confers low locomotion costs. Elephants have evolved to range widely, and if we confine them in small parks we should not be surprised when they wander outside.

Landscape modification outside parks

Elephants prefer a mixture of vegetation types; a greater abundance of fruiting trees is found in primary forest (Merz 1981), while the disturbed vegetation that follows logging or farming is very attractive to elephants (Barnes et al. 1991; Dudley et al. 1992).

In the forests of West and central Africa farmers clear a patch of land to plant their crops. After a year or two the patch is abandoned and is soon covered by weeds and other soft-stemmed leafy herbs that grow into a tangled herbaceous mixture, often with remnant cassava or other food crops (Ahn 1961). Woody shrubs soon appear and after perhaps two more years the patch becomes a thicket that gradually evolves into secondary forest as more quick-growing and light-demanding trees establish themselves. Consequently, more browse per unit area is available to elephants in this farmbrush than in the forest itself. Meanwhile the farmer has cleared new fields nearby, providing islands of succulent crops within the farmbrush. Thus the farmer has created a mosaic of herbaceous tangles, thicket and young secondary forest with patches of different ages and in varying stages of development, interspersed with small fields of maize and cassava, and probably with scattered plantains and other crops. This vegetation mosaic is very

attractive to elephants (Nchanji 1994). In their efforts to feed themselves and their families, farmers are inadvertently managing the landscape for the benefit of elephants.

The vegetation mosaic outside the park boundary may be more attractive to elephants than the forest that has been officially set aside for them. The longer this situation prevails the more difficult it becomes to solve because people are clearing more and more land, often immediately adjacent to the park boundary, and replacing high forest with vegetation preferred by elephants. Note that we are not being judgmental in this analysis. The farmers are acting in what they perceive to be their best interests; it is unfortunate that this type of land use is also in the best interests of elephants. As each day passes and more land is modified by farmers, we move further and further away from a solution to the crop-raiding problem.

Viewed in these terms, it appears crop raiding is not perverse behaviour by elephants but rather an inevitable consequence of their isolation in a human-dominated landscape. Crop raiding by elephants is what optimal foraging theory would predict under these circumstances. It becomes clear that the aspirin approach—shooting in the air or banging drums and similar behaviour—will not work because elephants are attracted to the mosaic outside. Gunshots and drums may deter them for awhile but they eventually become habituated to loud noises. Addressing the causes of the problem by managing the landscape to make it less attractive is more likely to reduce the frequency of crop raiding. If elephants are to remain in forest fragments then wildlife managers will have to work with land-use planners, agricultural extension officers, district assemblies and farmers' associations to create a landscape that reduces the probability of attracting elephants. However, it is unlikely that one will reduce that probability to zero and there will always be the need for some aspirin.

The pressure for short-term solutions

Tackling the roots of the problem requires a delay. Wildlife managers need to examine the area and familiarize themselves with the setting. Then they need to examine the local communities and their farming

practices. They need to understand the park as a component of the regional landscape. To the farmer who wants action now, all this looks like prevarication and procrastination. Eventually farmers may refuse to cooperate with the managers, who will feel frustrated by the very people they are trying to help. The pressure will be on wildlife managers to find a short-term answer and they will be discouraged from seeking a long-term one. In some cases, intensive aspirin therapy may give managers the time they need to seek the long-term answer.

Discussion

Many parks have seen an increase in crop raiding over the last two decades. Farmers complain to the warden that the increase is due to burgeoning elephant numbers. Sometimes such increases reflect a change in elephant behaviour, for example, protection in the decade since Kakum became a national park has emboldened elephants. Formerly only males raided and then only at night, according to farmers and Dudley et al. (1992), but these days family groups raid, occasionally even during daytime. We have little evidence for or against an increase in elephant numbers in West African forest parks where crop raiding is a problem. On the other hand, the human population outside such parks has increased dramatically. The mean rate of increase for Ghana is 2.8% per annum (United Nations 2000), which means that the population doubles every 25 years. In addition, farmers have moved from the drier parts of the country to the forest zone, primarily to grow cocoa, and my guess is that the human density around Kakum is growing at about 5% per annum—that is, doubling every 15 years. The rate of a chemical reaction, r , is proportional to the concentration of the reactants A and B:

$$r = k \cdot [A] \cdot [B]$$

where k is a constant. If the rate of crop raiding is proportional to the density of elephants and the density of people (or density of fields), then the increase in crop raiding is probably due to the growth of the human population around the park and its effect upon the landscape.

This analogy may help us understand why crop-raiding problems often seem to suddenly get out of

control. If the human population is growing at say 5% per annum, then after 10 years the rate of raiding will have increased to 1.6 times its former level. But if both elephant and human populations are growing at 5%, then after 10 years the rate will be 2.7 times its former level. The lesson is that non-linear relationships (exponential growth of human and elephant populations) mean that if one does not act early, elephant management headaches can quickly become unmanageable (Barnes 1983).

We may think crop raiding is a headache today for wildlife managers in the Upper Guinea forest zone, but it is likely to become a migraine tomorrow. As agriculture expands and landscapes are modified further around protected areas we must expect an increase in crop raiding around those sites where it is mild today, and the occurrence of crop raiding at those sites that today are still free of it. We must look ahead and address the root causes of the problem around the sites where it is not yet an issue.

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READER RESPONSE

How many southern white rhinos were there? A response to Kees Rookmaaker

Richard H. Emslie and P. Martin Brooks

IUCN SSC African Rhino Specialist Group

In the last edition of *Pachyderm*, no. 32, Kees Rookmaaker published a paper in which he concluded that 'there is no reason to believe that there were ever less than 200 white rhino in Zululand before 1929' and that reported numbers at the end of the 19th century 'were kept low for political reasons'. We would like to make two points.

First, we do not believe the evidence he presented is sufficient for him to conclude so categorically that there had to have been at least 200 animals. Rather we contend that we cannot accurately estimate the true number around 1900 but that it was most likely to have been in the region of 20 to 50 animals.

Secondly, while we accept that it is quite possible that southern white rhino numbers in the late 1890s and early part of the 20th century were deliberately underestimated for political reasons, an alternative explanation for the low figures is simply that they could have been guestimates or minimum counts that underestimated the true number of animals.

Accuracy of early estimates unknown

To evaluate the potential accuracy and bias of the early estimates, additional information is required on the sampling approaches used, the search effort made, the frequency distribution of sightings of all individually recognizable animals, the numbers of sightings of 'clean' rhino (that is, those without obvious distinguishing features), and whether or not many new identifiable adult animals were continuing to be seen for the

first time or not at the end of sampling. Around 1900, the science of population estimation was not highly developed, and such additional information is unlikely to be available for the earliest estimates. This makes it difficult to critically evaluate the numbers given.

In all probability, those making the earliest estimates would have made no attempt to estimate undercounting bias (that is, how many additional animals were likely to be in the population but that were not seen during the surveys). It is most likely that early estimates would have been either the minimum number seen or 'gut-feel' guestimates. The latter are notorious for underestimating true numbers.

Number of founders needed

While we can't be sure about the accuracy of early figures, another approach is to ask the question: If there had been as few as only 10–15 or so founders around 1903, could numbers have reached the estimated 150 in 1929 only 26 years later and the estimated 206 by 1934?

To answer this question we simulated how many rhinos there would be, given different initial numbers of rhinos (from 10 to 200), and differing annual growth rates (5 to 8.4%) over 26- and 31-year periods (1903–29 and 1903–34). At low densities in prime habitat, natural population growth rates of white rhino are likely to have been good, unless significant unrecorded poaching continued to chip away at numbers. The growth rates modelled were 5% (minimum target for growth in national and continental rhino plans), 7% (should be

achievable in a rapidly growing population well below ecological carrying capacity) and 8.4% (rate achieved by white rhino in the rapidly expanding Kruger National Park population over an approximately 15-year period, 1980–95; Danie Pienaar pers. comm.). The results are given in table 1.

The figures in table 1 suggest that it is unlikely that numbers could have been as low as 10 or 15 in 1903 and this gives support to the assertion that ‘reported numbers [at the end of the 19th century] were kept low for political reasons’.

However, allowing for the fact that the 1929 and 1934 estimates may have been underestimates of the true numbers, the results indicate that there most likely were between 20 and 50 animals left in 1903. Unless poaching had a significant impact on growth rates, it was most likely that the number left was closer to 20–25 than to 50.

Conclusion

We disagree with Rookmaaker that ‘there is no reason to believe that there were ever less than 200 white rhino in Zululand before 1929’. We feel it would be better to conclude, based on some simple population modelling, that there were most probably somewhere between 20 and 50 animals at the beginning of the 20th century, unless poaching levels during the early part of the 20th century were so high that they largely cancelled out the likely rapid population growth during this period. However, the modelling does suggest that there were probably more than 10 or 15 rhinos left in 1903 and that these early estimates were probably either deliberately low for political reasons or were simple minimum counts or guesses that underestimated the true number at the time, or both.

Table 1. Modelled growth rates of white rhino populations over 26- and 31-year periods

Annual growth rates	Starting number of rhinos in 1903						
	10	15	20	25	50	100	200
Expected number of rhino in 1929 (after 26 years) (population estimate for 1929 = 150)							
5%	36	56	71	89	187	373	747
7%	58	93	116	155	311	621	1243
8.4%	81	132	163	221	441	883	1765
Expected numbers of rhino in 1934 (after 31 years) (population estimate for 1934 = 206)							
5%	45	68	91	113	227	454	908
7%	81	122	163	204	407	814	1629
8.4%	122	183	243	305	609	1219	2437

Erratum: The title of the article by Kees Rookmaaker on page 22 and in the contents of issue 32 should have read ‘Miscounted population of the southern white rhinoceros (*Ceratotherium simum simum*) in the early 20th century?’ — not ‘... in the early 19th’. Our apologies for overlooking such a blatant error.

RHINO NOTES

Project Black Ghost

Campbell Scott

Djuma Game Reserve, Sabi-Sand Wildtuin, Mpumalanga, South Africa
email: campbell@djuma.co.za or hubert.planton@wanadoo.fr

The status of the western black rhino (*Diceros bicornis longipes*) was uncertain until the late 1980s, when Dr Hubert Planton brought evidence that some 60 individuals still remained free ranging in northern Cameroon. The international community was formally informed of the situation between 1989 and 1992 (San Diego rhino conference 1991 and African Rhino Specialist Group 1992). The subspecies was recognized at the 1996 Cincinnati rhino conservation meeting by WWF, IUCN and its AfRSG affiliate, and presently it is rated as *Critically Endangered* on the IUCN Red List. The population over the last two decades has been reduced by poaching from a few hundred individuals to its present estimate of fewer than 10 animals scattered over an area 25,000 km².

Of the four subspecies of black rhino in Africa, *D. b. longipes* represents the most distant, and thus the most important, genetic population of the species *D. bicornis*. No individuals are known to exist in zoos or parks anywhere in the world today, thus emphasizing the importance of conserving the last remaining population.

After several detailed action plans drawn up in the last decade, little progress has been made for the long-term protection of these animals. In 2001, following a major multi-stakeholder mission to Cameroon to develop a recovery plan for the subspecies, WWF conducted a location and identification project in collaboration with IUCN/AfRSG and other NGOs. Over 40 signs and tracks of these rhino were logged using a global positioning system (GPS) in northern Cameroon, but no sightings were confirmed, although incidental sightings were and are still being reported.

Unfortunately, as no rhinos were seen and positively identified in the 2001 survey, it failed to establish and confirm the viability of a minimum founder population. Being able to do this was a prerequisite for continuing with the next stage of the agreed recovery plan. As a result of failing to get direct sightings of sufficient numbers of rhino, IUCN and WWF decided that they could no longer support efforts in Cameroon, as conservation funding is limited in general and any western black rhino recovery programme would be very expensive, requiring major funding over an extended period, and without having a reasonable likelihood of success. However, if the existence of sufficient numbers of rhino could be confirmed then the recovery plan could again proceed to the next stage provided sufficient funds could be raised to consolidate and protect the remaining animals successfully.

Dr Hubert Planton, who has spent 12 years in northern Cameroon working with local communities and wildlife, is recognized as the authority on these rhinos. Together with other top field wildlife veterinarians and rhino capture experts on the continent, we intend to put together for 2003 a private expedition—Project Black Ghost. We are calling upon adventure travellers to participate in a once-in-a-lifetime opportunity, and through this effort, to help fund the expedition. The expedition will give them the opportunity to participate in the capture of one of the most endangered large mammals alive today and to contribute to what may possibly be the last effort to find and fit radio transmitters on the remaining individuals.

Earlier this year, I was fortunate to read an article published in *Africa Geographic* by Dr Mike Kock on his expedition last year in northern Cameroon while he was on the trail of the elusive *D. b. longipes*. The first thing that struck me was that this is the type of adventure all young naturalists must dream of, just to have the opportunity to explore an area like northern Cameroon, and to have a mission while doing so.

Well, I was sold, and I am convinced that there are people out there in the world who will and can pay for such a unique experience. Perhaps I am an optimist, but there are more people who can afford to participate in such an expedition than there are donor organizations. So having convinced myself, I contacted appropriate people, and it wasn't long before I had joined forces with Dr Hubert Planton.

Project Black Ghost this far has been fortunate to attract interest from a variety of people dedicated to its cause. One such individual is Coenraad Vermaak, a well-known and respected hunting operator in South Africa. Through him we have been able to connect with two of the largest international hunting clubs, Dallas and Shikar Safari clubs, who are very supportive of the idea. Another key organization that will prove integral in the project is Conservation Force, a US-based foundation bridging conservation and hunt-

ing. Through its president, John Jackson III, we are able to operate the project through the foundation, which has various advantages, one being the tax benefit to the potential participants, making it even more attractive.

We have now passed the halfway mark in our preparations for 2003. We have a memorandum of agreement between Conservation Force, the Cameroon Wildlife Department, the African Rhino Specialist Group, the International Rhino Foundation, and the IUCN French Committee, and we have the support of various other organizations. We are now on an extensive marketing campaign through the various hunting clubs and publications and through various wildlife Web sites. We intend launching this expedition in April 2003 and are hoping to raise around USD 250,000 through Project Black Ghost (total needed is USD 500,000.) This amount, with additional funding, will allow us to have a good go at finding these animals.

The second phase of the project has always been a major issue, as merely finding the animals is only the beginning towards a long-term solution. We hope that through this initiative, and with the people who join us, Project Black Ghost will pave the way towards a long-term survival plan.

African rhino numbers continue to increase

Richard H. Emslie

Scientific Officer, IUCN SSC African Rhino Specialist Group

Status and trends in African rhino numbers

This short note summarizes the main points to emerge from AfRSG's compilation of continental rhino statistics (as of December 2001). The compilation was undertaken at AfRSG's last meeting, held at Malilangwe, Zimbabwe, in June 2002. As with previous continental statistics, speculative gues-timates are not included in the country totals. Nor are individual population totals presented here—for security reasons and to respect the wishes of some range states. Country totals are given by subspecies in table 1.

White rhino

Southern white rhino, *Ceratotherium simum simum*, numbers have continued to increase to an estimated 11,640 in 2001, up from 6784 in 1993, 7532 in 1995, 8441 in 1997 and 10,377 in 1999. Northern white rhinos remain limited to Garamba National Park in the Democratic Republic of Congo but have fared better in the second civil war. Surveys estimate there were 30 northern white rhino (*C. s. cottoni*) in 2002.

The status of the two white rhinos that were seen alive in Mozambique and that were probably escapees from Kruger is unknown, and they are presumed dead. White rhino numbers in Zambia have remained stable.

Table 1. Numbers of white and black rhinos in Africa in 2001, by country and subspecies

Country	White rhinos				Black rhinos					
	<i>C. s. cottoni</i> (north- ern)	<i>C. s. simum</i> (south- ern)	Total	Trend	<i>D. b. bicornis</i> (south- western)	<i>D. b. longipes</i> (west- ern)	<i>D. b. michaeli</i> (east- ern)	<i>D. b. minor</i> (south- ern central)	Total	Trend
Botswana		39	39	up						
Cameroon						8				
Chad						temp?				
D R Congo	30		30	up?						
Kenya		170	170	up			430		430	up
Malawi								7	7	stable
Mozambique		extinct?	0	down				extinct?	0	
Namibia		170	170	up	893 ^a				893	up
Rwanda							extinct		0	down
South Africa		10,988	10,988	up	50		35	1,094	1,179	up
Swaziland ^b		50	50	up				10	10	up
Tanzania							33	16 ^a	49	up
Zambia		5	5	stable						
Zimbabwe		218	218	up				524	524	up
Total	30	11,640	11,670	up	943	8	498	1,651	3,100	up

Numbers were compiled by the IUCN SSC African Rhino Specialist Group at the 2002 AfRSG meeting held in Zimbabwe 1–6 June 2002. Table excludes speculative guestimates. Ivory Coast southern white rhinos are excluded as they are semi-captive and out of range. Countries listed with 0 may possibly have rhinos, but their presence needs confirmation.

^a Numbers of *D. b. bicornis* in Namibia and *D. b. minor* in Tanzania may well be higher, but this requires confirmation.

^b Exact Swaziland numbers were given to AfRSG but are being kept confidential for security reasons. The table shows approximations to true number.

However, in all other countries with wild white rhino populations, numbers have increased.

South Africa remains by far the most important range state with 94.2% of the wild white rhino population, amounting to almost 11,000 white rhinos; while Zimbabwe (218), Namibia (170) and Kenya (170) conserve most of the remainder. A total of 2853 (24.5%) of the continental total are now privately owned.

Black rhino

At the continental level, black rhino numbers stabilized at about 2400–2500 between 1992 and 1995, increasing up to 2700 by 1999. Encouragingly, the latest 2001 black rhino estimate of 3100 indicates numbers continue to creep upwards. The major range states are still South Africa (1179 black rhinos), Namibia (893), Zimbabwe (524) and Kenya (430). While the increase is encouraging, some rated populations in a number of range states have been

performing suboptimally and may be overstocked.

The **western** subspecies, *Diceros bicornis longipes*, remains the most critically endangered. The estimates used here were based on surveys by Dr Mike Kock in 2001, which indicate that some rhinos were likely to have survived as a very small scattered metapopulation in northern Cameroon.

Overall numbers of the **eastern** *D. b. michaeli* have shown a small increase with the majority (86.3%) being conserved in Kenya. However, Namibia remains the stronghold of the **south-western** black rhino, *D. b. bicornis*, conserving 94.7% of the estimated 943 animals in 2001. Sadly, since 1999, this subspecies has become extinct in Rwanda.

The most numerous subspecies, the **southern central** *D. b. minor*, occurs in five range states of which South Africa with 1094 (66.3%) and Zimbabwe with 524 (31.8%) are by far the most important. Overall numbers of this subspecies have increased from 1298 in 1995 to 1363 in 1997 to 1467 in 1999 and 1651 in 2001.

Some Zimbabwe populations in particular continue to show very rapid growth, although the snaring and disruption caused by the land invasions and resettlement in some conservancies are a cause for serious concern.

After a period of rapid metapopulation growth in the early to mid 1990s, growth rates in some AfRSG-rated *Key* and *Important* populations in a number of range states have declined. It is believed that conservative removals from some donor populations have resulted in overstocking and subsequently in density-dependent declines in performance. If the recommendations to emerge from the SADC Rhino Management Group (RMG) Biological Management Meeting (attended by representatives of all the 'Big 4' rhino range states) are adopted, this should, in time, lead to an improvement in metapopulation performance.

AfRSG-rated continentally *Key* and *Important* populations

Table 2 gives a breakdown by country and species of the 93 AfRSG-rated *Key* and *Important* populations in 2001. The number of rated populations has increased (up from 76 in 1999), and in 2001 these populations conserved 2720 (87.7%) and 9887 (84.7%) of Africa's black and white rhinos respectively.

Corresponding proportions of the subspecies conserved in AfRSG-rated populations in 2001 varied from 83.9% (eastern black) to 84.9% (southern white) to 88.2% (south central black) to 88.8% (south-western black) to 100% for the two rarest subspecies (northern white and western black).

The five white and five black populations rated *Key 1* conserved 7997 (68.5%) and 1373 (44.3%) of Africa's white and black rhinos respectively. The 11 *Key 2* black rhino populations conserved 773 (24.9%) rhinos, and the 9 *Key 2* white rhino populations conserved 606 (5.2%) rhinos. In 2001, the 30 AfRSG *Key*-rated populations conserved 2146 (69.2%) black rhinos and 8573 white rhinos (73.5%). The 19 *Important* black rhino populations conserved a further 574 (18.5%) rhinos with the 44 *Important* white rhino populations conserving 1314 (11.3%) rhinos. The remaining 51 unrated black and 269 unrated white rhino populations conserved 380 (12.3%) and 1783 (15.3%) rhinos respectively.

Rhinos under various management models

African rhino numbers in 2001 were broken down according to species, subspecies, and management or ownership models. White rhinos in the Kruger National Park area are listed as state owned, while

Table 2. Number of *Key* and *Important* African rhinoceros populations by country in 2001 (1999)

Country	Black rhinos			White rhinos			Rated populations Key & Imp.
	Key 1	Key 2	Imp.	Key 1	Key 2	Imp.	
Botswana						1 (0)	1 (0)
Cameroon ^a	1 (1)						1 (1)
DR Congo				1 (1)			1 (1)
Kenya		4 (2)	5 (7)		1 (1)	2 (2)	12 (12)
Namibia	2 (2)		2 (1)		1 (0)	2 (3)	7 (6)
South Africa ^b	2 (2)	3 (1)	7 (6)	4 (4)	6 (5)	34 (25)	56 (43)
Swaziland						2 (1)	2 (1)
Zimbabwe		4 (3)	5 (4)		1 (0)	3 (5)	13 (12)
Total	5 (5)	11 (6)	19 (18)	5 (5)	9 (6)	44 (36)	93 (76)

Numbers in parentheses give 1999 numbers for comparison.

^a In recognition of the rarity of this subspecies, the Cameroon metapopulation of western black rhinos has historically been rated as a *Key 1* 'metapopulation', although strictly speaking each discrete group of animals should be treated as a separate population.

^b Two *Important* South African black populations have 20+ animals but the animals are being temporarily held in separate, discrete areas within these parks. Strictly speaking, each discrete group should be treated as a different population, and then neither of these populations would be classified. However, the plan is to consolidate these discrete groups into a single population in each park.

those resident in the adjoining three private nature reserves are listed as privately owned.

While approximately three out of every four African rhinos are still conserved in state-run protected areas (73.9%), 20.1% are privately owned with a further 4.1% managed by the private sector on a custodianship basis for the state. Rhinos on communal land account for a further 1.1% with only 0.9% under other ownership or management models.

The bulk of privately managed black rhinos are under custodianship on behalf of the state (19.3% of all black rhinos). Only 3.4% of black rhinos are privately owned. This differs from white rhinos, where 24.5% are privately owned. Overall the number and proportion of all rhinos managed by the private sector in Africa has increased from 2912 (22.2%) in 1999 to 3585 (24.3%) in 2001.

More black rhinos than white rhinos occur on communal land (138 vs. 22), accounting for 4.5% of all black rhinos.

The state conservation sector

Just under three-quarters of both Africa's rhino species are conserved on state land in gazetted national parks, game reserves and nature reserves. These parks and reserves are run by formal state conservation bodies.

Numbers of populations by model

In 2001, of the 330 known white rhino populations in Africa, 260 (78.8%) were privately owned and included 4 *Key 2* and 27 *Important* white rhino populations. However, many of these privately owned white rhino populations are small, with an average size of only 11 rhinos, compared with an average of 174 in state-run protected areas. The 50 state populations conserved 74.5% of Africa's white rhinos in 2002.

Of the 86 black rhino populations in 2001, 45 occurred on state-protected areas with an average population size of 50 rhinos. Of those that are privately managed, 26 populations (about 30% of all populations) were managed by the private sector on a custodianship basis (average size = 23 rhinos). In 2001 there were 10 privately owned black rhino populations, averaging only 10.5 rhinos each.

In four of the white rhino range states (Botswana, Kenya, Namibia and Swaziland), more white rhinos occur on privately managed or owned land or com-

munal land than on land managed by the formal state conservation bodies. In Zimbabwe in 2001, approximately twice as many black rhinos were managed by the private sector on a custodianship basis (348) than were conserved in state-run protected areas (176). A further 251 black rhinos were managed under custodianship in Kenya, Namibia and Swaziland, with 105 being privately owned in South Africa.

Private ownership

By 2001, 2853 (24.5%) of Africa's southern white rhinos were privately owned, with most of these in South Africa.

In 2001, 4 of the 14 AfRSG-rated *Key* white rhino populations in the world were privately owned populations, and a further 17 of the 35 AfRSG-rated *Important* white rhino populations occurred on private land. One of the 5 *Key 1* populations was a national park linked to adjacent private game reserves.

Custodianship

In contrast to the pattern with white rhinos, there are many black rhinos on private land in Kenya, Namibia, Swaziland and Zimbabwe that are managed on a custodianship basis for the state (as opposed to being privately owned). In 1999, the 11 AfRSG-rated *Key* populations of black rhinos included two Zimbabwean conservancies and one Kenyan sanctuary, with a further five *Important* custodianship populations. From 1997 to 1999, numbers of black rhinos managed by the private sector on a custodianship basis increased from 394 to 483.

Communal land

Black rhino numbers have, in general, declined markedly over the last decade on much of the communal land where they used to occur. At present, 17.6% of the south-western black rhinos and 2.0% of the eastern black rhinos are conserved on communal land.

Overall, 5.2% of Africa's black rhinos occurred on communal land in 1999, compared with only 0.2% of Africa's white rhinos.

Municipal and county council reserve areas

In South Africa and Kenya, a limited number of reserves and conservation areas are run by local area or

municipal authorities. The Masai Mara National Reserve in Kenya is run by the local Narok and Trans Mara county councils, and in Tanzania the Ngorongoro Area Authority manages Ngorongoro and the surrounding area. South Africa also has seven small, municipally owned and run parks that have a few white rhinos.

In 1999 such municipal and county council local-area authority parks held 39 white rhinos and 42 black rhinos, accounting for about 0.6% of Africa's rhinos. All such black rhinos are of the eastern subspecies; they make up 8.6% of this subspecies in the wild.

Table 3 gives a breakdown by management ownership model of the number of rated populations.

Table 3. Number of *Key* and *Important* African rhinoceros populations by management model in 2001

Management model	Black rhinos			White rhinos		Rated populations	
	Key 1	Key 2	Imp	Key 1	Key 2	Imp	Key & Imp
Communal	1					1	2
Other (Defence/Zoo NRs) ^a							0
Municipal & country council			1				1
Privately owned			1		4	27	32
Private custodianship		4	5				9
State ^b	4	7	12	4	5	15	47
State and private ^c				1			1
State-owned, privately run						1	1
Total	5	11	19	5	9	44	93

^a Defence/Zoo NRs refer to populations of rhino conserved on Defence Force conservation land or in nature reserves run by zoos.

^b See also table 2 notes a and b.

^c Kruger National Park and three adjoining private reserves form one large, contiguous conservation area of 21,413 km². While the majority of white rhinos occur in the national park area, a further 285 are on adjoining private land.

Progress in developing a Scene of the Crime training course

Roderick Potter and Richard H. Emslie

Ezemvelo KZN Wildlife and IUCN SSC African Rhino Specialist Group

Significant progress has been made in the project of developing a Scene of the Crime training course, which is being funded by the SADC Regional Programme for Rhino Conservation. Rod Potter had completed the full series of lecture notes and the project leader had reviewed them by the end of September. The lecture notes are currently being converted into the course handbook by

- adding sections to each chapter outlining the skills the trainees should have by the end of the chapter
- including course exercises and adding space for

the trainees to write up the exercises and add examples from class

- outlining how participants will be assessed on each course chapter and specifying how many marks the exercises in each chapter will count towards the final course mark (some chapters count for more than others).

The course handbook is on schedule to be completed by the next SADC rhino programme consortium meeting on 29 October.

An updated list of the countries and organizations

requesting this training was compiled at the recent September 2002 Rhino and Elephant Security Group of a southern Africa meeting held at Victoria Falls, Zimbabwe. The basic structure of the course modules was outlined at the meeting, and delegates once

again expressed strong interest in this course. When funding for the SADC rhino programme resumes, it is hoped Scene of the Crime training courses can be held in the different range states.

RESG holds two more meetings

Richard H. Emslie

IUCN SSC African Rhino Specialist Group

The resuscitated Rhino and Elephant Security Group of southern Africa (RESG) has held two meetings since the Windhoek meeting reported in *Pachyderm* 31. To save costs, RESG meetings have been designed to dovetail with the meetings of Interpol's Environmental Crime Task Group.

The 11th meeting of the RESG was held on 11 April 2002 in Pilanesberg National Park, South Africa. In addition to reviewing the revised terms of reference, this meeting determined requirements for software and training needs of each conservation agency. Demand for the Law database and training in its use and for Scene of the Crime training courses was high. A list of members with specific skills was drawn up.

The 12th meeting of RESG was held on 19 and 20 September 2002 at Victoria Falls in Zimbabwe. After the usual country and organizational reports, the meeting was addressed by the Zimbabwean minister of Environment and Tourism, Honourable Minister Cde Francis Nhema.

A representative of the Zimbabwean attorney-general's office gave an informative presentation on scene of the crime management and the expected chain of evidence required in environmental crime

cases. What was said echoed what is being included in the handbook for the SADC Scene of the Crime training course, which is being developed by Ezemvelo KZN Wildlife's Rod Potter (see preceding note).

The meeting was informed of recent progress in analysing horn fingerprinting data, and a number of discussions were held on the use and value of transponders and transponder databases. Once again, RESG reiterated its support for using only Trovan or Destron transponders in the interests of standardization.

Delegates went through RESG terms of reference to make sure the objectives were being addressed, and they listed activities being undertaken. As part of this process, a number of initiatives were identified that needed funding, and the RESG chair, Lovemore Mungwashu, and AfRSG's Richard Emslie were given the task of submitting funding proposals to appropriate bodies.

In addition, the meeting decided that it would be desirable for future country and organizational reports to follow a more standard format, and in so doing help achieve the listed objectives of the group.

A THANK YOU TO OUR REVIEWERS

Pachyderm, like any refereed journal, relies heavily on its reviewers. These people contribute immensely to the quality of the journal, working unpaid and invisibly. Some have even agreed to work especially quickly to help us to meet publication deadlines. We would here like to acknowledge those who have re-

viewed papers over the last five issues. If we have overlooked someone, we apologize—and blame the oversight on the crash of our computer hard disk that we underwent a few months ago, wiping out most of our old records.

Keryn Adcock
David Balfour
Richard Barnes
Rob Barnett
Steve Blake
Fred de Boer
Rob Brett
Colin Craig
Raoul du Toit

Richard Emslie
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John Waithaka
Elizabeth Wambwa

GUIDELINES FOR CONTRIBUTORS

Aim and scope

Pachyderm publishes papers and notes concerning all aspects of African elephants, African rhinos and Asian rhinos with a focus on conserving and managing 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.

Submission of manuscripts

Where possible, manuscripts should be submitted both in hard copy and on floppy disk. Alternatively, the text can be submitted by email. Whatever media are used, the hard copy of the script must be identical to the floppy or email version.

Send contributions to:

The Editor, *Pachyderm*

IUCN/SSC AfESG

PO Box 68200

City Square, 00200

Nairobi, Kenya

tel: +254 2 576461; fax: +254 2 570385

e-mail: afesg@wwfnet.org

Preparation of manuscripts

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

Title and authors: The title should contain as many of the key words as possible but should not be more than 25 words long. Follow with the name(s) of the author(s) with full postal address(es). Indicate the corresponding author, to whom proofs and editorial comments will be sent; give post, fax and email addresses for the corresponding author.

Research papers: Should be not more than 5000 words and be structured as follows: 1) Title (as above),

2) Abstract of not more than 200 words (informative type, outlining information from the Introduction, Materials and methods, Results (not detailed), Discussion, 3) additional key words (if any) not appearing in the title. 4) Introduction, 5) Materials and methods, 6) Results, 7) Discussion, 8) Conclusions if appropriate, 9) Acknowledgements (optional, brief), 10) References, 11) Tables, 12) Figure and photo captions, 13) Figures and photos.

Papers may be reports of original biology research or they may focus more on the socio-economic aspects of conservation, including market surveys.

Preferably provide figures and maps in their original form, for example, Excel files, maps as eps or tif files (17 x 15 cm, 600 dpi), when submitting in electronic form. Indicate clearly the source of figures and maps, if other than the author's, and credit line for photographs.

Notes from the field: The journal welcomes notes from the field. They may contain figures and tables but should be brief.

Book reviews: *Pachyderm* invites reviews of newly published books, which should be no more than 1500 words long.

Letters to the editor: Letters are welcome that comment on articles published in *Pachyderm* or on any other issue relating to elephant and rhino conservation in the wild.

Journal conventions

Nomenclature

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

Use an 's' for the plural form for animals: rhinos, elephants.

Spelling

Use British spelling, following the latest (10th) edi-

tion of the *Concise Oxford Dictionary*, using 'z' instead of 's' in words like 'recognize', 'organization', 'immobilized'; but 'analyse', 'paralyse'.

Numbers

Use SI units for measurement (m, km, g, ha, h) with a space between the numeral and the unit of measurement. Give measurements in figures, for example 12 mm, 1 km, 3 ha, except at the beginning of a sentence.

Spell out numbers under 10 if not a unit of measurement unless the number is part of a series containing numbers 10 or over, for example: 14 adult males, 23 adult females and 3 juveniles.

In the text, write four-digit numbers without a comma; use a comma as the separator for figures five digits or more: 1750, 11,750. The separator will be a full stop in French papers. In tables, however, use a comma for four-digit figures in a column containing figures of more than four digits.

References

Use the author-year method of citing and listing references. Remember that every reference cited in the text, tables and figures must be included in the reference list, and every listing in the References must be cited in the text, tables or figures.

In the text, cite two authors: '(X and Y 1999)' or 'X and Y (1999)'; cite more than two authors '(X et al. 1996)' or 'X et al. (1996)'. Note that there is no comma between the author(s) and the year.

In the reference list, cite publications using the fol-

lowing examples. List in alphabetical order then chronological order. Write out journal titles in full.

Adams, J.X. 1995b. Seizures and prosecutions. *TRAFFIC Bulletin* 15(3):118.

Dobson, A.P., and May, R.M. 1986. Disease and conservation. In: *Conservation biology: The science of scarcity and diversity*, ed. M.E. Soulé. Sinauer Associates, Sunderland, MA. p. 123–142.

Struhsaker, T.T., Lwanga, J.S., and Kasenene, J.M. 1996. Elephants, selective logging and forest regeneration in the Kibale Forest, Uganda. *Journal of Tropical Ecology* 12:45–64.

Sukumar, R. 1989. *The Asian elephant: ecology and management*. Cambridge Studies in Applied Ecology and Resource Management. Cambridge University Press, Cambridge.

Cite unpublished reports as follows:

Tchamba, M.N. 1996. *Elephants and their interactions with people and vegetation in the Waza-Logone region, Cameroon*. PhD thesis, University of Utrecht, The Netherlands. 142 p. Unpublished.

Woodford, M.H. 2002. [Title]. [*Journal or publisher*]. Forthcoming. [if publication date is known]

Woodford, M.H. [Title]. [*Journal or publisher*]. Forthcoming. [if publication date is not known]

Government reports, reports to wildlife departments, MSc theses, PhD theses, etc. are to be noted as unpublished.

Not accepted as references are papers in preparation or submitted but not yet accepted.

'Pers. comm.' accompanied by the name of the person and the date are cited in the text but not given in the reference list.

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