Pachyderm

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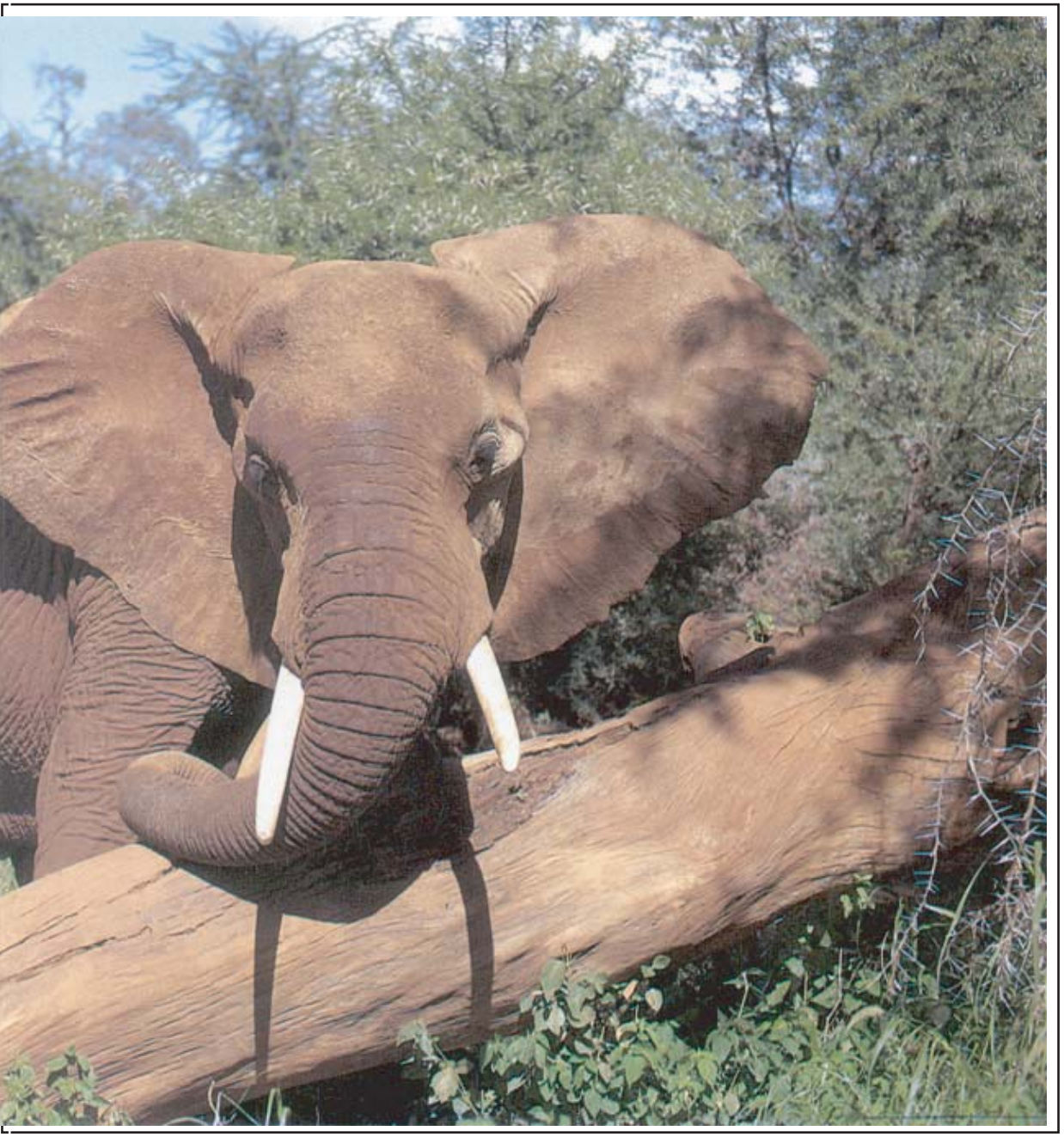

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Pachyderm

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Cover: In Samburu National Park, Kenya
Photo: Julian Blanc

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CHAIR REPORTS
RAPPORTS DES PRESIDENTS

African Elephant Specialist Group report
Rapport de Groupe des Spéclialistes des Eléphants d'Afrique

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The AfESG meeting

The fifth members' meeting of the IUCN/SSC African Elephant Specialist Group took place in Shaba National Reserve in Kenya from 28 January to 1 February 2002. In true AfESG fashion, the meeting was both productive and enjoyable, which made all the hard work done by the AfESG Secretariat in the months leading up to the meeting seem worthwhile. This year's meeting consisted of a number of presentations and working sessions, which provided valuable guidance to the AfESG Secretariat, working groups and task forces on a number of technical issues that will need to be tackled in the future. Topics discussed included conservation and management implications of multiple species of African elephant; listing of the African elephant using the IUCN Red List criteria; human–elephant conflict; illegal killing and trade; elephant translocation and reintroduction guidelines; and development of national and subregional elephant conservation strategies. A report summarizing the main discussions is found on page 74 of this issue.

Meeting of the Data Review Task Force

The Data Review Task Force, which oversees the *African Elephant Database* (AED) on behalf of AfESG members, met in Naivasha, Kenya, from 30 November to 2 December 2001. A number of im-

La réunion du GSEAf

La cinquième réunion du Groupe des Spécialistes des Eléphants d'Afrique de la CSE/UICN s'est déroulée dans la Réserve Nationale de Shaba, au Kenya, du 28 janvier au 1er février 2002. Typiquement GSEAf, la réunion fut à la fois productive et agréable, ce qui justifie le dur labeur produit par le Secrétariat du GSEAf dans les mois qui ont précédé la réunion. La réunion de cette année se composait d'un certain nombre de présentations et de réunions de travail, qui ont fourni au Secrétariat du Groupe, aux groupes de travail et aux exécutants, des conseils appréciables sur de nombreuses questions techniques qui devront être abordées à l'avenir. Les sujets traités incluent les implications, en matière de conservation et de gestion, du fait que les espèces d'éléphants africains sont plusieurs ; l'inscription de l'éléphant d'Afrique en utilisant les critères de la Liste Rouge de l'UICN ; les conflits hommes-éléphants ; les massacres illégaux et le trafic ; les directives en matière de translocations et de réintroductions d'éléphants ; et le développement de stratégies de conservation des éléphants nationales et sous-régionales. Un rapport qui résume les principales discussions se trouve en page 74 de ce numéro.

Réunion des Responsables de la Révision des Données

Les responsables des Données qui s'occupent de la *Base de Données sur l'Eléphant d'Afrique* (BDEA) pour les

provements for future editions of AED publications were agreed upon, including merging previous database updates with future information into a single, integrated database. New systems are also being implemented to automate, to the greatest extent possible, the production of reports from the new integrated database. These reports will form the basis of future AED publications, which will henceforth be published under the new title *African Elephant Status Report* (AESR). It will contain tables describing and explaining changes in numbers or range between editions at site, national, regional and continental levels. A brief descriptive history of elephant populations in each country will be added. Other suggested new features include charts describing the quality of the information available for each country and region, a new chapter on carcass ratios, and improvements in the way that elephant range is depicted. Finally, the plan is to link reference tables from the *African Elephant Database* to the African Elephant Bibliography, and to integrate survey reports and other AED source data into the African Elephant Library.

In January 2002 the conservation programme of the Environmental Systems Researcher Institute (ESRI), the developers of ArcView and ArcInfo GIS software, awarded the AED an in-kind grant consisting of ESRI's most advanced GIS software worth over USD 20,000. This new software will greatly improve AED analytical and technical capabilities.

MIKE update

Activities of the CITES Monitoring of Illegal Killing of Elephants (MIKE) programme have picked up considerably since the last update. The subregional support officers, who will help implement MIKE at site, national and subregional levels, have been recruited and are busy training range-state staff in how to implement it. Savannah and forest protocols have been harmonized with help from the MIKE Technical Advisory Group, and agreement is widespread that collection of the data that MIKE requires needs to get under way at all sites. The plan is to have population data for every site by the middle of 2003.

The first round of subregional training in monitoring law enforcement is nearly complete and will be followed soon by data management training. The final training stage will consist of population survey work.

membres du GSEAf se sont réunis à Naivasha, au Kenya, du 30 novembre au 2 décembre 2001. Ils se sont mis d'accord sur plusieurs améliorations à apporter aux éditions futures de la publication de la BDEA, y compris la fusion des mises à jour précédentes de la base de données avec les nouvelles informations, pour former une seule base de données intégrée. On est aussi en train de mettre au point de nouveaux systèmes qui permettront d'automatiser, autant que faire se peut, la production des rapports de la nouvelle base de données intégrée. Ces rapports constitueront la base des futures publications de la BDEA qui paraîtront désormais sous le nouveau titre *African Elephant Status Report (AESR).* Il contiendra des tableaux qui décriront et expliqueront les changements de nombre ou de répartition entre les éditions, au niveau des sites, du pays, de la région et du continent. On y ajoutera une brève description historique des populations d'éléphants dans chaque pays. On a aussi suggéré d'y ajouter des graphiques décrivant la qualité des informations disponibles pour chaque pays ou région, un nouveau chapitre sur les ratios de carcasses, et des améliorations de la façon dont la distribution des éléphants est décrite. Enfin, on voudrait lier les tables de références de la *Base de Données de l'Eléphant d'Afrique* à la Bibliographie sur l'éléphant d'Afrique et intégrer les rapports de recherches et les autres sources de données de la Base de données dans la *African Elephant Library.*

En janvier 2002, le programme de conservation de l'*Environmental Systems Researcher Institute (ESRI)* —ceux qui ont mis au point les programmes ArcView et ArcInfo GIS—ont récompensé la BDEA d'un prix en nature sous la forme du programme GIS le plus avancé du ESRI, d'une valeur de plus de 20.000 USD. Ce nouveau programme va grandement améliorer les capacités analytiques et techniques de la BDEA.

Mise à jour de MIKE

Les activités du Programme CITES de Contrôle des Massacres Illégaux d'Eléphants (*Monitoring of Illegal Killing of Elephants—MIKE*) ont pris une ampleur considérable depuis la dernière mise à jour. Les responsables sous-régionaux du soutien, qui vont aider à mettre MIKE en pratique au niveau du site, du pays et de la sous-région, ont été recrutés et sont déjà occupés à former du personnel dans les pays de l'aire de répartition sur la façon de l'appliquer. Les protocoles pour la savane et pour la forêt ont été harmonisés avec l'aide du Groupe de conseil technique de MIKE, et il

Human–elephant conflict task force

Last year the AfESG's Human–Elephant Conflict Task Force submitted a proposal to the World Wide Fund for Nature's (WWF) African Elephant Programme for mitigating human–elephant conflict at 10 sites across the continent. The proposal, which was approved in March 2002, aims to reduce levels of conflict by training human–elephant conflict managers over the next three years in the latest mitigation methods. A secondary aim of the project is to test and improve the new human–elephant conflict decision support system, data collection protocol and training manual for enumerators of elephant damage.

Another project under way is the production of maps from satellite images of human–elephant conflict sites with the help of a geographic information system. Producing up-to-date, standardized maps of sufficient resolution to show crop fields, villages, corridors of elephant movement between natural habitats, fencing and habitat types will be useful for designing strategies to reduce human–elephant conflict. Maps are currently being generated for three sites in Kenya, Zambia and Guinea-Conakry. If the exercise proves successful it is hoped that this methodology will be applied widely across the continent.

AfESG Web site

Since the last report the AfESG Web site www.iucn.org/afesg has been updated and improved. For instance, the human–elephant conflict decision support system is now available in both French and English and the 'Frequently asked questions about elephants' section has been expanded. Links to important documents such as the 'Review of African elephant conservation priorities' and new photographs have also been added. These improvements are already starting to bear fruit as demonstrated by the high number of 'hits' that the site is receiving. According to statistics provided by IUCN, the AfESG site regularly features among the top 10 most-visited IUCN SSC Web sites.

Elephant translocations

Early last year the Senegalese National Parks Service contacted the AfESG Secretariat regarding the proposed translocation of 12 to 15 elephants from Arly National Park in Burkina Faso to Niokolo Koba National Park in Senegal. AfESG has stressed that the

est généralement reconnu que la récolte de données dont MIKE a besoin doit démarrer sur tous les sites. Le but est de disposer de données sur les populations pour chaque site au milieu de 2003.

Le premier cycle de formation sous-régionale au contrôle de l'application des lois est presque terminé et il sera suivi sous peu par la formation à la gestion des données. Le stage final de la formation consistera en un travail d'étude de population.

Force spéciale chargée des conflits hommes–éléphants

L'année dernière, le groupe du GSEAf chargé des conflits hommes–éléphants a soumis une proposition au Programme pour l'Eléphant d'Afrique du Fonds Mondial pour la Nature (WWF) destinée à réduire les conflits hommes–éléphants en 10 endroits du continent. La proposition, adoptée en mars 2002, vise à réduire l'importance de ces conflits par la formation, pendant les trois prochaines années, de gestionnaires des conflits aux dernières méthodes de mitigation. Un objectif secondaire du projet consiste à tester et à améliorer le nouveau système de support des décisions dans les conflits hommes-éléphants, le protocole de récolte des données et le manuel de formation pour les descriptions des dommages.

Un autre projet en cours est la production de cartes à partir d'images satellite des sites des conflits, au moyen d'un système d'information géographique. Il sera très utile de produire des cartes standardisées, actualisées et d'une résolution suffisamment fine pour montrer les champs, les villages, les corridors de déplacements des éléphants entre leurs habitats naturels, les clôtures et les divers types d'habitats, pour élaborer des stratégies destinées à réduire les conflits hommes–éléphants. On est en train de préparer les cartes pour trois sites, au Kenya, en Zambie et en Guinée-Conakry. Si l'exercice s'avère fructueux, on espère que cette méthodologie pourra être appliquée à l'échelle du continent.

Site Internet du GSEAf

Le site Internet du GSEAf http://iucn.org/afesg a été remis à jour et amélioré depuis le dernier rapport. Par exemple, le système de support des décisions dans les conflits hommes–éléphants est maintenant disponible en français et en anglais et la section « questions fréquemment posées au sujet des éléphants » a été élargie. On a aussi ajouté des liens avec des documents importants tels que « *Review of African elephant con-*

two range states must ensure that a professional technical evaluation of the feasibility of the exercise is conducted at both the donor and the recipient sites before the translocation proceeds. Detailed terms of reference for the evaluation team have now been sent to the project proponents. In the meantime the AfESG Secretariat has been in touch with several translocation experts regarding the proposed evaluation, and we hope that a team composed of relevant technical experts will be ready to visit the two sites by the time funding for the exercise comes through.

This is unlikely to be the last time that AfESG is approached for a technical opinion on the feasibility of elephant reintroductions or translocations. Such assessments would greatly benefit from the existence of formal technical guidelines giving advice on the many factors that need to be taken into account when planning such moves. The new AfESG Reintroduction Task Force (RTF), which will help to produce these guidelines, plans to hold its first meeting in the next few months. The RTF will start its work by reviewing case studies of past elephant translocations and will consult a number of technical experts before making its final recommendations. If all goes well, and if sufficient funds can be made available, the guidelines should be ready within 12 to 18 months after the first RTF meeting.

West Africa programme office

At the time of the last report Lamine Sebogo, the AfESG Programme Officer for West Africa, had just finished a tour of the West African range states to promote the West African elephant conservation strategy. Since then most of the range states have appointed focal points to implement the strategy and many have begun formulating national plans for conserving and managing their elephant populations. In January a workshop was held in Ouagadougou to discuss the development of a national elephant strategy for Burkina Faso. Côte d'Ivoire, Niger and Togo are all expected to hold similar workshops in the near future.

In an effort to keep the momentum going, AfESG recently approached the US Fish and Wildlife Service for additional funds for AfESG to continue advocating strategy implementation and to introduce the strategy to the relevant authorities in Guinea-Bissau, Liberia and Sierra Leone, which were not visited during the previous promotional tour because of

servation priorities » et de nouvelles photos. Ces améliorations sont déjà en train de porter des fruits, comme le montre le grand nombre de « *hits* » que reçoit le site. D'après les statistiques fournies par l'UICN, le site du GSEAf figure régulièrement au Top 10 des sites web les plus visités de la CSE de l'UICN.

Translocations d'éléphants

Au début de l'année dernière, le Service des Parcs Nationaux sénégalais a contacté le Secrétariat du GSEAf au sujet du projet de translocation de 12 à 15 éléphants du Parc National d'Arly au Burkina Faso vers le Parc National de Niokolo Koba au Sénégal. Le GSEAF insistait pour que les deux états de l'aire de répartition s'assurent qu'il y ait une évaluation technique professionnelle de la faisabilité de cette opération, aussi bien dans le site de départ que dans celui d'arrivée, avant de procéder à la translocation. On a maintenant envoyé à ceux qui ont présenté le projet les termes de références détaillés de l'équipe qui va faire cette évaluation. Entre-temps, le Secrétariat du GSEAf est entré en contact avec plusieurs experts de la translocation au sujet de l'évaluation en question, et nous espérons qu'une équipe composée d'experts techniques compétents sera prête à visiter les deux sites au moment où le financement de cet exercice arrivera.

Il est probable que ce ne sera pas la dernière fois que le GSEAf est contacté pour un avis technique au sujet de la faisabilité de réintroductions ou de translocations d'éléphants. Ce genre d'évaluations bénéficieraient grandement de l'existence de directives donnant des conseils au sujet des nombreux facteurs qu'il faut prendre en compte lorsqu'on prévoit de tels déplacements. La nouvelle Force Spéciale du GSEAf chargée des Réintroductions (FSR), qui va aider à rédiger ces directives, prévoit de tenir sa première réunion dans les prochains mois. La FSR commencera sa tâche en révisant les études de cas de translocations d'éléphants antérieures et consultera de nombreux experts techniques avant de faire ses recommandations finales. Si tout se passe bien, et si l'on peut disposer de fonds suffisants, les directives pourraient être prêtes 12 à 18 mois après la première réunion de la FSR.

Bureau des Programmes en Afrique de l'Ouest

Lors de la parution du dernier rapport, Lamine Sebogo, le Responsable des Programmes pour l'Afrique de l'Ouest venait de terminer une tournée dans les états

insecurity at the time.

Central Africa programme office

Elie Hakizumwami, the Programme Officer for Central Africa, started work on 1 September 2001. His main focus has been to establish contact with AfESG members in the subregion and to coordinate with partner organizations. There is now need for a broader perspective on elephant conservation challenges in Central Africa and to strengthen the membership from the subregion as well as to identify the priority areas where AfESG can bring its technical expertise to bear. To achieve these objectives, we have requested additional funds from our donors to enable Elie to undertake extensive travels in the subregion over the coming months.

AfESG office move

On 1 March 2002 the AfESG Secretariat moved from its offices within the WWF Eastern Africa Regional Office in ACS Plaza in Nairobi to another office space on the second floor of the same building, right next to the CITES MIKE office. Despite a few inevitable problems associated with the office move, the Secretariat is now settled and fully functional in the new premises. The new email, telephone and fax details are listed on the contents page.

ouest-africains de l'aire de répartition pour promouvoir la stratégie pour la conservation de l'éléphant en Afrique de l'Ouest. Depuis lors, la plupart de ces états ont nommé des points focaux pour appliquer la stratégie et beaucoup ont commencé la rédaction de plans nationaux pour la conservation et la gestion de leurs populations d'éléphants. En janvier, un atelier s'est tenu à Ouagadougou pour discuter le développement d'une stratégie nationale pour l'éléphant au Burkina Faso. La Côte d'Ivoire, le Niger et le Togo devraient aussi tenir des ateliers semblables très prochainement.

Afin de maintenir l'élan observé, le GSEAf a récemment contacté le *Fish and Wildlife Service* américain pour qu'il accorde des fonds supplémentaires afin de continuer à défendre la mise en place de la stratégie et pour la présenter aussi aux autorités compétentes en Guinée-Bissau, au Liberia et en Sierra Leone, pays qui n'ont pas été visités au cours du premier tour en raison de la grande insécurité.

Bureau des Programmes en Afrique Centrale

Elie Hakizumwami, le Responsable des Programmes pour l'Afrique Centrale, a commencé à travailler le 1er septembre 2001. Son premier objectif fut d'établir des contacts avec les membres du GSEAf de la sous-région et de faire la coordination avec les organisations partenaires. Il faut maintenant une perspective plus large sur les défis que pose la conservation des éléphants en Afrique Centrale et un renforcement du partenariat de la sous-région, et il faut identifier les domaines prioritaires où le GSEAf pourrait apporter son expertise technique. Pour remplir ces objectifs, nous avons demandé des fonds supplémentaires à nos donateurs pour permettre à Elie d'entreprendre les voyages nécessaires dans la sous-région au cours des prochains mois.

Le Bureau du GSEAf déménage

Le 1er mars 2002, le Secrétariat du GSEAf a quitté ses locaux au Bureau Régional du WWF en Afrique de l'Est dans le ACS Plaza, à Nairobi, pour un autre espace de bureaux au deuxième étage du même bâtiment, directement à droite du bureau de MIKE (CITES). Malgré quelques problèmes inévitables liés au déménagement du bureau, le Secrétariat est maintenant bien installé et tout à fait fonctionnel dans ses nouveaux locaux. Le nouvel e-mail, le téléphone et le fax sont repris sur la table des matières.

African Rhino Specialist Group report
Rapport du Groupe des Spécialistes des Rhinos d'Afrique

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New triennium and next AfRSG meeting

Work is well advanced on planning our next AfRSG meeting, which will be held at Malilangwe in Zimbabwe, 1–6 June 2002. The official continental statistics will as usual be updated at the meeting, and these new statistics will be included in the next edition of *Pachyderm*. I will also report on the meeting in the next edition.

Cameroon

In the last *Pachyderm*, I mentioned that a WWF-funded survey of the potential rhino range had just been completed by Mike Kock and the results were awaited. The minimum number and demographic structure agreed upon at the technical experts' meeting held in Yaoundé in late 2000 for continuation of the recovery programme was five unrelated rhinos, of which three had to be female and one male. Unfortunately, despite 600 km of walking, the survey undertaken between April and August 2001 failed to sight any rhino, although old spoor confirmed the likelihood of there being five rhino left, with the probability of a further three. One rhino was, however, spotted outside the formal survey by a tracker. Concerns raised included the number of poaching camps and cable snares encountered and the apparent low intensity of law enforcement. Given the situation in Cameroon, the failure to establish whether a nucleus for a viable population remained, together with the extreme difficulty and cost of procuring, establishing and conserving a population in a fenced sanctuary over the medium to long term, resulted in the decision that the Specialist Group would not continue to actively support the programme. However, the Cameroon government was encouraged to protect the remaining rhinos in situ and to create conditions conducive to their long-term survival.

Nouvelle période de trois ans et prochaine réunion du GSRAf

On a bien avancé dans les préparatifs de notre prochaine réunion GSRAf qui se tiendra à Malilangwe, au Zimbabwe, du 1er au 6 juin 2002. Les statistiques officielles pour le continent seront mises à jour pendant cette réunion et elles seront reprises dans la prochaine édition de *Pachyderm*. J'y ferai aussi le rapport de la réunion.

Cameroun

Dans le dernier *Pachyderm*, je signalais qu'une étude de l'aire de répartition potentielle des rhinos, financée par le WWF, venait d'être terminée par Mike Kock et qu'on en attendait les résultats. Le nombre minimum et la structure démographique, sur lesquels on s'est mis d'accord lors de la réunion qui a rassemblé les experts techniques à Yaoundé fin 2000 pour la poursuite du programme de rétablissement, concernaient cinq rhinos non liés ensemble, dont au moins trois femelles et un mâle. Malheureusement, malgré qu'on ait parcouru à pied 600 km, l'étude réalisée entre avril et août 2001 n'a pas permis de voir le moindre rhino ; malgré tout, de vieilles traces confirment la probabilité qu'il reste cinq rhinos, et peut-être même trois de plus. Un des traqueurs a toutefois repéré un rhino en dehors de l'étude officielle. Des inquiétudes subsistent étant donné le nombre de camps de braconniers et de pièges en lacets observés et aussi le peu d'activités de maintien des lois. Etant donné la situation actuelle au Cameroun, le fait qu'on n'a pas pu établir s'il restait un noyau de population viable, auquel s'ajoutent l'extrême difficulté et le coût pour se procurer, installer et préserver une population dans un sanctuaire clôturé à moyen ou à long terme, a entraîné la décision que le Groupe des Spécialistes ne continuerait plus à soutenir activement ce programme. Cependant, le gouvernement camerounais est vivement encouragé à protéger les rhinos restants *in situ* et à créer des conditions favorables à leur survie à long terme.

SADC RMG biological management workshop

One of the recommendations to emerge from the biological management workshop that the SADC Rhino Management Group held in KwaZulu-Natal, South Africa, in 2001 was that the proposed revised strategy for black rhino should be actively communicated to relevant conservation agencies and management teams. The proceedings of this workshop (compiled by the AfRSG Scientific Officer) served as the background document for an Ezemvelo KZN Wildlife black rhino management strategy meeting held in April 2002, at which this organization formally adopted the strategy for all its populations. The revised strategy and proceedings are due to be presented at a scheduled workshop the South African National Parks will be holding in August 2002 to revise their black rhino strategy. Plans are also being made for the Scientific Officer to present the revised biological management strategy to both the Namibian Ministry of Tourism and Environmental Affairs and the Kenya Wildlife Service for their consideration. There are also future plans to make the Proceedings available in PDF format on the SADC rhino programme Web site. Any conservation agency wanting details of the new approach being adopted to maximize black rhino population growth and increase the supply of surplus animals available to establish new populations should please contact me.

Re-establishment of white rhino at Chief's Island, Botswana

Following the revision of the Botswana rhino conservation plan there has been a most encouraging development. A viable founder population of white rhino is being re-established at Chief's Island, Moremi National Park. This is a joint initiative between the Botswana Department of Wildlife and National Parks and the private sector. For further details see Moremi Tjibae's note in the Notes from the African Rhino Specialist Group on page 87.

Other news in brief

During the interim bridging period, the SADC Regional Programme for Rhino Conservation continues to be as productive as possible. It is hoped that full funding will once again resume from the beginning

Atelier de gestion biologique du GGR SADC

Une des recommandations issues de l'atelier biologique que le Groupe de Gestion des Rhinos a tenu au KwaZulu-Natal, en Afrique du Sud, en 2001, fut que la proposition révisée de stratégie pour le rhino noir soit communiquée activement aux organismes et aux équipes de gestion concernés. Les comptes-rendus de cet atelier, compilés par le responsable scientifique du GSRAf, ont servi de documents de base pour une réunion d'Emzevelo KZN Wildlife sur la stratégie de gestion des rhinos noirs qui s'est tenue en avril 2002, et au cours de laquelle l'organisation a formellement adopté la stratégie pour toutes ses populations. La stratégie révisée et les comptes-rendus doivent être présentés lors d'un atelier que les Parcs Nationaux d'Afrique du Sud tiendront en août 2002 pour réviser leur stratégie pour les rhinos noirs. On prévoit aussi que le responsable scientifique propose la stratégie révisée de gestion biologique à l'attention du Ministère Namibien du Tourisme et des questions Environnementales et du Kenya Wildlife Service. Il existe aussi un projet pour proposer les Comptes-rendus en format PDF sur le site Internet du programme rhino de la SADC. Tout organisme de conservation qui souhaiterait des détails sur les nouvelles approches adoptées pour maximiser la croissance de la population des rhinos noirs et accroître le surplus d'animaux disponibles pour installer de nouvelles populations sont invitées à me contacter.

Réinstallation du rhino blanc sur Chief's Island, au Botswana

Suite à la révision du plan de conservation du rhino au Botswana, on a constaté un développement très encourageant. On est en train de rétablir une population reproductrice viable de rhinos blancs sur Chief's Island, dans le Parc National de Moremi. C'est une initiative conjointe du Département de la faune et des parcs nationaux du Botswana et du secteur privé. Pour plus de détails, voyez la note de Moremi Tjibae dans les Notes du Groupe des Spécialistes des Rhinos d'Afrique plus loin dans ce numéro 87.

Autres nouvelles en bref

Pendant la période intermédiaire, le programme régional de la SADC pour la conservation des rhinos continue à être aussi productif que possible. On espère que le financement complet reprendra au début de 2003. Le

of 2003. The SADC Rhino Programme coordinator, Rob Brett, briefly reports on recent progress in Notes from the African Rhino Specialist Group on page 89.

The inaugural meeting of the SADC Rhino Recovery Group is scheduled to take place in late May 2002 in Malawi. This group comprises representatives of African range states that have either lost or almost lost their rhino populations and wish to plan for their re-establishment and recovery.

AfRSG is concerned about the situation in various rhino areas, not least Tsavo National Park, Kenya, where at least four black rhinos were recently poached in the free-release area (see 'Renewed threat to Kenya's rhino conservation efforts' in Notes from the African Rhino Specialist Group, p. 85) and also in Zimbabwe. In the latter case, land invasions into the rhino conservancies pose a major threat. Raoul du Toit gives an update in Notes from the African Rhino Specialist Group, page 83.

I reported in the last edition that the AfRSG Scientific Officer has been working cooperatively with Raj Amin of the Zoological Society of London and an MSc student to continue developing horn fingerprinting analysis techniques. A brief report on their findings is included as a short note from AfRSG (p. 90).

The Scientific Officer assisted Swaziland's Big Game Parks and the public prosecutor, appearing as an expert witness in a case before the Swaziland chief justice of possessing and dealing in rhino horn. Mickey Reilly of the Kingdom of Swaziland's Big Game Parks reports on this case and the deterrent sentences handed down in another note found in Notes from the African Rhino Specialist Group, page 81.

I would like to encourage all members to submit suitable short notes to the Scientific Officer for inclusion in the next edition of *Pachyderm*.

Acknowledgements

Once again I would like to thank WWF especially for their continued financial assistance to AfRSG, without which it would be impossible for us to operate effectively.

coordinateur du Programme Rhino de la SADC, Rob Brett, fait un bref rapport des progrès réalisés dernièrement dans les Notes du Groupe, en page 89.

La réunion inaugurale du Groupe de Rétablissement des Rhinos de la SADC doit avoir lieu fin mai 2002 au Malawi. Ce groupe comprend des représentants des états africains de l'aire de répartition qui ont soit perdu, soit presque perdu leur population de rhinos et qui veulent prévoir leur rétablissement.

Le GSRAf s'inquiète de la situation dans plusieurs endroits où il y a des rhinos, et spécialement au Parc National de Tsavo où au moins quatre rhinos noirs ont été braconnés récemment dans la zone de remise en liberté (voir « Nouvelles menaces pour les efforts de conservation des rhinos au Kenya » dans les Notes du Groupe, page 85) et aussi au Zimbabwe. Ici, ce sont les invasions dans les aires de conservation des rhinos qui représentent les plus grands risques. Raoul du Toit donne les derniers développements dans les Notes du Groupe des Spécialistes des Rhinos d'Afrique (page 83).

J'ai signalé dans le dernier numéro que le Responsable scientifique du GSRAf travaillait en collaboration avec Raj Amin de la Société Zoologique de Londres et avec un étudiant qui fait un MSc pour la poursuite du développement des techniques d'analyses de la corne par empreintes génétiques. Un bref rapport sur leurs découvertes se trouve dans une courte note du GSRAf (page 90).

Le Responsable scientifique a aidé les Parcs de Grande Faune du Swaziland et le ministère public, en paraissant comme témoin devant le Président de la Cour suprême du Swaziland dans une affaire de détention et de trafic de corne de rhino. Mickey Reilly, des Parcs de Grande Faune du Royaume de Swaziland, fait un rapport sur cette affaire et sur les peines dissuasives qui l'ont sanctionnée dans une autre note qui se trouve dans les Notes du Groupe dans ce numéro (page 81).

J'aimerais encourager tous les membres à proposer de courtes notes intéressantes au Responsable scientifique pour les publier dans le prochain numéro de *Pachyderm*.

Remerciements

Une fois encore, je voudrais remercier le WWF qui continue à aider financièrement le GSRAf. Sans lui, il nous serait impossible de travailler efficacement.

Asian Rhino Specialist Group report
Rapport du Groupe des Spécialistes des Rhinos d'Asia

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Vietnam

In December 2001, Programme Officer Nico van Strien conducted a short mission to Cat Loc in southern Vietnam, the home of the last Javan rhinos on the South-east Asian mainland. The purpose was to help improve monitoring and data collection as well as to reassess the population status.

There has been great progress in protection, with new guard posts and other infrastructure in place, and more guards conducting regular patrols throughout the rhino area. The education programme has established the rhino as an important symbol and icon in the area. Hence, both the local community and the government widely support conserving rhinos and their habitat. A first step has already been made to secure more land for them and a better habitat.

Although they appear to be quite safe now from poaching there are still serious concerns about the viability of the population. The area the rhinos use is very small—only about 4000 ha. Moreover, the reproductive potential of the population has so far not been confirmed. Since intensive monitoring started almost four years ago, there has been no sign of reproduction. A review of the data collected since 1998 suggests the presence of probably no more than three animals—one confirmed female, one other adult, probably also female, and a young one born in 1996/97.

During the 2002 dry season, monitoring through track studies and camera trapping will intensify, and this should collect data on the rhinos and their distribution. Later this year, the situation will be assessed again and the action plan reviewed and revised as necessary.

India

In February 2002, a team from the Assam Forestry Department (Wildlife), the Rhino and Tiger Conservation Fund, WWF's AREAS programme, the Inter-

Vietnam

En décembre 2001, le Responsable de Programmes Nico van Strien a réalisé une brève mission à Cat Loc, dans le sud du Vietnam, aire des derniers rhinocéros de Java sur la partie continentale du sud-est asiatique. Il avait pour but d'aider à améliorer la surveillance continue et la récolte de données ainsi que de réévaluer le statut de la population.

La protection a fait de grands progrès, avec de nouveaux postes de gardes et des infrastructures mises en place, et il y a plus de gardes qui effectuent des patrouilles régulières dans toute la zone des rhinos. Le programme d'éducation a fait du rhino un symbole important et un emblème pour la région. C'est pourquoi la communauté locale et le gouvernement supportent activement la conservation des rhinos et de leur habitat. On a déjà fait un premier pas en vue de leur garantir un plus grand territoire et un meilleur habitat.

Bien qu'ils semblent maintenant plutôt à l'abri du braconnage, des inquiétudes subsistent quant à la viabilité de la population. La zone fréquentée par les rhinos est très limitée, environ 4000 ha seulement. Qui plus est, jusqu'à présent, le potentiel reproducteur de la population n'a pas été confirmé. Depuis que la surveillance continue a commencé, il y a presque quatre ans, il n'y a eu aucun signe de reproduction. Une révision des données récoltées depuis 1998 suggère la présence d'un maximum de trois animaux, une femelle confirmée, un autre adulte probablement aussi une femelle, et un jeune qui est né en 1996/97. Pendant la saison sèche de 2002, la surveillance continue va s'intensifier, par l'étude des traces et les photos automatiques, et ceci devrait fournir des données sur les rhinos et leur distribution. On réévaluera la situation plus tard dans l'année et, si nécessaire, on révisera le plan d'action.

national Rhino Foundation (IRF) and AsRSG visited all the Indian rhino habitats in Assam, both actual and potential. The purpose was to observe recent developments, identify needs for external support, discuss the prospect of translocating rhinos to other appropriate areas, and move towards metapopulation management of rhinos within Assam.

In general the Indian rhino is doing well in Assam, with the overall numbers increasing steadily, in particular in Kaziranga National Park. However, in Manas National Park and in the smaller areas of Pobitora and Orang, pressure on rhinos is more intensive, not only from poaching but also from encroachment for agriculture and cattle grazing A few areas—Laokhowa, Sonai Rupa and Panidihing—have lost rhinos through poaching or blockage of migration routes, and in Orang only a few rhinos remain. Nevertheless, protection has improved, as has the infrastructure and equipment. Poaching has declined to a level far below the recruitment rate of the rhino population. The encroachment problems are more difficult to solve, although the government is determined to restore the areas for rhinos and other wildlife and is very active in improving protection and increasing the size of the conservation areas. Recently a large new wildlife sanctuary, Dubrasaikhowa, which was created in the east, has great potential for rhino conservation.

All rhino areas and potential rhino areas, with the exception of Manas, are located along the banks of the mighty Brahmaputra River, in the alluvial plains that are flooded annually. The lack of adequate and safe flood refuges is a serious constraint in all areas, rendering the rhinos particularly vulnerable during the monsoon season. Artificial highlands have been created and a number of hillocks adjacent to rhino areas have been included into the rhino conservation areas, but more refuges are needed. During the dry season when water in the river is low, the rhinos graze on the islands in the Brahmaputra and move among the various rhino habitats. Now such migrations are fewer, probably because vast numbers of cattle are herded there seasonally.

One of the major new and encouraging developments is the inclusion of a large stretch of the Brahmaputra riverbed in the Kaziranga National Park. This addition will, once cattle herding has been contained, allow rhinos access to the fertile grazing areas on the islands and will restore the traditional dry-season migration routes. Once the control over

Inde

En février 2002, une équipe du Département des Forêts de l'Assam (Faune), du Rhino and Tiger Conservation Fund, du Programme AREAS du WWF, de l'International Rhino Foundation (IRF) et du GSRAs a visité tous les habitats du rhino unicorne de l'Inde en Assam, tant réels que potentiels. Ils voulaient observer les derniers développements, identifier les besoins de supports externes, discuter la possibilité de déplacer des rhinos vers d'autres zones appropriées et progresser vers la gestion en métapopulation des rhinos en Assam.

En général, le rhinocéros de l'Inde se maintient bien en Assam, et le nombre total augmente rapidement, spécialement dans le Parc National de Kaziranga. Pourtant, dans le Parc National de Manas et dans les aires plus petites de Pobitora et d'Orang, la pression est plus forte sur les rhinos, due non seulement au braconnage mais aussi au grignotement de l'habitat pour l'agriculture et le pâturage du bétail. Quelques zones – Laokhowa, Sonai Rupa et Panidihing – ont perdu des rhinos à cause du braconnage ou de la fermeture des voies de migration, et à Orang, il n'en reste que quelques-uns. Néanmoins, la protection s'est améliorée, de même que les infrastructures et l'équipement. Le braconnage des rhinos s'est réduit à un niveau bien inférieur au taux de croissance de la population. Les problèmes de grignotement de l'habitat sont plus difficiles à résoudre, même si le gouvernement est bien décidé à rétablir les aires attribuées aux rhinos et au reste de la faune sauvage et qu'il se montre très actif pour améliorer la protection et pour augmenter la taille des aires de conservation. On a créé récemment dans l'est un vaste nouveau sanctuaire pour la faune sauvage, Dubrasaikhowa, qui présente un potentiel excellent pour la conservation des rhinos.

Toutes les aires des rhinos, potentielles ou réelles, à l'exception de Manas, sont situées sur les rives du puissant Brahmapoutre, dans les plaines alluviales qui sont inondées chaque année. Le manque de refuges adéquats et sûrs en cas d'inondation est un inconvénient de taille dans tous ces sites car il rend les rhinos particulièrement vulnérables pendant la mousson. On a créé des endroits surélevés artificiels, et un certain nombre de buttes adjacentes aux aires des rhinos ont été inclues dans les aires de conservation, mais il faudra encore plus de refuges. Pendant la saison sèche, lorsque l'eau du fleuve est basse, les rhinos vont manger sur les îlots au milieu du Brahmapoutre et se déplacent entre leurs divers habitats. Aujourd'hui, de telles migrations sont devenues rares, probablement à cause du grand nombre de têtes de bétail qui y sont conduites à ce moment.

the riverbed has been intensified, it is hoped that natural migration will reoccur and the rhinos will re-establish in other areas along the Brahmaputra.

Therefore, it is recommended that the protection zone be extended to the west at least as far as Laokhowa/Bura Chapori and Orang, and probably to Pobitora. This will effectively link all but one (Manas) of the current rhino areas and allow free migration in between. The creation of such a metapopulation will improve the vitality of the population and will allow a significant increase in numbers. Extending the Brahmaputra conservation area to the east as far as Panidihing could also be considered, as until about 10 years ago rhinos used to migrate there seasonally from Kaziranga. The new Dubrasaikhowa sanctuary has the potential for a few hundred rhinos. Once appropriate control and protection have been established rhinos could be moved there through a capture and translocation programme, as the distance is too far for natural migration.

Manas National Park on the border with Bhutan lost most of its rhinos during the many years of political unrest and insurgency, and the area is geographically isolated by development from the other rhino areas. Once security returns to normal Manas may also qualify for a capture and translocation programme to restore its rhino population.

Indonesia/Malaysia

In March 2002, an international team of reproductive biologists from Malaysia, Indonesia and the US visited the Sumatran rhino managed breeding programmes in Way Kambas, Indonesia, and Sungai Dusun, Malaysia, to assess the condition of the animals and to investigate some specific health and reproductive concerns. We will publish a full report of the results in the next issue of *Pachyderm***.**

Une des nouvelles les plus importantes et encourageantes est l'inclusion d'une vaste section du lit du Brahmapoutre dans le Parc National de Kaziranga. Cet ajout, dès que le pâturage du bétail aura été mis sous contrôle, permettra à tous les rhinos l'accès à des zones fertiles sur les îles et restaurera les voies de migration traditionnelles de saison sèche. On espère que, dès que le contrôle du lit du fleuve aura été intensifié, les migrations naturelles vont reprendre et que les rhinos vont se réinstaller dans d'autres zones le long du Brahmapoutre.

C'est pourquoi on recommande que la zone de protection soit étendue vers l'ouest au moins jusqu'à Laokhowa/Bura Chapori et Orang, peut-être même Pobitora. Ceci relierait toutes les aires actuelles des rhinos (sauf Manas) et permettrait la libre migration entre elles. La création d'une telle métapopulation devrait améliorer la vitalité de la population et permettre un accroissement significatif de ses effectifs. On pourrait aussi envisager d'étendre l'aire de conservation du Brahmapoutre vers l'est jusqu'à Panidihing, puisque jusqu'à il y a environ dix ans, les rhinos avaient l'habitude de migrer là-bas saisonnièrement depuis Kaziranga. Le nouveau sanctuaire de Dubrasaikhowa pourrait accueillir quelques centaines de rhinos. Une fois qu'on y aura établi les contrôles et la protection appropriés, on pourrait y transférer des rhinos dans le cadre d'un programme de capture et translocation car la distance est trop grande pour une migration naturelle.

Le Parc National de Manas, à la frontière du Bhoutan, a perdu la plupart de ses rhinos au cours des nombreuses années d'instabilité et d'insurrections politiques, et cette région est isolée géographiquement des autres aires de conservation des rhinos. Dès que la sécurité reviendra à la normale, Manas pourrait aussi être qualifié pour bénéficier d'un programme de capture et translocation afin de rétablir sa population de rhinos.

Indonésie/Malaisie

En mars 2002, une équipe internationale de biologistes spécialistes de la reproduction venus de Grande Bretagne, d'Indonésie et de Malaisie a visité les programmes de reproduction assistée des rhinos de Sumatra à Way Kambas, en Indonésie, et à Sungai Dusun, en Malaisie, pour évaluer l'état des animaux et étudier certains aspects spécifiques de leur santé et de la reproduction qui posent problème. Nous publierons un rapport complet des résultats dans le prochain numéro de *Pachyderm.*

RESEARCH AND REVIEW

Conflits homme–éléphant autour de la Forêt classée du Haut-Sassandra (Côte d'Ivoire)

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Résumé

C'est dans le cadre de l'aménagement de la Forêt classée du Haut-Sassandra, et face aux nombreuses plaintes des paysans concernant la destruction de leurs cultures par les éléphants, que ces études de conflits entre hommes et éléphants ont été menées en 1995. Ces études ont été faites sur la base des enquêtes (auprès des paysans) et des inventaires des dégâts sur des placeaux. Ces placeaux sont de forme carrée et les côtés ont 50 m de longueur. Ces placeaux ont été installés dans les zones d'intrusion des éléphants, dans le domaine rural. Il en ressort que ce sont seulement les cultures qui sont dévastées et cela, le plus souvent en saison sèche. Ce sont principalement les cultures vivrières (le taro, la banane, le manioc, l'ananas et l'igname) et les cultures industrielles (le cacao). Les dégâts sont inférieurs à 5 % des revenus du paysan mais engendrent une colère et une inquiétude chez les paysans qui conduisent à l'abattage de certains de ces animaux en forêt.

Mots clefs supplémentaires : dégâts, cultures

Abstract

Because of numerous complaints from farmers on the destruction of their crops by elephants from the Haut-Sassandra Forest Reserve, studies were carried out in 1995 to determine the extent of human–elephant conflict in the region. Methods used were questioning farmers and taking inventories of damage on farms. The farms are within areas where elephants can easily intrude. Results show that mainly food crops such as taro, banana, casava, pineapple and yam, and cash crops like cocoa are destroyed, particularly during the dry season. Damage calculated is less than 5% of the farmers' income. But the destruction angers the farmers enough to drive them to slaughter some of these animals in the forest.

Additional key words: damage, crop

Introduction

L'explosion démographique et l'avènement des cultures industrielles en Côte d'Ivoire ont favorisé l'extension des cultures dans les voisinages immédiats des aires protégées et parfois à l'intérieur de celles-ci. Cela a entraîné une proche cohabitation entre hommes et animaux qui a engendré de nombreux conflits. Ces cultures sont très souvent installées dans les aires de

répartition ou dans des couloirs de migration des animaux qui les abîment à leur passage. Cela entraîne des dommages à la population humaine vivant autour de ces aires (Parker et Graham 1989 ; Sukumar 1990 ; Barnes et al. 1995 ; Hoare 1995 ; Thouless et Sakakwa 1995 ; Barnes 1996a, 1996b ; Dickinson 1998 ; Naughton-Treves 1998 ; Vanleeuwe et Lambrechts 1999 ; Waithaka 1999). Les causes d'intrusion des animaux dans le domaine rural et l'importance des dommages occasionnés sont divers. La détermination de l'importance de ces dommages, utile pour la prise de décisions pour l'aménagement de ces aires protégées fait très souvent défaut.

La présente étude a été effectuée en 1995 autour de la Forêt classée du Haut-Sassandra (figures 1 et 2) forêt gérée par la Société de développement de forêts (SODEFOR). C'est une étude ponctuelle qui a pour objectif d'y estimer l'importance des conflits entre les hommes et les éléphants pour faire des propositions dans le cadre de l'aménagement de cette forêt. Elle a été essentiellement basée sur les observations sur le terrain (inventaires des dégâts dans les plantations et enquêtes auprès des populations) ; les données officielles étant pratiquement inexistantes.

Pour faciliter la compréhension du texte, les noms scientifiques des plantes ne seront pas suivis des noms d'auteurs ni des familles. Ces informations sont présentées plus loin dans le tableau I.

Milieu d'étude

La Forêt classée du Haut-Sassandra est située au Centre-Ouest de la Côte d'Ivoire (figure 2). Elle a été définie en 1969 avec une superficie de 961,2 km^2 (SODEFOR 1996a). A la suite de politiques de conservation des forêts naturelles, cette superficie est passée à 1024 km^2 en 1974. Depuis l'avènement des cultures d'exportation, notamment le café et le cacao, la ruée vers cette forêt classée a été plus importante (notamment en 1986) et des populations non autochtones se sont installées autour et même à l'intérieur de cette forêt (SODEFOR 1996b). Suite aux attributions de certaines parcelles à des fins agricoles, le milieu forestier naturel n'occupe aujourd'hui qu'environ 950 km^2. De grandes plantations et de nombreux villages

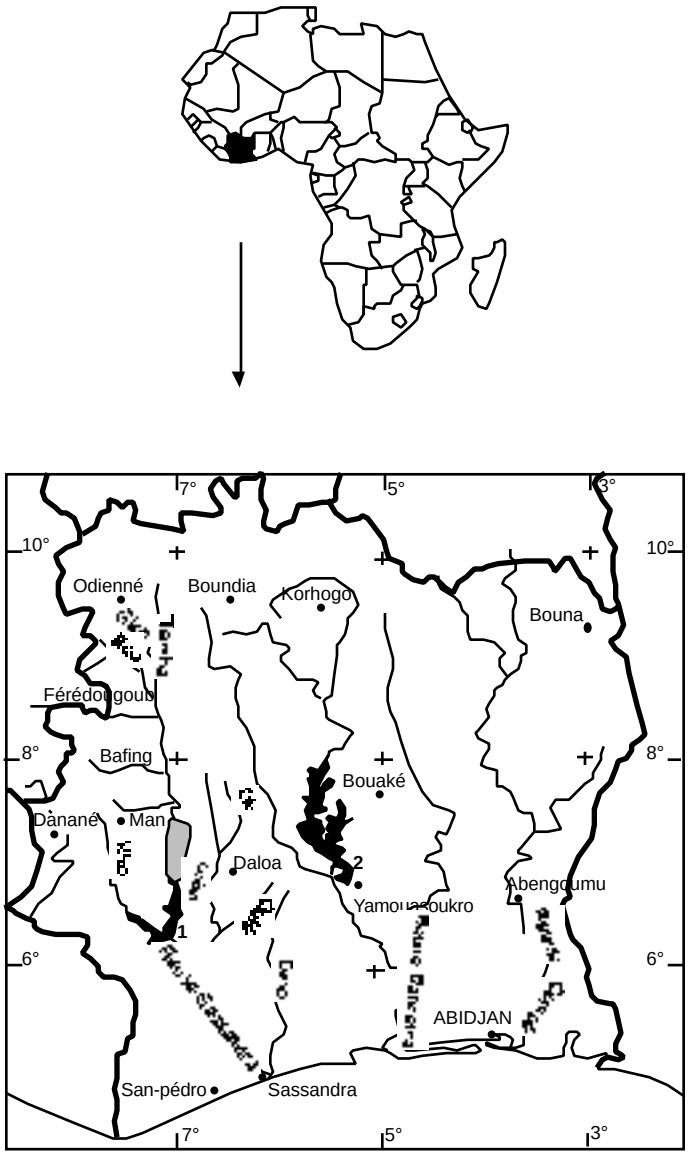

Figure 1. Situation géographique de la Forêt classée du Haut-Sassandra en Afrique et en Côte d'Ivoire.

Figure 2. Situation des principaux villages et campements autour et à l'intérieur de la Forêt classée du Haut-Sassandra (échelle : 1 / 800 000ème).

et campements (figure 1) se trouvent aujourd'hui tout autour et à l'intérieur de cette forêt.

Les données climatiques de SODEXAM/MN/DMARN-CLIMATOLOGIE de 1987 à 1996 autour de la Forêt classée du Haut-Sassandra, montrent deux saisons bien marquées. Une longue saison des pluies de mars à octobre (huit mois) avec deux maxima de pluies. Le premier maximum (179 mm de pluies) se situe en avril et le second (128,7 mm de pluies) en septembre. Une saison sèche allant de novembre à février (quatre mois) avec un minimum de pluies en janvier (7,2 mm).

Cette forêt n'est traversée que par des cours d'eau saisonniers. Le seul cours d'eau permanent est le fleuve Sassandra qui la longe sur sa limite ouest. Ce fleuve connaît aussi des périodes d'étiages souvent très prononcés à certains endroits.

Le sol de cette forêt est essentiellement un sol ferralitique moyennement désaturé. Il est issu de granite et de roches métamorphiques schisteuses (vers le sud). Il présente un horizon humifère peu épais et un horizon gravillonnaire peu développé (Perraud et De la Souchère 1970).

La formation végétale est essentiellement une forêt dense humide semi-décidue du type à *Celtis spp*. et *Triplochiton scleroxylon* (Guillaumet et Adjanohoun 1969).

L'extrême Nord-Ouest de cette forêt renferme de petites savanes climatiques à *Borassus aethiopum* (Arecaceae) et *Panicum phragmitoïdes* (Poaceae).

Cette forêt est de plus en plus ouverte et perturbée par des installations agricoles et surtout par l'exploitation de bois en grumes qui s'y déroulent depuis des dizaines d'années.

Matériel et méthodes d'étude

Matériel d'étude

Le matériel d'étude comprend essentiellement :

- une boussole 'Broussarde Chaix' pour l'orientation précise des placeaux ;
- quatre jalons pour faciliter les visées à la boussole ;
- une chaîne en acier de 20 m pour la mesure des distances ;
- un ruban plastique de deux mètres de longueur pour les mensurations de la circonférence des plantes ;
- une carte de végétation et des layons de la forêt classée au 1/100.000ème.

Le concours de trois personnes a été sollicité pour l'installation des placeaux et pour la réalisation des différentes mesures.

Méthodes d'étude

Cette étude a été réalisée en combinant plusieurs techniques d'étude dont des enquêtes auprès des paysans, le parcours des limites de la forêt pour la localisation des zones d'intrusion des éléphants dans le domaine rural, et l'estimation des dégâts par des inventaires sur des placeaux dans les zones d'intrusion.

Enquêtes

Les enquêtes sont menées auprès des paysans vivant autour de la forêt classée. Ils sont interrogés sur : la fréquence des intrusions d'éléphants dans leurs plantations, les caractéristiques des animaux nuisibles, les périodes des raides des plantations, le type de cultures dévastées, les pertes occasionnées par les éléphants, les méthodes de protection des cultures et les moyens de compensation pour les productions perdues.

Localisation des zones d'intrusion des éléphants dans les plantations

La localisation des zones d'intrusion des éléphants dans le domaine rural (plantations) s'est faite par le parcours des limites de la forêt et le relevés topographiques des limites des zones d'activités des éléphants (marquées par les empreintes, les crottes, les dégâts, etc.) dans ce domaine. Lors de ce parcours, les paysans rencontrés sont encore interrogés sur la fréquence et les périodes des intrusions des éléphants dans leurs plantations. Compte tenu des moyens alloués très limités et des problèmes socio-politiques (ces données n'étant pas officiellement disponibles) toutes les plantations et la population autour de la Forêt classée n'ont pu être recensées.

Estimation des dégâts dans les plantations

L'estimation des dégâts causés par les éléphants dans les plantations s'est effectuée par la réalisation d'inventaires des plantes cultivées sur des placeaux de 50 m x 50 m. Ces placeaux, au nombre de 8 sont installés dans le prolongement des layons des inventaires forestiers. Dans chacun des placeaux, les plantes de chaque type de cultures (café, cacao, banane, etc.) sont comptées. Les nombres de plantes intactes et abîmées (déracinées, cassées, organes consommés, etc.) sont précisés. La hauteur de ces plantes et leur d.b.h (de l'anglo-saxon "diameter at breast height") sont aussi indiqués. Pour les végétaux de taille inférieure à 1,3 m, le diamètre est mesuré au niveau de la première feuille.

La fréquence de consommation d'un organe de plante donnée (espèce végétale) est obtenue par le rapport du nombre d'observations de la consommation de l'organe considéré sur le nombre total d'observations de la consommation des différents organes de la plante. Un organe est dit fréquent (fréquemment consommé) s'il est consommé dans plus de 50 % des cas. Il est dit peu fréquent (peu fréquemment consommé) lorsqu'il est consommé dans 25 % à 50 % des cas. Il est dit rare (rarement consommé) lorsqu'il est consommé dans moins de 25 % des cas (tableau 1).

La production et le revenu à l'hectare de chaque culture ont été estimés en fonction des chiffres de production locaux et des coûts moyens sur le marché local (F CFA et dollar US en 1995). Le calcul des pertes a été simplifié en ramenant la production de chaque culture par pieds à l'hectare.

Ces inventaires sur placeaux ont été menés à la fin de la saison sèche dans le souci de prendre en compte le maximum des dégâts causés dans les plantations.

Résultats

Enquêtes

Des enquêtes effectuées autour de la forêt classée, il ressort que l'aire de répartition des éléphants s'étendait autrefois dans l'actuel domaine rural. Cette aire se déplacerait sous la pression de trois principaux facteurs qui sont l'agriculture, la chasse et l'exploitation de bois en grumes. Les zones d'intrusion des éléphants dans le domaine rural se seraient donc déplacées au fil des ans pour se localiser essentiellement à la limite nord-est durant la période de notre étude.

Les intrusions des éléphants dans les plantations ont été rarement (3 %) signalées en saison pluvieuse par les paysans. Elles sont fréquentes (97 %) en saison sèche où ces animaux, très méfiants, arrivent très souvent dans les plantations pendant la nuit (en l'absence des paysans). Les dommages enregistrés concernent essentiellement les cultures. Les données ont montré (tableau 1 et figure 3) que les cultures les plus consommées par les éléphants sont les cabosses de cacao (*Theobroma cacao*), la banane et les "tiges" de bananiers (*Musa paradisiaca*), les tubercules de taro (*Colocasia esculenta*), les racines tubéreuses de manioc (*Manihot esculenta*), les fruits de l'ananas (*Ananas comosus*) et les tubercules d'ignames (*Dioscorea* sp.). La plupart des paysans de la zone d'intrusion prétendent perdre pratiquement toute la production de la partie de leur plantation se trouvant à moins de 100 mètres de la limite de la forêt. Par conséquent, ils exigent de l'Etat, des dédommagements financiers.

Les moyens utilisés par les paysans pour éloigner les éléphants des plantations et des campements sont :

Tableau 1. Liste des cultures consommées par les éléphants autour et dans la Forêt classée du Haut-Sassandra et fréquences relatives de la consommation des différents organes

Nom scientifique	Famille	Nom français	Fruits et graines	Feuilles	Tige	Racines et tubercules	Type biologique
Musa paradisiaca L.	Musaceae	bananier plantin	p	r	f		h
Colocasia esculenta (L.) Schott	Araceae	taro				f	h
Manihot esculenta Crantz	Euphorbiaceae	manioc				f	
Musa sapientum L.	Musaceae	bananier (banane douce)	r	r	f		h
Theobroma cacao L.	Sterculiaceae	cacao	f	p			a, mp
Ananas comosus (L.) Merr.	Bromeliaceae	ananas	f				h
Dioscorea sp.	Dioscoreaceae	igname		p	r	f	h
Carica papaya L.	Caricaceae	papayer	f	r			h, mp
Coffea sp.	Rubiaceae	café	p	r			a, mp
Elaeis guineensis Jacq.	Palmaceae	palmier	r				a, mp
Mangifera indica L.	Anacardiaceae	manguier	f	p			a, mp
Oryza sativa L.	Gramineae	riz	r	r	r		h
Zea mays L.	Gramineae	maïs	f	p	p		h

a : arbustes et arbres, f : fréquent, h : herbe, mp : microphanérophyte, p : peu fréquent, r : rare

- des feux sur les bords des plantations aux points d'entrées fréquents des éléphants
- la création de fumée à ces points par le brûlage d'anciens pneus (voiture, bicyclette, etc.) et des cires de certaines plantes
- le bruit, en frappant sur des boîtes et des bouteilles vides, lorsque a l'entend dans la forêt, des bruits provoqués par le passage des éléphants , et parfois
- l'abattage de quelques éléphants

Les méthodes du feu et de la fumée sont jugées inefficaces par les paysans car ces feux s'éteignent toujours pendant la nuit en leur absence. Aucun paysan n'a jamais passé une fois toute une nuit dans sa plantation pour la surveillance et l'entretien des feux. Ils trouvent que ce serait peine perdue car ils jugent les éléphants très intelligents et dangereux. Ils les qualifient souvent même de génies. Ils affirment que les éléphants évitent les plantations (parties des plantations) quand les hommes s'y trouvent. Ils y pénètrent dès que les hommes les quittent ou au moment où ils s'attendent le moins. Ils disent que les éléphants ne font du bruit que sur leur chemin de retour, lorsqu'ils ont déjà accompli leur forfait.

Les victimes des dégâts trouvent que le bruit est d'une efficacité temporaire, juste durant la présence de l'homme dans sa plantation. Selon eux, les éléphants nuisibles ne s'éloignent guère des plantations et ils les regagnent dès que les paysans qui les croient partis entrent au village.

Les abattages d'éléphants se font le plus souvent illégalement en forêt. Les éléphants déprédateurs (des cultures) sont suivis en forêt pour être abattus par des braconniers engagés par les victimes des dégâts. La vente des produits (viande, défenses, peau, etc.) des éléphants ainsi abattus se fait aussi illégalement. Selon nos enquêtes, dans la région, le kilogramme de défense d'éléphant (ivoire) serait vendu à 12.000 francs CFA (24 dollars US) par les chasseurs et 30.000 francs CFA (60 dollars US) par les revendeurs.

Les cas de menaces d'abattages ou d'abattages d'éléphants dans la Forêt classée du Haut-Sassandra signalés lors de cette étude sont les suivants.

- En mars 1994, le chef d'un village (Konanbokro) situé à 1 km au Nord-Est de la Forêt classée du Haut-Sassandra, avait obtenu un permis d'abattage d'éléphants délivré par le Préfet de Vavoua et avait engagé un chasseur d'éléphants.
- Le 25 novembre 1995, une dépouille de deux jours d'un éléphant a été découverte dans la partie Nord de la Forêt classée du Haut-Sassandra à moins de 4 km de la limite nord.

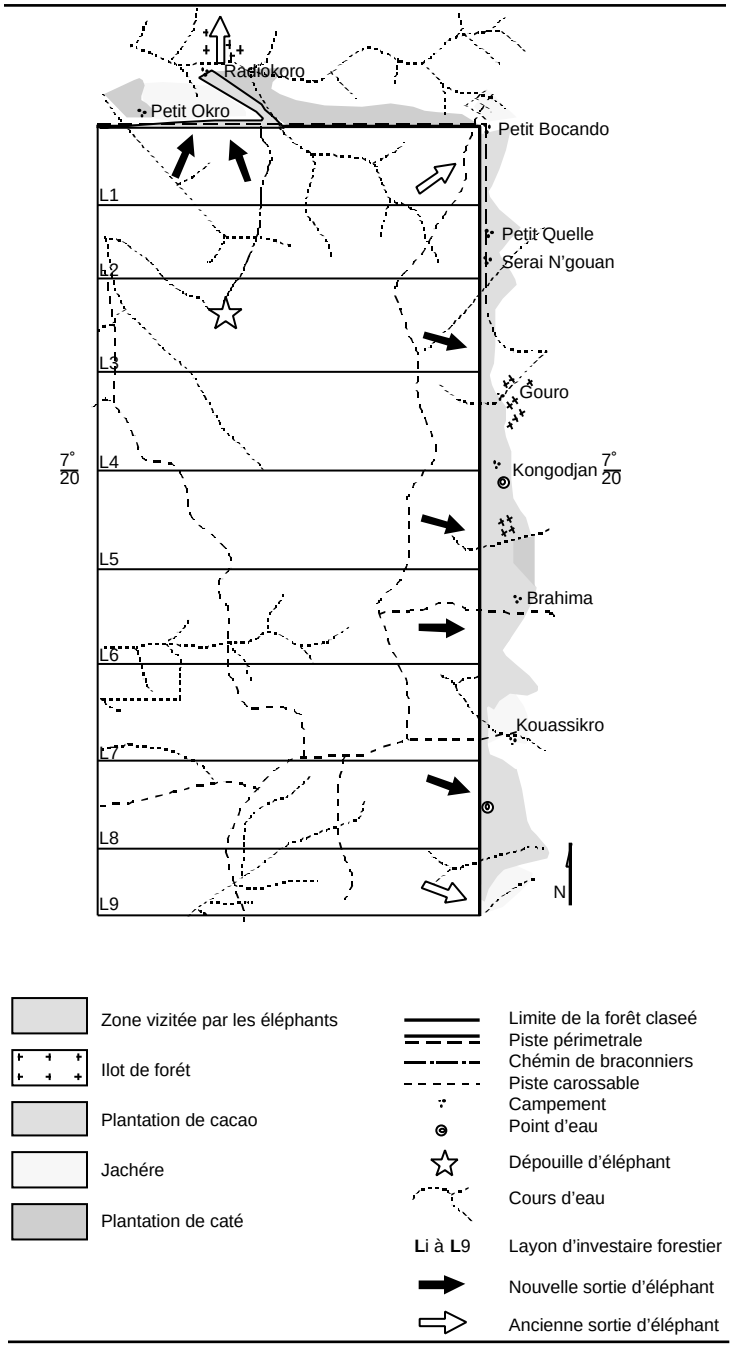

Figure 3. Zones d'intrusion des éléphants dans les cultures autour de la Forêt classée du Haut-Sassandra (échelle : 1 / 130 000ème).

Delimitation des zones d'intrusion des elephants

Les données des parcours des limites de la forêt (figure 3) ont confirmé que les principales sorties des éléphants se situent au niveau de la limite nord-est. D'autres sorties moins importantes ont été constatées dans l'enclave de Gbeubli et au niveau de la partie centrale de la limite est. Le constat des dégâts et le releve des limites des zones d'activités des éléphants dans le domaine rural montrent que les dégâts sont apparemment plus importants dans les 100 premiers mètres à partir de la limite de la forêt et que les éléphants ne s'aventurent à plus de 200 mètres de la forêt que pour rejoindre des îlots de forêt ou des points d'eau. Les points de sortie et d'entrée des éléphants sont souvent séparés de 500 m ; deux ou trois sorties et entrées pouvant être effectuées par un même troupeau pendant une nuit.

Estimation des dégâts dans les plantations

Le tableau 1 présente les noms scientifiques des cultures consommées par les éléphants autour de la Forêt classée du Haut-Sassandra, leur famille et les fréquences relative des différents organes. Les estimations de certains dégâts sont présentées à la figure 4. Les proportions de plantes abîmées et les pertes par hectare en déduites ont été récapitulées dans le tableau 2.

Les organes renfermant les substances de réserve (fruits, racines tubéreuses et tubercules) sont plus consommés que les autres (feuilles, écorces et racines).

Les bananiers sont cassés pour consommer les fruits et les parties apicale et centrale des "tiges" (ce sont de fausses tiges) riches en eau. Ces parties de "tiges" sont mâchées et les résidus sont souvent rejetés le long de leurs chemins. Les écorces de manguier étaient fréquemment mangés.

Les dommages causés aux cultures industrielles (plants de cacaoyers) sont généralement des cassures de branches ou, rarement, des déracinements de jeunes plants. Ils sont faibles dans l'ensemble puisqu'ils se limitent à 1,5 % du nombre de pieds. Même dans les

Tableau 2. Proportions (%) de plants abîmés et pertes (en francs CFA et en dollars 1995) à l'hectare occasionnées par les éléphants en 1995 dans les plantations en bordure de la Forêt classée du Haut-Sassandra (USD 1 = F CFA 500)

Cultures	Proportion (%) de plants abîmés		Coût total* par hectare	
	Par rapport à la culture elle-même	Par rapport à l'ensemble des cultures	F CFA	USD (1995)
Ananas	23,6	0,43	325	0.65
Banane	12,4	3,63	5425	10.85
Igname	90,0	0,15	675	1.35
Manioc	35,0	0,75	2250	4.5
Taro	19,3	5,32	5965	11.93
Cacao	1,5	0,58	7455	14.91
Total		10,86	22095	44.19

* pertes exprimées en fonction des chiffres de production locaux et des coûts moyens sur le marché local. Le taux de plantes abîmés par type de culture (% pa) = tc /Ttc ; où tc est le nombre total de plants abîmés par type de culture et Ttc est le nombre total des plantes de tous les types de cultures.

nouvelles plantations où ces dégâts sont plus importants par piétinement, ils ne représentent que 5,37 % de jeunes plants cassés et 0,24 % de jeunes plants déracinés. En somme, les éléphants ne consomment que les cabosses (cacao) et les dommages demeurent en dessous de 20 % de la production dans les zones très fréquentées.

Les dommages causés aux cultures vivrières (taro, manioc, igname, etc.) sont également négligeables. Ces denrées sont très souvent cultivées pour la consommation personnelle et, de ce fait, n'occupent que de petites surfaces ou sont disséminées dans les plantations de cacaoyers. C'est notamment le cas de l'igname (figure 3 et tableau 2) où on a en moyenne 5 pieds à l'hectare et dont 4,5 sont déracinés. Le taux de destruction de cette culture est très important mais la culture est en quantité insignifiante.

En 1995, 10,86 % des plants ont été dévastés dans les zones d'intrusion des éléphants (tableau 2). Les dégâts ont été estimés, en moyenne, à 22 095 francs CFA (USD 44.19) à l'hectare. Ce montant représente environ 3,8 % du revenu total du paysan à l'hectare par an. Cependant, les paysans sont tous mécontents des dégâts "très apparents" causés par les éléphants et sont surtout effrayés par leur présence (empreintes) à proximité des campements.

Il faut noter qu'aucune perte en vie humaine provoquée par les éléphants n'a été enregistrée autour de la Forêt classée du Haut-Sassandra et que les dégâts concernaient uniquement les cultures.

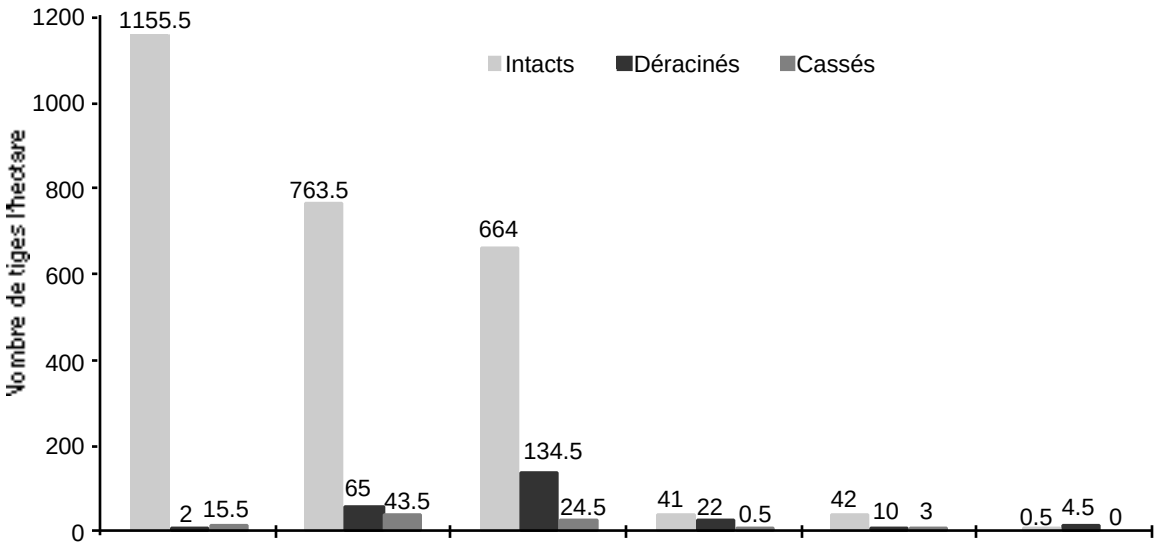

Figure 4. Estimation (en nombre de pieds à l'hectare) des dégâts causés par les éléphants dans les plantations riveraines de la Forêt classée du Haut-Sassandra en mars 1995.

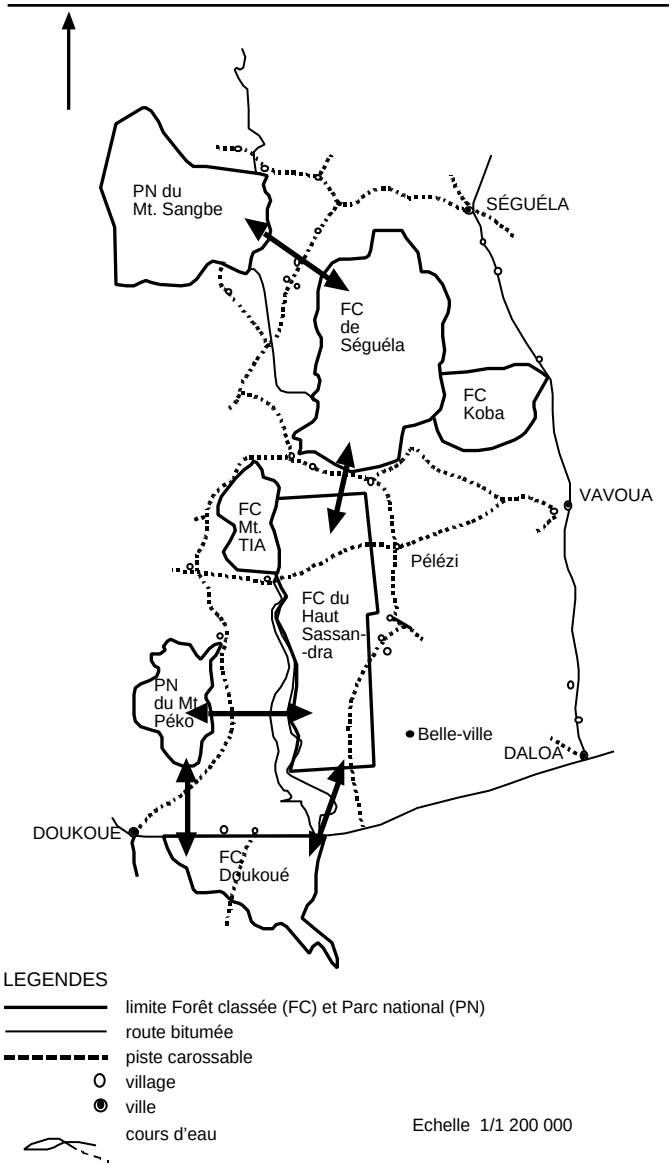

Figure 5. Proposition de couloirs de migration des éléphants autour de la Forêt classée du Haut-Sassandra ; les flèches correspondent aux propositions des couloirs de migrations.

Discussions

Les conflits entre paysans vivant autour de la forêt et animaux résultent principalement de dégâts causés par ces derniers aux cultures. En effet, pendant la saison sèche (de décembre à février), les éléphants visitent régulièrement les plantations agricoles intérieures et proches de la Forêt classée du Haut-Sassandra. Selon Soulemane (2000), plusieurs facteurs favorisent la migration des éléphants dans le domaine rural en cette saison dont le manque d'eau à l'intérieur de la forêt, l'intensification de la pression humaine (braconnage, feux de brousse et coupes de bois) et la modification de la situation nutritionnelle en forêt.

En effet, pendant cette période, les éléphants ont tendance à éviter le fleuve Sassandra et le centre de la forêt à cause du braconnage. Ils se concentrent au Nord-Est de la forêt où ils sont attirés par une forte densité de fruits dont ils sont friands. La recherche de nourriture pour compléter leurs besoins alimentaires dont les fruits ne peuvent satisfaire à eux seuls, les conduit dans les cultures qui sont à la périphérie de la forêt.

Les dommages causés aux cultures par les éléphants ne sont, en général, pas importants ; ils constituent moins de 5 % du revenu du paysan à l'hectare. Ils sont inférieurs à ceux causés aux cultures par les oiseaux et autres mammifères (Dudley et al. 1992) et à ceux causés par les insectes et les maladies aux plantations de cacaoyers (Martin 1982). La nature très visible des dégâts et la peur engendrée par la présence des éléphants aux abords des plantations et à proximité des campements inquiètent très souvent les paysans. Certains paysans profiteraient de cette situation pour conspirer des abattages d'éléphants. Ainsi, surestiment-ils ou dramatisent-ils souvent les dégâts pour obtenir des permis d'abattage d'éléphants. Comme exemple, certains paysans arguent dans leurs plantes que les éléphants ont consommés toute leur production d'igname, ce qui est très désastreux et effroyable pour l'autorité administrative et politique qu'ils gagnent ainsi facilement à leur cause. Lorsque l'équipe d'inventaire se rend dans les dites plantations pour faire le constat des dégâts, ces paysans ont des problèmes pour leur montrer les plantations d'ignames en question. Ces plantations sont en fait inexistantes car ce sont très souvent (fig. 3 et tableau 2) cinq plantes d'igname dispersées sur un hectare.

En général, les dégâts causés par les éléphants de forêt aux cultures ne sont toujours pas aussi désastreux que cela est très souvent rapporté. Theuerkauf (1995) pense qu'il n'y a pratiquement pas de problèmes avec

les éléphants de forêt qui quittent la Forêt classée de la Bossématié car il estime que les dommages gardent des dimensions très réduites. Opoku (1988) estime à seulement 1.200.000 "cedis" soit 400 000 F CFA ou 2000 dollars US, les pertes causées par les éléphants aux cultures de cacao, banane, taro, igname, manioc et maïs de 30 plantations à la frontière du Parc National de Bia au Ghana. Ces dommages ne touchant que 7 % de la production de maïs, 28 % de banane plantin et pratiquement pas les pieds de cacaoyers ont pourtant occasionné l'abattage de 20 éléphants par des agents officiels.

La dépouille d'éléphant découverte en forêt témoigne de l'existence encore de braconnage d'éléphant dans cette forêt. Sous l'effet de la colère engendrée par le constat des dégâts provoqués par les éléphants dans leurs plantations, certains paysans s'aventurent encore en forêt à la recherche des "coupables". Cette tache est dévolue aux agents des Eaux et Forêts doivent donc exécuter eux-mêmes l'abattage des éléphants à problèmes et demander aux autres autorités compétentes d'arrêter de délivrer des permis d'abattage aux paysans.

Conclusion et recommandations

Les faits que les paysans s'investissent très peu dans la protection de leurs cultures et que les éléphants ont encore peur de rencontrer les paysans sont, indubitablement, le signe d'une certaine tolérance. Mais, vu l'augmentation du nombre de paysans mécontents et la pénétration de quelques-uns d'entre eux dans la forêt classée pour abattre les éléphants, certaines dispositions sont à prendre pour éviter l'aggravation de ces conflits. Ainsi, nous recommandons :

- la sensibilisation des gestionnaires des aires protégées, et des autorités politiques et administratives à la conservation de la nature ;
- la création de points d'eau permanents en forêt par la construction de digues ;
- le suivi de l'évolution de la population d'éléphants et du braconnage ;
- l'assistance et la formation des paysans à d'efficaces techniques d'éloignement des éléphants des plantations ;
- la réalisation d'études plus détaillées autour et à l'intérieur de la forêt pour mieux cerner les problèmes (caractéristiques des troupeaux nuisibles, recensement de toutes les victimes et de toutes les plantations autour de la forêt, etc.) et adopter des solutions plus pratiques pour éviter l'extension et la complication des conflits ;
- la récolte des cultures dès leur maturation ;
- le déplacement des paysans qui sont à l'intérieur de la forêt classée ;
- l'interdiction de l'établissement de permis d'abattage d'éléphants ou d'autres grands mammifères ; l'abattage de ces animaux doit être mené par des agents des Eaux et Forêts ;
- l'aménagement de couloirs de migration d'une part entre la Forêt classée du Haut-Sassandra et les forêts voisines (Forêt classée de Séguéla, Forêt classée du Mont Tia, Forêt classée de Duékoué et le Parc national du Mont Péko) et d'autre part, entre ces forêts voisines elles-mêmes (figure 5).

Remerciement

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Miscounted population of the southern white rhinoceros (in the early 19th century?

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Abstract

In 1900 the total number of white rhinos in the world was thought not to exceed 20 animals, which were living in a remote corner of Zululand, South Africa. While this fact is often repeated, there are discrepancies in the reports concerning the date and the total number. The historical evidence is placed in a context of game slaughter to eradicate the tsetse fly menace and efforts of a small conservation-minded community to safeguard the wilderness. There are no records before 1894, and between 1899 and 1927 the status of the white rhino was determined from hearsay only, with reported numbers remaining stable between 4 and 50 specimens. Indications are that actually in no one period did a great decrease in the population occur. Numbers reported were kept low for political reasons, and there are reasons to suggest that there must have been up to 200 white rhinos in Zululand throughout this period.

Résumé

En 1900, on pensait que le nombre total de rhinos blancs dans le monde n'excédait pas 20 animaux, qui vivaient dans un coin perdu du Zululand, en Afrique du Sud. Alors que cette affirmation est souvent reprise, il existe des divergences dans les rapports au sujet des dates et du nombre total. Les preuves historiques sont à situer dans un contexte d'abattage de gibier destiné à éradiquer la menace posée par la mouche tsé-tsé tandis qu'une petite communauté soucieuse de conservation s'efforçait de sauvegarder la vie sauvage. Il n'existe aucun rapport antérieur à 1894 et, entre 1899 et 1927, le statut du rhino blanc se basait uniquement sur des ouï-dire, les nombres restant stables, entre 4 et 50 spécimens. On dispose d'indications selon lesquelles, à aucun moment, il n'y a eu de forte diminution de la population. Les nombres rapportés ont été maintenus bas pour des raisons politiques et l'on a des raisons de penser qu'il y a eu jusqu'à 200 rhinos blancs au Zululand à cette période-là.

Introduction

The southern white rhinoceros, *Ceratotherium simum simum* (Burchell, 1817), which once ranged over large tracts of southern Africa, was almost exterminated at the beginning of the 20th century. At its lowest point, scarcely 20 animals were reported living in one small population in Zululand, South Africa. The population recovered and is now the most numerous rhinoceros taxon. This account is familiar, as it is found throughout rhino literature, both popular and scientific. However, on careful analysis, we discover variations on this theme. The year in which the minimum was reached is stated to be 1895 . . . or 1900 or 1910 or 1920. The number of remaining animals was maybe a handful . . . or 20 or 50 or 100. These inconsistencies have been noted earlier, for instance by Foster (1960), Player and Feely (1960), and Skinner and Smithers (1990). Here I provide historical background to determine if the evidence placed in the context of its times allows an improved understanding of this discrepancy.

Extinction of the white rhino

At the end of the 19th century, the educated public in Europe and America became increasingly aware of

the dwindling numbers of game animals in Africa, once thought to be abundant and inexhaustible. This impression was gained from the popular and well-informed writings of Frederick C. Selous (1851–1917), who first arrived in South Africa in 1871. He followed the example of contemporary hunters and adventurers in travelling from the coast directly to the regions between the Limpopo and Zambezi Rivers. In *A Hunter's Wanderings in Africa* (1881a), he expressed his growing concern about the reduction in the number of white rhinos. He illustrated his apprehension by quoting his own experiences on the River Chobe: in 1874 the white rhinoceros was a common sight; in 1877 only tracks could be found and in 1879 even those had disappeared. The conclusion was inevitable: 'it must be almost extinct in that portion of the country' (Selous 1881b). While he still hunted the species in Zimbabwe in 1882, Selous repeated his misgivings in his *Travel and Adventure in South-East Africa* of 1893, convinced that the white rhino was 'upon the verge of extinction' (Selous 1893: 58). According to him, 'some few white rhinoceroses no doubt still survive, but it is not too much to say that long before the close of the century the white rhinoceros will have vanished from the face of the earth' (Selous 1893: 158). These sentiments were generally echoed in the works of his contemporaries, and soon most people were convinced that the white rhinoceros was no more, or would be extinct very soon.

New discoveries

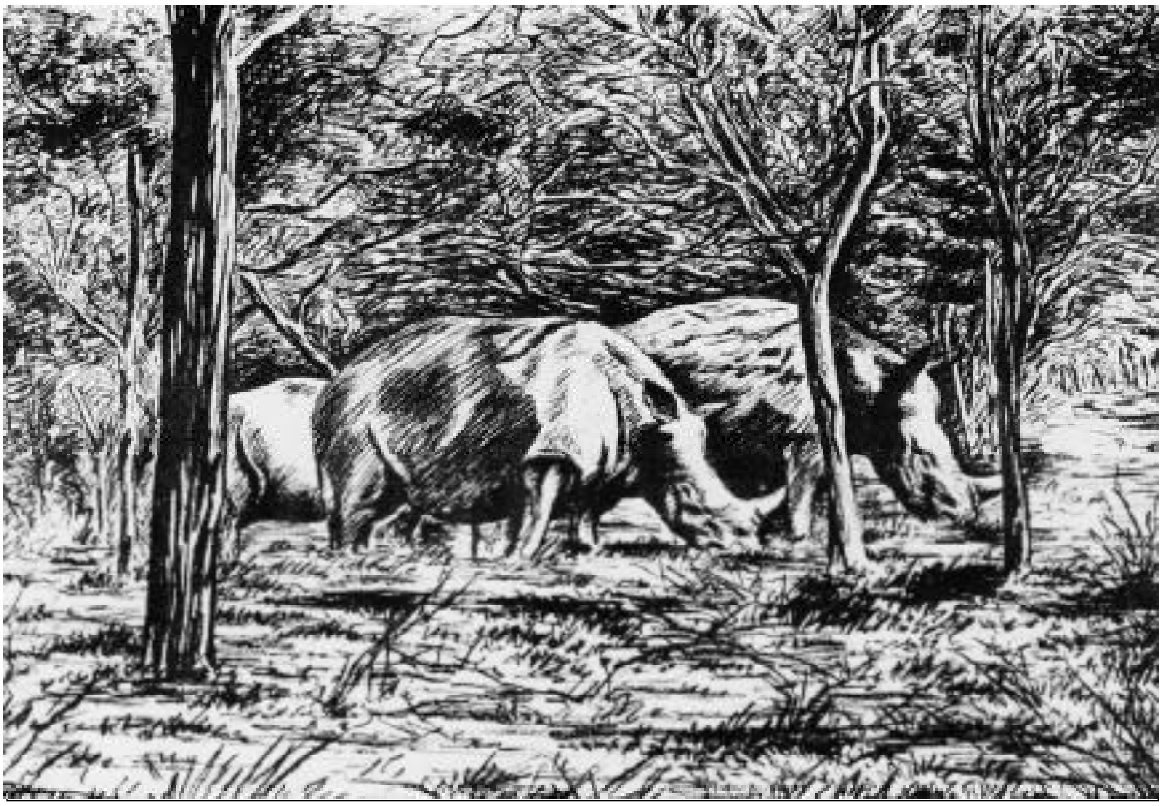
Although there were no known procedures to reduce the risk of imminent extinction, new discoveries diminished the pressure to act. In 1900, Major Alfred St Hill Gibbons returned to England with the skull of a rhinoceros killed in the Lado Enclave of Sudan, finally confirming the occurrence of the white rhino in central Africa. In 1911, Colonel Theodore Roosevelt mounted a major expedition to Rhino Camp in Uganda to secure specimens for the National Museum in Washington, DC, showing that the white rhino was locally abundant (Heller 1913). An earlier discovery was contained in news from South Africa that in 1894 a shooting party organized by C. R. Varndell had killed six white rhinos at the junction of the Black and the White Umfolozi Rivers in Zululand (Player 1972: 33). This was a surprise, because until that time nobody really suspected the existence of a population of white rhinos on the south-east coast of South Africa. That fact was hardly known and certainly not publicized. There were two reasons why these animals had remained undetected for a long time. In the first place, hunters or zoologists rarely visited Zululand during the 19th century. Only Adulphe Delegorgue (1814–1850) had secured a specimen of the white rhino near the Umfolozi River in 1842; that specimen was later donated to the Natural History Museum in Paris. Maybe the Zulus, perceived to be an aggressive tribe, deterred casual visitors from coming to the region. Second, the land was infested by tsetse flies, causing farmers who came early to settle in the neighbourhood of Durban to opt for less dangerous areas.

Preservation of the rhinoceros

When it became known that six rare white rhinos had been shot in Zululand in 1894, local conservationists successfully petitioned the government for their protection, and on 30 April 1895 the Umfolozi Junction Reserve was proclaimed. The area was undeveloped, unexplored, remote, uninhabited because of the prevalence of tsetse, and the game had remained undisturbed. This situation continued for quite awhile and was unchanged when Frederick Vaughan Kirby was appointed the first game conservator of Zululand in 1911 (he retired in 1928). In the years following this, however, Zululand became the focus of intense political campaigning, because farmers and settlers wanting to move into the area called for action to eradicate the tsetse fly (Pringle 1970). The government yielded to pressure from the strong farming community and ordered the extermination of all game. This decision resulted in an unimaginable slaughter of wildlife, impossible to comprehend or visualize today. In August 1917, Operation Game Extermination lifted all existing restrictions, allowing all animals except rhinos, hippos and nyala to be shot. No wonder the small community of conservation-minded zoologists in Durban started to lobby for the protection of wildlife. The white rhino, already extinct elsewhere, of great rarity and intrinsic value was certainly their most important weapon. In 1912, the white rhino was included in Schedule C (Royal Game), which meant that they could be captured or killed only under permit from the administrator. When the Umfolozi Reserve was deproclaimed in August 1920, as a result of demands by local farmers, the white rhino remained protected as Royal Game. The reserve was re-established in 1930.

Table 1. Estimates of numbers of white rhinos in South Africa, 1899–1938

Date	Region	Numbers	Reference
1899	Zululand	4	Renshaw 1904
1900	Zululand	a few	W.L. Sclater 1900, vol.1: 302
1901	Zululand	a few	Selous 1901: 185
1902	Zululand	2 escaped and were killed in December	C.R. Saunders in Newton 1903; Renshaw 1904
1903	Umfolozi	about 15	Magistrate of Mahlabatini, in Vincent and Geddes Page 1983: 78
1903	Zululand	traces abundant in reserve, animal not seen during short visit; total about 10	C.R. Saunders, in Newton 1903
1909	Zululand	12, including 2–3 calves	Selous 1914: 15
1911	Zululand	a few	Schouteden 1911
1912	Zululand	some 15	Stevenson-Hamilton 1912: 67
1913	Zululand	some 10	Heller 1913: 36
1916	Zululand	between 30 and 40 adult animals resident in the reserve, as well as a useful number of calves	Kirby in Pringle 1970: 124
1917	Umfolozi GR	about 30–40 plus a useful number of calves	Kirby 1917
1917	Zululand	about 12	Millais 1919: 154
1920	Now very scarce, found only in Zululand (where even there it is uncommon and where a special reserve exists for its preservation), and in parts of Rhodesia		Haagner 1920: 125
1920	Zululand	about 20 in the game reserves	Fitzsimons 1920: 207
1920	Zululand	about 20	Kirby 1920a
1920	Zululand	4 shot by Henry A. Snow, out of a population of 28	Hornaday 1924: 12; Kirby 1920b: 11
1920	Zululand	it can be assumed that there were between 150 and 200	Vincent and Geddes Page 1983: 79
1921	Zululand	extinct in the wild, a few semi-wild under government protection	Dollman 1921
1923	Umfolozi	a few	Lang 1923: 156, caption for fig. 1
1923	Umfolozi	certainly not more than 16, and probably not more than 12 in the reserve; two were shot by a young man	J. Stevenson-Hamilton, letter of 12 Oct 1923, published in Hornaday 1924; cf. Lang 1924: 174
1926	South Africa	20	Hobley 1926
1928	Umfolozi	28	Kirby, report of game conservator, in Pringle 1970: 135
1929	Zululand	official count 120, maybe 150	H. Lang in Shortridge 1934: 426
1930	Zululand	about 50	Ernest Warren in Shortridge 1934: 426
1930	Umfolozi	count: 120 in the reserve plus 30 on adjacent ground	Skinner and Smithers 1990: 567
1932	Umfolozi	220 counted	Kluge 1950
1934	Umfolozi GR	134 in the reserve and 72 outside	Capt. H.B. Potter in Vincent and Geddes Page 1983: 79
1936	Umfolozi GR	226 excluding calves	Kluge 1950
1938	Umfolozi GR	estimated at 300	Capt. H.B. Potter in Vincent and Geddes Page 1983: 79



White rhinoceros in South Africa. Undated drawing by Charles Bammy preserved in the South African Library, Cape Town.

Status of the white rhinoceros in Zululand

Before 1899, the number of rhinos living between the Black and the White Umfolozi Rivers was unknown. The estimates of the numbers published between 1899 and 1938 are listed in table 1. Two general observations are apparent. First, most figures were provided by people (like Selous), who never had an opportunity to obtain first-hand evidence in Zululand. Second, the numbers remained relatively stable during the entire period from 1899 to 1929, ranging from 4 to 50. Visits to the Umfolozi Reserve were rare, even by the authorities in charge; indeed for many years it was closed to the public entirely.

C.R. Saunders, the chief magistrate and civil commissioner of Zululand, went there in 1902 and while he saw many tracks, he failed to see a rhino. He estimated their number at about 10. Kirby went to Umfolozi during his official tours as game conservator of Zululand. In a paper published in 1917, he recognized that it was very difficult to compute the number of rhinos present inside or outside the reserve. He guessed that there would be 30 to 40 adults. As he excluded the unknown number of calves and all animals outside the reserve's boundary, his estimate could mean that there were almost certainly over 50 white rhinos alive in that part of Zululand. In 1922, Kirby gave a revised number of 20 white rhinos, and it is this latter figure that has been regularly quoted in the more recent literature on the subject (Vincent and Geddes Page 1983: 79). An unexpected response to Kirby's estimate was given by Maqubu Mtombela, who was employed as a game guard in Umfolozi from 1918. When Maqubu was interviewed in the late 1950s, he laughed about the number of rhinos and said that Kirby was hiding them: 'Maqubu maintained that there were far more white rhino in Umfolozi then than there are at present. The big decline in numbers came in the drought of 1932' (Foster 1960: 24).

Wildlife authorities in the USA, when approached by members of nature conservation bodies in Natal in the 1920s, were greatly concerned about the continued existence of the rhinoceros in Zululand

(Hornaday1924). In 1927, Dr Herbert Lang, associate curator of mammals of the American Museum of Natural History in New York, came to South Africa and spoke on behalf of the conservation movement, hoping to stem the tide of the anti-tsetse campaign (Pringle 1970: 127). The official war against wildlife continued unabated with an inconceivable effort. Between May 1929 and November 1930, for instance, 26,162 wild animals were killed in the buffer zone around Umfolozi and 377 inside the reserve (Pringle 1970: 132). Although possibly the rhino was officially spared, one wonders if a few were not accidentally included in the slaughter.

In 1928, Kirby stated that 28 rhinos existed, but a ranger called Wehrner counted 150. Herbert Lang knew that it was important to understand the actual numbers in the Umfolozi Reserve. At the end of the 1920s, he attempted an actual count and walked through the entire reserve, from dawn until night, and concluded that the only positive way to conduct a census was by individual identification of each animal (Pringle 1970: 135). Requested by the Game Advisory Committee, Lang spent another three weeks in the reserve in November 1929 and reported 100 animals inside and 38 outside the reserve. R.H.T.P. Harris, who was in charge of tsetse fly research, in 1929 estimated the number to be 120 (Foster 1960). The estimates for the period between 1925 and 1930, therefore, ranged from 28 to 150 white rhinos in Umfolozi, with an unknown number outside the reserve.

A success story

We can now put the various pieces of evidence into perspective. The first question to answer is to what number was the southern white rhino reduced. The figures in tables 1 and 2 show that the estimates of between 4 and 50 animals were unrealistic. Even if this figure were applied to the Umfolozi Reserve alone, it does not take into account the remnant populations in other regions. It is also evident that none of the so-called estimates were based on actual counts or even on first-hand information. While Kirby (1917) estimated 30–40 adult animals, he said nothing about

Table 2. Estimates of numbers of white rhinoceros in Botswana, Mozambique, Zambia and Zimbabwe, 1896–1931

Date	Region	Estimate	Reference
1896	Matamiri bush, south bank of Sabi River	'has been favourite resort, but they have become almost extinct now even there. In 1895, I came upon a cow and big calf, but they are decidedly rare.'	Kirby 1896: 9
1899	Botswana, Lake Ngami	7, of which 3 left in 1904	Dr Gunning (Pretoria) in Renshaw 1904
1901	N. Mashonaland	a few still exist	Selous 1901: 185
1903	Botswana, Lake Ngami	4	Sidney 1965: 59
1909	Mashonaland	'a few may still linger in the neighbourhood of the Angwa River in northern Mashonaland'	Selous 1914: 15
1909	Mashonaland	not more than a dozen wild specimens, in one corner of north-eastern Mashonaland and in Umfolozi	Bryden 1909: 60
1912	Zimbabwe	'I heard, quite lately, that one or two had been seen in southern Rhodesia'	Stevenson-Hamilton 1912: 67
1920	Zimbabwe	'I understand it is now entirely extinct in Rhodesia'	Kirby 1920a: 224
1920	Zimbabwe	one or two in remoter parts	Fitzsimons 1920: 207
1923	Zambia, Tara	'there are quite a few at present living not far from here, just how many it is impossible to say'	Hubbard 1923: 229 [unlikely, says Lang 1924: 175]
1931	Zimbabwe	7 still exist on the Portuguese–Nuenetsi border	J.F. Fleming, 12 Jan 1931, in Shortridge 1934: 426

the number of calves (possibly five?), nor about the unknown number of rhinos living outside the reserve. Other sources are equally vague. The numbers were kept low for political reasons, rather than to reflect the true status. This was neatly summarized by Skinner and Smithers (1990: 567): 'By the end of the 19th century the southern white rhinoceros was reduced to only one population of about 50 to 100 in the southern part of the area which now forms the Hluhluwe–Umfolozi Game Reserve in Natal. It appears the population estimate of 20 for this time was a deliberate under-estimate to convince politicians of the urgency of the situation.'

The year in which the population reached its minimum size is inconclusive from the literature. There are no records before 1894. From that time until about 1927, most authors, lacking first-hand observations, quoted very low numbers, up to a maximum of 40 white rhinos in southern Africa. Then suddenly in 1929, there were at least 150. This in itself is quite impossible as there must have been some change, positive or negative, during the period. In the absence of data, we may never know the truth.

It is my supposition, based on this historical evidence, that there is no reason to believe that there were ever less than 200 white rhinos in Zululand before 1929, initially perhaps augmented by another 50 elsewhere in Botswana, Mozambique, South Africa and Zimbabwe. The subspecies was exterminated in all areas outside Zululand during the first three decades of the 20th century.

I would say that the number of white rhinos never was as few as suggested in much of the literature. However, this historical analysis does show how effective conservation can be. There are now over 9000 white rhinos of the southern subspecies in the world—in national parks and on private land in South Africa, in other African countries, and in zoos and circuses around the world (Emslie and Brooks 1999). These numbers have come about because of stringent protection, law enforcement, personal devotion and far-sighted management on the part of the staff and authorities in South Africa. A similar effort is now necessary to save the northern white rhinoceros, *Ceratotherium simum cottoni* (Lydekker 1908), from extinction.

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Ed. note: The author has published a similar paper, 'The alleged population reduction of the Southern White Rhinoceros *(Ceratotherium simum simum)* and the successful recovery' in 2001 in *Saugetierkundliche Mitteilungen* 45(2):55–70. We are publishing this version to bring the paper to a wider readership.

Elephant diet at the edge of the Fynbos Biome, South Africa

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Abstract

Qualitative observations of the diet of the African elephant near Knysna over the decade 1990–2000 made by forest guards Wilfred Oraai and Karel Maswati are presented and discussed. The elephants studied were the last three native elephants and two introduced juveniles. This is the first evidence that elephants routinely eat the nutrient-poor, heathy shrubs and wiry grasslike plants of fynbos. The introduced juveniles generally ignored the relatively nutrient-rich, soft shrubs and herbaceous plants, including legumes and tuberous monocotyledonous plants regenerating after fire. Fynbos appears to be a far more attractive food resource than were the saplings of the tallest species of forest trees. *Pterocelastrus tricuspidatus* (Celastraceae) and species of *Acacia* introduced from Australia were among the most palatable trees to elephants near Knysna. Even the introduced juveniles routinely broke far more trees of *Acacia* spp. than they could eat. Seeds of these species seldom germinated from their faeces, suggesting that elephants may be useful in controlling invasive exotic trees in the south-western Cape. Barring of the original routes to the coast may have left the Knysna elephants deficient in iodine and selenium, explaining their slow reproduction and avoidance of plants potentially aggravating deficiency of these elements. This study provides encouragement for renewed attempts to conserve the African elephant in the Fynbos Biome.

Résumé

Ici sont présentées et discutées les observations qualitatives du régime alimentaire des éléphants de la région de Knysna, qui ont été faites par les gardes forestiers Wilfred Oraai et Karel Maswati entre 1990 et 2000. Les éléphants étudiés étaient les trois natifs derniers de l'endroit et deux juvéniles qui ont été introduits. C'est la première preuve du fait que les éléphants mangent habituellement les arbustes rabougris et les plantes herbeuses drues pauvres en nutriments du fynbos. Les juvéniles introduits ignorent généralement les arbustes plus tendres et les plantes herbeuses relativement riches en nutriments, y compris les légumineuses et les monocotylédones tubéreuses qui repoussent après les feux. Le fynbos semble être une ressource alimentaire bien plus appréciée que ne le sont les repousses des plus grandes espèces d'arbres. *Pterocelastrus tricuspidatus* (Celastraceae) et les espèces d'*Acacia* introduites d'Australie comptent parmi les espèces les plus appréciées des éléphants de la région de Knysna. Les juvéniles introduits cassent même régulièrement plus de troncs d'*Acacia* spp. qu'ils n'en pourraient manger. Les semences de ces espèces germent rarement à partir de leurs excréments, ce qui suggère que les éléphants peuvent être utiles pour le contrôle des arbres exotiques envahissants dans le sud-ouest de la province du Cap. La fermeture des voies d'accès originales vers la côte pourraient avoir entraîné chez les éléphants de Knysna une déficience en iode et en sélénium, ce qui expliquerait la lenteur de leur reproduction et leur aversion pour des plantes qui pourraient éventuellement aggraver leur déficience dans ces éléments. Cette étude constitue un encouragement pour de nouvelles tentatives destinées à maintenir l'éléphant d'Afrique dans le biome du Fynbos.

Introduction

The most southerly survivors of the African elephant (*Loxodonta africana* Blumenbach) today occur inland of Knysna, a town on the south coast of South Africa. An attempt was made in July 1994 to increase the relict population by introducing three orphaned female juveniles from Kruger National Park. One died soon after release, and although the two surviving

juveniles were healthy and grew normally, they were removed in July 1999 (Withers 2001).

The nutrition of the African elephant in the Fynbos Biome of the south-western Cape (from Cape Town to Port Elizabeth) is of interest, in view of the nutrient-poor local soils. The Knysna elephants have reproduced too slowly to maintain their population, despite excellent body condition and a lack of competing species of large herbivores (Carter 1971; Koen 1984; Seydack et al. 2000; Milewski 2002). Fynbos is a complex of shrubby, evergreen, nutrient-poor vegetation. It varies from tall thickets through heathlands to low, open vegetation dominated by wiry grasslike plants, according to soil moisture and depth, and stage of regeneration after fire. Knysna is marginal to the Fynbos Biome, because fynbos is here interrupted by the largest area of indigenous evergreen afromontane forest (hereafter referred to as forest) in South Africa.

The diet of native and introduced individuals of the African elephant was documented from opportunistic observations made by forest guards Wilfred Oraai and Karel Maswati near Knysna from 1990 to 2000. Several lines of investigation suggest that attempts should be renewed to conserve the African elephant in the Fynbos Biome.

History of the population

The African elephant was common near Knysna during the 19th century and was hunted for ivory until approximately 1900 (Seydack et al. 2000). The population declined to approximately 20 animals in 1908, to 10 in 1970, and 3 in 1983. For half a century (1920–1970), the Knysna elephants failed to increase despite minimal losses to hunting and the continual presence of sexually mature females (Seydack et al. 2000). During the present study (1990–2000), only one individual (a female now more than 50 years old, and probably post-reproductive) was thought to remain. Subsequently, it was realized that the population still comprises three sexually mature individuals (Withers 2001). Since I cannot be sure which of the three native individuals was trailed and occasionally glimpsed during fieldwork, I refer to these collectively as the last native elephants.

The African elephant has survived in the south-western Cape long after the extermination of the two largest species of African bovids, the African buffalo (*Syncerus caffer*) and the eland (*Tragelaphus oryx*) (Phillips 1925; Skead 1980). The last native elephants have been extremely secretive, confining themselves largely to forest and fynbos on government land.

The introduced juveniles were 5 to 12 years old during the study period, attaining 90% of mature female shoulder height by the time they were removed, in good condition. Authorities decided to capture them because they remained outside government land, out of contact with the last native elephants. The introduced juveniles are now sexually mature females residing in Shamwari Game Reserve, east of Port Elizabeth (Withers 2001).

Study area

The study area of 250 km^2 extends approximately 25 km from west to east, north-east of Knysna, and consists partly of natural vegetation straddling the poorly defined edge of the Fynbos Biome (fig. 1). The home ranges of the last native elephants are cut off from

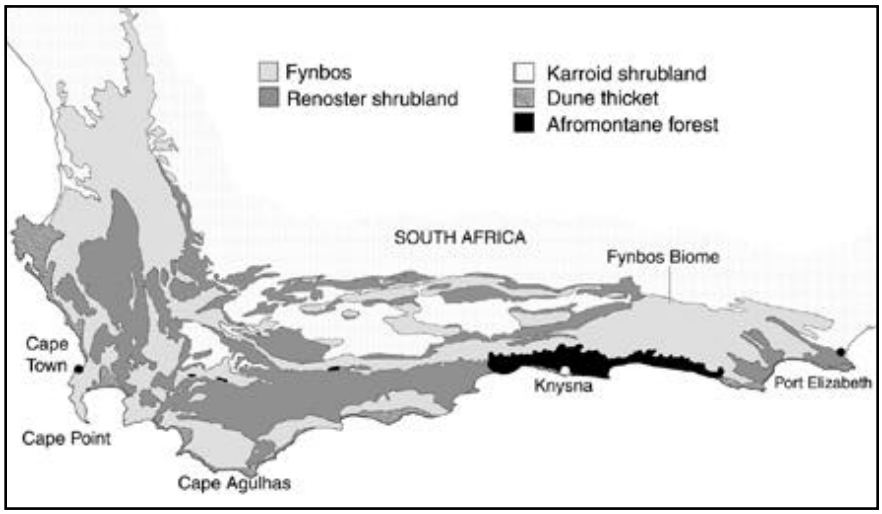

Figure 1. The Fynbos Biome showing various shrubby vegetation types within this biome and the strip of afromontane forest that forms an enclave between fynbos and the coast near Knysna (map adapted from that kindly supplied by Thomas Köhler, Redhouse).

the coast by cleared and built-up areas, a national highway and sea cliffs approximately 100 m high in the Harkerville area (Carter 1971). The south-west of the study area is a nutrient-poor coastal plain, with forest and tall, dense fynbos similar to the thickets of *Erica* and other shrubs characteristic of mountains in East Africa. The north-east of the study area includes foothills of the east–west sandstone range of the Outeniqua Mountains, covered with low fynbos, rich in plant species. Dry, north-facing slopes of the Keurbooms River gorge have grassy vegetation with aloes, repeatedly crossed by the introduced juveniles in 1998–1999. Forest is mainly on government land, whereas fynbos is most extensive on private land, some of which serves as rough pasture for cattle.

Forest and fynbos differ greatly in vegetation height, floristic composition, and fire regime. Forest is essentially free of fire, whereas most plants of fynbos depend on fire for regeneration. The genus *Acacia*, although native to the south-western Cape, is represented near Knysna only by several species introduced from Australia. One of these, *A. melanoxylon*, has valuable timber but is not confined to plantations.

Methods

Information accumulated by observant game guards has value, even if it is not collected systematically. Unless recorded by scientists, such data are likely to be lost when personnel retire.

The information used in this study was gathered by W. Oraai and K. Maswati, employed by the South African Department of Water Affairs and Forestry (DWAF), and based in the Diepwalle forest block. Over the study decade, these two forest guards routinely spent several days at a time locating and following both the last native elephants and the introduced juveniles as part of their official duties in monitoring the Knysna elephants. W. Oraai spent most of his working time following the introduced juveniles over five years (1994–1999). The last native elephants remained shy despite repeated attempts to approach them. Therefore, their diet could be assessed only indirectly from damage to vegetation, disturbance of earth and contents of fresh faeces. The introduced juveniles became habituated to the point of allowing the two guards to approach within 50 m. This permitted direct observations of the diet of these fast-growing elephants as they approached sexual maturity.

My role was to record and interpret the observations after the fieldwork was complete. The guards shared their knowledge in three interviews in the Afrikaans language at Diepwalle Forest Station in July and September 2000. I first interviewed both guards together for seven hours and then interviewed W. Oraai alone 45 days later for three hours. Several published field guides to trees and shrubs and a compendium of colour photographs of most of the herbaceous plants of forest and forest edge in the study area (Baard 1994) were used to identify plant species. The guards supplied information from memory, since they had not made written notes. No quantitative data emerged from this study. However, I checked the consistency of replies by repeating many questions during the second interview. Less than 3% of all replies were inconsistent. During the first interview, I was told that *Chasmanthe*, *Clutia*, *Gymnosporia*, and *Solanum* were not eaten, whereas during the second interview I was told that these taxa were eaten. The third interview took the form of a one-day visit (17 Sept. 2000) by four-wheel-drive vehicle to foraging sites of the introduced juveniles in fynbos and farmland. This was led by W. Oraai, at a time when most species of herbaceous plants were apparent in the spring of 2000. Results (including all tables) refer collectively to the introduced juveniles and last native elephants, except where stated otherwise. Although several differences between the diets of the introduced juveniles and the last native elephants emerged in the course of the interviews, it will require further interviews to resolve these differences for the whole list of plant taxa eaten.

In addition, seven juvenile elephants are now kept in a large enclosure of fynbos and forest at the Knysna Elephant Park, outside the study area. Accompanied by W. Oraai, I noted the dietary preferences of the three elephants present at the time, in September 2000. The proprietors, I. and L. Withers, conducted my visit. Since the three elephants are not free living and are artificially provided with much of their food, they are excluded from the Results but are discussed where appropriate.

Results

The last native elephants remained in the south-west of the study area. During the study decade (1990–2000), they appear to have spent approximately 80% of their time in forest, 19% in low-altitude fynbos, and 1% in

plantations of exotic but non-invasive tree species.

The introduced juveniles initially spent less than two months with the last native elephants, mainly in forest (Seydack et al. 2000). They then left the home range of the Knysna elephants and spent years in fynbos in the north-east of the study area, wandering on the foothills of the Outeniqua Mountains. The introduced juveniles and last native elephants alike were attracted to fynbos, which was regenerating freshly less than six months after the few and localized fires recorded during the study period. However, the juveniles spent most of their time in mature fynbos with varied densities of Australian species of *Acacia* and *Hakea,* which are invasive exotics over much of the south-western Cape. They appeared to be most strongly attracted to fynbos in winter.

During the five years of their stay (1994–1999), the introduced juveniles spent more than 80% of their time in fynbos and rough pasture, 10% in patches of forest, 5% in well-grown plantations, and less than 5% near croplands, where they occasionally raided pumpkins, cabbages, tomatoes and oats. Attempts were made in 1999 to attract the introduced juveniles to a capture site with bales of lucerne, molasses and oranges. These foods were accepted but did not prove attractive enough. The capture was thus delayed and was eventually made in fynbos elsewhere (Withers 2001).

Forest plants eaten

Only 11 of more than 35 species of forest trees and shrubs available in their home range were eaten by the last native elephants (tables 1–4). The introduced juveniles apparently ate mainly bark (possibly for the cambium and phloem layers) when in forest. *Pterocelastrus tricuspidatus* (Celastraceae) was the indigenous tree species most conspicuously damaged by the introduced juveniles and the last native elephants alike, and its intact seeds were found in elephant faeces (table 1). Mistletoe from several species of trees was eaten, often by breaking the host branch and sometimes by breaking the entire host plant.

Fynbos plants eaten

Most of the common genera of shrubs and grasslike plants of fynbos, particularly *Erica*, were routinely eaten (table 2). *Leucadendron* was the only indigenous member of the Proteaceae observed to be eaten. The elephants pulled out the mature tussocks of wiry, grasslike plants, particularly *Bobartia*, and ate the pale stem bases, discarding the green parts. Foliage was likewise discarded when they were eating the bases, rhizomes and corms of Iridaceae. Very few of the many indigenous species of legumes were eaten, despite luxuriant growth of *Virgilia* and *Aspalathus* after fire. The introduced juveniles and last native elephants ignored most herbaceous plants common after fire, eating mainly grasses and grasslike plants (including their leaves) at this stage of regeneration.

Exotic plants eaten

The elephants occasionally damaged eucalypts and pines growing in plantations, eating mainly bark. The introduced juveniles, and to a lesser degree the last native elephants, frequently ate invasive exotic *Acacia* species (table 3), which were available in forest, fynbos and disturbed vegetation. The introduced juveniles frequently destroyed juvenile-form trees of *Acacia mearnsii* up to 8 m high, breaking the bole and leaving most of the plant to decay, although some of the bark, foliage and pods were eaten.

Earth eaten

Although the introduced juveniles and last native elephants ignored most geophytes (for example,

Table 1. Species of ripe fruits eaten by free-living elephants near Knysna, 1990–2000

INDIGENOUS (FLESHY FRUITS)	*Rhus chirindensis*, possibly *R. lucida*
Burchellia bubalina	*Solanum hermannii**
*Cassine papillosa**	INVASIVE EXOTICS (PODS)
Ilex mitis	*Acacia mearnsii* (arils in some cases still brightly coloured in faeces)
Maytenus acuminata	*Acacia melanoxylon* (arils in some cases still brightly coloured in faeces)
Pterocelastrus tricuspidatus	
*Rapanea melanophloeos**	

* species found germinating in old faeces of elephant

Haemanthus, Ornithogalum, Scadoxus, Wachendorfia), they excavated the tubers and rhizomes of herbaceous plants such as Iridaceae and bracken fern (*Pteridium*) in forest and fynbos (table 4). The introduced juveniles also excavated sites for dust bathing. However, there is no evidence that the elephants ate earth as a nutritional supplement.

Table 2. Indigenous plant species of which foliage was eaten by free-living elephants near Knysna, 1990–2000

FOREST TREES

Celtis africana
*Ilex mitis**
Kiggelaria africana
Maytenus acuminata†
Platylophus trifoliatus
*Pterocelastrus tricuspidatus**†
*Rapanea melanophloeos**
Rhus chririndensis
Sideroxylon inerme

FOREST UNDERSTOREY/EDGE SHRUBS

Brachylaena neriifolia
Burchellia bubalina
Canthium inerme
Clutia pulchella
Diospyros dichrophylla (not preferred)
Grewia occidentalis
Gymnosporia buxifolia
Hibiscus ludwigii
Rubus fruticosus
Scutia myrtina†
Trichocladus crinitus†

FOREST HERBACEOUS PLANTS

Cyathea capensis (rosette of tree-fern destroyed to obtain pith; recorded also by Carter 1971)
Secamone alpini† (pulled from *Podocarpus latifolius*, which was sometimes felled to obtain this high-climbing vine)
Viscum obscurum and *Viscum.* sp. (mistletoe) on *Virgilia* and *Cunonia* (which were damaged only to obtain mistletoe), and on *Pterocelastrus* and *Acacia melanoxylon*

FYNBOS SHRUBS

Berzelia intermedia
Brunia nodiflora
Chrysanthemoides monilifera (after fire)
Cliffortia odorata†
Cliffortia sp. or spp.
Colpoon compressum (introduced juveniles)
Cyclopia subternata
Erica hebecalyx, E. lanata, E. scabriuscula (preferred, although *E. cerinthoides* and *E. densifolia* not eaten)
Euryops virgineus (not preferred)
Gnidia denudata
Laurophyllus capensis
Leucadendron spp.
Metalasia muricata (not preferred)
Passerina falcifolia and spp.
Phylica paniculata and spp.
Rhus lucida
Struthiola sp.

FYNBOS HERBACEOUS PLANTS

Aloe ferox (introduced juveniles; stem pith eaten, by breaking whole plant and discarding leaves and flowers)
Aloe striata (introduced juveniles; leaves of this procumbent species eaten)
Blechnum spp. (fern rosette pith, after fire)
Carpobrotus spp. (introduced juveniles)
Polygonum salicifolium
Rhoicissus digitata
Solanum hermannii

GRASSLIKE PLANTS

Bobartia sp. or spp. (mainly stem-bases and rhizomes, but also flowers)
Ehrharta rehmannii (in fynbos regenerating after fire)
Juncus sp. or spp.
Panicum maximum
Stipa dregeana (grass in forest)
Tetraria involucrata (pale shoot-bases only where tussocks mature; greens where tussocks regenerating after fire)
several unidentified tussock grasses and sedges

Trees of *Podocarpus latifolius* and *Canthium mundianum* were broken without being eaten.
* species whose boles were broken and stripped of bark, which was eaten
† species recorded eaten by elephant near Knysna by Phillips (1925), who also recorded *Clematis brachiata, Sparmannia africana, Maytenus peduncularis*, and the exotic *Quercus pedunculata*

Table 3. Exotic plant species (excluding agricultural crops) eaten by free-living elephants near Knysna, 1990–2000

*Acacia melanoxylon**† (mainly in forest)
*Acacia mearnsii**† (mainly in fynbos)
Hakea sp. (foliage, in fynbos)
Eucalyptus diversicolor and spp. (bark, in plantations)
Pinus spp. (introduced juveniles; bark, in plantations)
Pennisetum clandestinum (lawn grass; *Trifolium* also recorded by Koen 1983)

Albizia lophantha and *Sesbania punicea* were not eaten
* species of which boles were broken and bark stripped and eaten, in addition to the foliage and pods being eaten
† species recorded by Phillips (1925), who also listed *Quercus pedunculata* and *Physalis* sp. as eaten by the Knysna elephants; Carter (1971) recorded *Rosa* sp. and the seeds of *Quercus* (in elephant faeces) as eaten by the Knysna elephants

Table 4. Indigenous plant species excavated by free-living elephants near Knysna, 1990–2000

TREES
Ocotea bullata (shallow roots excavated in forest)
HERBACEOUS PLANTS (LEAVES, FLOWERS AND GREEN STEMS DISCARDED; ONLY STEM-BASES, RHIZOMES OR CORMS EATEN)
Chasmanthe aethiopica (forest edge)
Dietes iridioides (forest)
Pteridium aquilinum (rhizomes, in disturbed areas; recorded also by Carter 1971)
Tritoniopsis caffra (corms, in fynbos)
Typha capensis (introduced juveniles; rhizomes)
Watsonia spp. (introduced juveniles; corms, in fynbos regenerating after fire)

The elephants sometimes ate the pale stem bases of the Iridaceae in the above list by pulling up the shoots with the trunk, without excavating corms on these occasions.

Discussion

Knowledge of the diet of the Knysna elephants in forest has accumulated for many years (Phillips 1925). However, this appears to be the first record of free-living individuals of the African elephant eating many of the common genera in fynbos, which are nutrient poor (Koen 1984; Seydack et al. 2000). As both forest and fynbos are extensive in the study area, it is noteworthy that the introduced juveniles chose fynbos as their main habitat. However, this refers to only two, largely self-educated individuals, and it remains unsure how representative their behaviour is of the Knysna elephants in their original state.

Selective foraging

The popular perception has been that the Knysna elephants eat most of the plants available in forest (Carter 1971). However, it is now clear that the elephants prefer *Pterocelastrus*, *Ilex* and *Rapanea* over many similar indigenous genera of trees, and exotic *Acacia melanoxylon* over indigenous forest species. Foliage is not eaten from the four tallest species of indigenous trees (*Podocarpus falcatus, P. latifolius, Olea capensis, Ocotea bullata*), although saplings and boles of *P. latifolius* are routinely broken, trees of *O. capensis* are sometimes pushed over, shallow roots of *O. bullata* are excavated and eaten, and fallen fruits of *P. latifolius* and *O. capensis* are infrequently eaten (Phillips 1925; Carter 1971; Von Gadow 1973; Koen 1983).

Several common species of forest edge and understorey have not been recorded in the diet. For example, the fast-growing, tall shrub *Halleria lucida* is ignored by the Knysna elephants (Von Gadow 1973). The protein-rich foliage of nitrogen-fixing indigenous plants appears to be discarded even where the associated mistletoe is eaten. For example, the only part of *Virgilia, Psoralea* and *Podalyria* definitely recorded as eaten is the seed pods (Phillips 1925; Koen 1983). Most species of vines are apparently ignored, including *Asparagus*, known elsewhere

to be eaten by kudu (*Tragelaphus strepsiceros*) and giraffe (*Giraffa camelopardalis*) (A. V. Milewski, unpublished), and Cucurbitaceae. The elephants apparently avoid plants defended by oxalate (for example, *Oxalis, Achyranthes, Rumex*), most Asteraceae, and aromatic plants (for example, *Leonotis, Plectranthus*). The only member of the Rutaceae known to be preferred by the Knysna elephants is *Zanthoxylum davyi*. The only trees with stout spines on the trunk, suggesting defence specifically against elephants, are *Z. davyi* and *Scolopia zeyheri*, both of which are uncommon in the study area (Von Gadow 1973). Spinescence is at best weakly correlated with dietary choices of elephants at the edge of the Fynbos Biome.

Pterocelastrus *as a food plant*

Pterocelastrus tricuspidatus dominates certain types of forest near Knysna (Seydack 1990) and occurs as a shrub in fynbos elsewhere in the south-western Cape, particularly on coastal dunes (Pierce 1984). The palatability of *P. tricuspidatus* is considerable, despite its content of flammable resin (Von Breitenbach 1974). The introduced juveniles ate this species mainly in the form of bark, possibly because they could not easily break the trees. Elsewhere in the south-western Cape, bovids (for example, eland, bushbuck *Tragelaphus scriptus* and common duiker *Sylvicapra grimmia*) eat fruits and foliage of *P. tricuspidatus* (A.V. Milewski, unpublished). Elephants apparently prefer *P. tricuspidatus* over other indigenous trees near Knysna, and possibly compensate for their damage by propagating this species.

The fruit of *P. tricuspidatus* is fleshy when ripe and contains 1–3 seeds, each covered by a thin but lipid-rich aril (Von Breitenbach 1974). The fruits generally retain their seeds after falling to the ground. *Cassine, Chionanthus, Ficus, Olea, P. latifolius, Rapanea, Rubus, Scutia* and *Solanum* all have succulent fruits and are disseminated by elephants and birds (Phillips 1925; Koen 1983; Rowan 1983). However, *P. tricuspidatus* differs from many other coexisting trees with fleshy fruits, because neither the bushpig (*Potamochoerus larvatus*) nor the local species of primates and fruit bat have been recorded consuming its ripe fruit (Seydack 1990; C.J. Skead, pers. comm.; C.J. Vernon, pers. comm.). Fruit production of *P. tricuspidatus* is asynchronous with that of bird-disseminated species (Pierce 1984). Although the yellow colour of the fruit suggests consumption by birds (J. Koen, pers. comm.), the only direct evidence for this appears to be an old list of fruits eaten by the Knysna loerie (*Tauraco corythaix*), which includes the genus *Pterocelastrus* (Rowan 1983). The germination of seeds recovered from faeces of the Knysna elephants should be studied, to test the hypothesis that *P. tricuspidatus* is disseminated by this large herbivore.

Diets of other herbivores

The Knysna elephants appear to provide food for, rather than compete with, the bushbuck. In forest, the bushbuck relies partly on coppice regrowth of *P. tricuspidatus, Platylophus trifoliatus, Ilex mitis* and *A. melanoxylon* (broken and eaten by elephants) and *O. bullata* (not broken or eaten by elephants) (Von Gadow 1973; Von Breitenbach 1974). Facilitation may also occur in the case of the blue duiker (*Cephalophus monticola*), which eats leaves of trees broken down to within reach by the elephants (for example, *Canthium* spp.), or shrubs unrecorded in the diets of the elephants (for example, *Carissa*) (Von Gadow 1973; H. Herd, pers. comm.). The grey rhebuck (*Pelea capreolus*) occurs in low fynbos and prefers shrubs of Asteraceae and *Aspalathus* although also eating Bruniaceae regenerating after fire (Beukes 1988; R. Knight, pers. comm.). The grysbuck (*Raphicerus melanotis*), like the grey rhebuck, may differ from the elephants in preferring Asteraceae (D. Gibbs, pers. comm.).

The African buffalo browses many species of shrubs, although it prefers grasses (De Graaff et al. 1973). The buffalo was formerly common near Knysna (Phillips 1925; Skead 1980) and may have filled the gap in foraging height and dietary preferences between the Knysna elephants and small bovids.

The eland probably did not penetrate forest but was important in open fynbos. The eland was temporarily reintroduced near Tsitsikamma, east of Knysna, but its diet was not recorded. Elsewhere in the south-western Cape, the eland eats, for example, Celastraceae, *Chrysanthemoides monilifera, Rhus, Viscum* and (sparingly) *Carpobrotus* spp. and *Sideroxylon inerme* while ignoring *Cassytha, Chironia, Cynanchum* and Urticaceae. These choices concur with those of the elephants near Knysna. However, the eland differs from the elephants in eating herbaceous Asteraceae, and the leaves and inflorescences of toxic geophytes such as *Brunsvigia* (Amaryllidaceae) (V. Deverson, pers. comm.).

The Knysna elephants facilitate the bushpig and the baboon (*Papio ursinus*) as well as competing with them (Phillips 1925). The Knysna elephants ignored oranges offered in the Harkerville area (Carter 1971) and do not compete with the bushpig for the fallen fruits of *P. falcatus* and most other species of forest trees (Seydack 1990). The elephants and the bushpig both eat ferns and grasslike plants, in fynbos as well as forest. However, the elephants appear to prefer *Bobartia*, whereas the bushpig appears to prefer the rhizomes of *Pteridium* and the fronds of other ferns (Seydack 1990). The geophytes chosen by the elephants are mainly the same cormous Iridaceae (for example, *Watsonia*) preferred by the bushpig and the baboon. Tubers of Aponogetonaceae, Araceae, Hyacinthaceae, Hypoxidaceae, Orchidaceae, Oxalidaceae, and Vitaceae are preferred by the bushpig but not the elephants (Seydack 1990; Baard 1994; I. and L. Withers, pers. comm.; A.V. Milewski, unpublished). Confirmation is required of the eating of fungi by the Knysna elephants, which is suggested by their having tilled the earth over several square metres at a time using tusks and feet (Carter 1971), and foraging for fungi by enclosed juveniles in Knysna Elephant Park (I. and L. Withers, pers. comm.). However, fungi are likely to contribute more to the diet of the bushpig than to that of the elephants (Seydack 1990). The baboon overlaps in diet with the elephants, eating the foliage of *Erica*, Proteaceae, and grasslike plants, the shoots, flowers and pods of invasive exotic *Acacia* as well as indigenous *Virgilia*, the corms and pale shoot-bases of Iridaceae, and the bark (cambium) of indigenous and exotic trees (Erasmus 1993). However, baboons excavate corms of Hypoxidaceae near Knysna, and root-tubers of ground orchids elsewhere in the Fynbos Biome (S. Privett, pers. comm.), which has not been recorded for the elephants.The bushpig and the baboon also differ from the elephants in supplementing their diets with animal matter.

Control of invasive exotics by herbivores

Large wild herbivores have a largely unexplored potential as agents for the control of invasive exotic trees and shrubs in forest and fynbos in conservation areas in the south-western Cape. The elephants apparently prefer invasive exotic *Acacia* to indigenous legumes and fast-growing trees at the edge of the Fynbos Biome. Invasive exotic species of *Acacia* all lack spines and contain tannins but vary from soft, bipinnate leaves to straplike phyllodes, which in the case of *A. melanoxylon* are as fibrous as the leaves of any indigenous tree species near Knysna. Enclosed juveniles in Knysna Elephant Park accept a staple diet of freshly cut branches of invasive exotic *Acacia*, collected by their keepers between Knysna and Plettenberg Bay (I. and L. Withers, pers. comm.) and have been observed eating a sapling of *Eucalyptus* growing in their enclosure (S. Privett, pers. comm.). They eat mainly *A. mearnsii* and *A. longifolia* but also accept *A. cyclops, A. pycnantha*, and *A. saligna* (I. and L. Withers, pers. comm.). Australian species of *Acacia* appear to be less defended by cyanogenic compounds than are African legumes, including indigenous species of *Acacia* (Conn et al. 1985).

The introduced juveniles frequently broke the boles of invasive exotics, in many cases eating only a small part of the tree before moving on. *Acacia mearnsii* does not survive if its bole is broken within 0.5 m of the ground; *A. melanoxylon* resprouts but is suppressed by the bushbuck, which prefers shoots of this species over most indigenous trees near Knysna (Von Breitenbach 1974). The Knysna elephants broke down *A. melanoxylon* frequently enough to prevent economic harvesting of its timber by DWAF in the study area (Von Gadow 1973). Mature phyllodes of invasive exotic *Acacia* spp. do not appear to be palatable to ruminants in the fresh state, but the eland and the grysbok eat the soft shoots, unripe pods and phyllodes that have dried on damaged branches (M. J. D'Alton, pers. comm.; D. Gibbs, pers. comm.). Germination of invasive exotic *Acacia* spp. from elephant faeces has been negligible (Koen 1983). The elephants, in combination with other indigenous herbivores, thus appear capable of reducing populations of invasive exotics without doing corresponding damage to ecologically similar indigenous plants.

Micronutrient deficiency?

The introduced juveniles and last native elephants at the edge of the Fynbos Biome have shown that after weaning, even vegetation on nutrient-poor soils is sufficient for body maintenance and growth. Ericaceae are also routinely eaten by the walia ibex (*Capra ibex walie*) in Ethiopia and the red deer (*Cervus elaphus*) in Scotland. It is unclear which is more attractive to the African elephant: forest regrowth after clearing or fynbos regenerating after fire.

The critical question is why the Knysna elephants

have reproduced so poorly, in contrast to the population in Addo National Park, just east of the Fynbos Biome. Micronutrient deficiency has been suspected for many years (Carter 1971; Koen et al. 1988). Although copper and zinc may be deficient to some degree (Koen 1984; Seydack et al. 2000), the elements with potentially the greatest effects on reproduction are iodine and selenium (Milewski 2000). Despite proximity to the coast, forestry workers in the study area risk iodine deficiency unless they supplement their diet with seafood (Steyn 1955). Iodine deficiency can repress reproduction of domestic livestock even when all other nutrients are sufficient (Milewski and Diamond 2000). Avoidance by the elephants of various apparently nutritious plants may possibly be owing to cyanogenic compounds (legumes), nitrate (Asteraceae), and oxalate (certain herbaceous plants), all of which indirectly aggravate deficiencies of iodine and selenium (Coleby 2002).

The Knysna elephants originally moved over a wide area (Phillips 1925), balancing their nutrition over the course of the year. Forest elephants in East Africa are known to make and maintain deep excavations for nutrient supplements of a quality probably unavailable near Knysna (Milewski 2000). Extensive low open fynbos apparently provides nutrients sufficient for the growth of juveniles, at least in combination with certain forest plants and protein-rich invasive exotics. However, the confinement of the last native elephants to forest and fynbos has possibly denied them the micronutrients required for pregnancy and lactation. Seaweed cast up after storms might have originally provided the necessary iodine and selenium, but the Knysna elephants no longer have access to the shore. Artificial supplementation of the elephants may be required for successful breeding on a diet of forest and fynbos plants near Knysna. This might be partly accomplished by means of occasional injections of iodized oil.

It is premature to accept the extermination of the last population of the African elephant appropriate to the Fynbos Biome. Various regimes of supplementation of micronutrients have yet to be attempted. Further reintroductions may not only perpetuate this symbolic animal of Knysna but also contribute towards the recruitment of an underestimated ally in the control of invasive exotic plants in conservation areas elsewhere in the south-western Cape.

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Recent translocation of elephant family units from Sweetwaters Rhino Sanctuary to Meru National Park, Kenya

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Abstract

As part of its strategy to conserve and manage Kenya's elephant population, the Kenya Wildlife Service has pursued translocation as one of the management options to address human–elephant conflict by moving identified problem elephants, thus restocking certain elephant ranges and reducing pressure on vegetation as a result of high densities in confined habitats. A total of eight translocations have been undertaken in various elephant ranges in Kenya since 1996 involving 141 individuals with 9.2% mortality recorded. This paper reports on the recent relocation that involved 56 elephants, among them family units.

Résumé

Dans le cadre de sa stratégie pour conserver et gérer la population d'éléphants du Kenya, le Kenya Wildlife Service poursuit les translocations, celles-ci étant une des options de gestion destinées à répondre aux conflits hommes–éléphants en déplaçant les éléphants identifiés comme fauteurs de troubles tout en repeuplant certaines aires de répartition et en réduisant la pression que subit la végétation lorsque de densités fortes d'animaux sont confinées sur des habitats restreints. Au total, huit translocations ont eu lieu dans différentes aires du Kenya depuis 1996, impliquant 141 individus, et pour lesquelles on a rapporté un taux de mortalité de 9,2 %. Cet article fait le rapport de la récente translocation qui a impliqué 56 éléphants, y compris des unités familiales.

Introduction

Elephant numbers in most range states in Africa have continued to show an upward trend since the international ban on ivory trade (CITES 2000). Alongside increasing elephant numbers is the increasing human population that brings with it high demand for land for settlement and economic activities. Consequently elephant habitats are being fragmented, and this has ultimately led to compression of elephant ranges and emergence of isolated habitats, leading in turn to increasingly frequent human–elephant interactions, which in many places have led to serious human–elephant conflicts. This scenario poses two major problems: the need to protect the elephant on one hand and the need to protect human life and property on the other.

To mitigate the conflicts and conserve the elephant, Kenya Wildlife Service (KWS) has initiated a number of conflict-management strategies. Constructing electric fencing and moats, and creating elephant sanctuaries and elephant drives have all been tried to ensure harmonious coexistence between people and wildlife. KWS has adopted translocation as another conflict-management method, preferable to shooting problem animals.

In Sweetwaters, habitat destruction has been caused largely by overconcentration of confined elephants. This situation has been exacerbated by elephants, giraffes, rhinos and other browsers competing for the same forage. Drought in most parts of the country has intensified the competition, forcing wildlife to move out of parks and reserves in search of water and forage. Elephants have moved into

adjacent areas, increasing the likelihood of human–elephant conflict. In April 2000, seven problem elephants were moved out to lessen the conflicts.

Sweetwaters Rhino Sanctuary, located on Ol Pejeta Ranch 25 km west of Nanyuki town in northern Kenya, covers an area of 95 km^2. An electric fence completed in 1989 completely encloses it and restricts animals from moving into or out of the reserve. In addition to protecting the black rhino, the fence also enclosed over 100 elephants, causing considerable competition among large mammals for available forage. Habitat quality and quantity, particularly in relation to *Acacia xanthophlea*, have declined over the past decade (Birkett et al. 2000). It was in the face of this habitat degradation that translocation of half the elephants in the sanctuary emerged as a management option. Meru was chosen as a release site because in the 1970s and early 1980s the ecosystem was home to over 2400 elephants (Douglas-Hamilton and Hillman 1976), but rampant poaching during the same period had reduced the population to a mere 306 (Kahumbu et al. 1999).

Historical background of elephant translocations

In early elephant translocations young animals were captured and transported mainly to safari parks, circuses and zoos in Europe and the United States. Although the use of drug immobilization in the 1960s made it possible to capture adult elephants, transportation of such large animals was thought at the time to be fraught with too many problems to be attempted (Pienaar 1967). Because it was difficult to capture breeding herds on foot, initially among the adults only bull elephants were drug immobilized. Using a helicopter in capturing breeding herds was first attempted in September 1966 in Kruger National Park in South Africa, when 27 young elephants below the age of 5 years were captured (Pienaar 1967). In 1976 the management of Kruger National Park began to capture juvenile elephants routinely for translocation to other areas. By 1992, 25 discrete populations of elephants within South Africa, one in Namibia and two in Swaziland had been built up by translocations of 761 juveniles. These translocations provided a useful body of data on the best ways to carry out such movements (Hall-Martin 1992).

However, it was not until 1993 that the first translocation of entire family units was attempted when 670 elephants were saved from starvation in Gonarezhou National Park in Zimbabwe and transported over distances greater than 1000 km, some to other conservation areas in Zimbabwe and others as far as to South Africa. The operation proved that elephant family units could be captured and successfully transported over large distances, providing an alternative to culling as a mode of population management (Dobb 1993; Coetsee 1996). Since then a great number of elephant family units have been translocated for various reasons, ranging from saving populations from collapse (as in Gonarezhou), to building up populations in areas where they had gone extinct (as in areas in South Africa) (Du Toit 1994; Savory 1996), to easing human–wildlife conflict (as in Kenya) (Njumbi et al. 1996).

A history of previous translocations undertaken in Kenya is given in table 1.

The objectives

The translocation from the Sweetwaters Rhino Sanctuary to Meru National Park had four major objectives:

- to resolve human–elephant conflict
- to reduce competition for food with other herbivores
- to reduce habitat destruction resulting from confinement
- to restock Meru National Park

Capture site

The capture site was Sweetwaters Rhino Sanctuary, in an area of low rolling hills, rising gently from an elevation of 1760 to 1820 m above sea level. A permanent river, the Ewaso Nyiro, which flows in a south–northerly direction, bisects the reserve. Other drainage lines in the reserve are only seasonal and run in an east–westerly direction.

The high-altitude sanctuary lies in the rain shadow of Mount Kenya. Rainfall is erratic, generally falling in localized showers produced by the build-up of convective clouds. The mean annual rainfall is about 800 mm, falling in two seasons, the 'long rains' from mid-March to June and the 'short rains' from November to December. There are also cold, dry spells.

The sanctuary was set up as a protected area for breeding black rhino, a species highly endangered in Kenya. The number of elephants enclosed was found to exceed the carrying capacity and the animals were

Table 1. Previous translocations undertaken, their objectives and results

Translocation	Stated objective	Pre-translocation monitoring	Mov'd (no.)	Mortality (no.)	Post-translocation monitoring	Measure of success
Mwea Nature Reserve to Tsavo East National Park, 1996	• reduce human–elephant conflict by reducing population by 50% • reduce numbers before entire fencing of the reserve	distribution, numbers, age, sex and family structure of the population done	21	5	radio-tracking for one year	no reports of conflict since translocation
Lewa Downs Conservancy to Kora NP, 1997	• reduce habitat destruction/human–elephant conflict • restock Kora National Park	well-known bulls identified by conservancy managers	10	0	ground and aerial monitoring	reduction in *Acacia xanthophlea* destruction; reduced no. of conflict incidents
Mwaluganje to Tsavo East, 1999	• reduce habitat destruction • reduce conflict	individual identification done	29	2	individual identification and ground monitoring	minimized number of conflict incidents
Shimba Hills to Tsavo West NP, 2000	• reduce conflict	rogue bulls identified by park managers	4	0	ground monitoring	minimized number of conflict incidents
Laikipia to Meru National Park, 2000	• reduce habitat destruction • reduce conflict	individual identification of problem bulls done	10	0	ground and aerial monitoring	reduced number of human–elephant conflicts
Ongata Rongai to Amboseli NP, 2001	• move stray elephant	not available	1	0	ground monitoring	monitoring continuing by the Amboseli elephant research project
Nakuru to Aberdares NP, 2001	• move stray elephants	not available	2	1	ground monitoring	not available
Sweetwaters to Meru National Park, 2001	• reduce habitat destruction • reduce conflict • restock Meru Park	4 months of monitoring, 120 identified, 16 family units and 20 lone bulls; 9 families, 9 bulls totalling 56 elephants selected for translocation	51	5	ground and aerial tracking ongoing	reduced habitat destruction; no conflict incidents reported so far
Totals			128	13		

competing with rhinos and giraffes for the available browse. They were also breaking through the electric fence to look for browse outside the sanctuary. This led to human–wildlife conflict. To revert to the optimum carrying capacity some elephants had to be moved out.

Release site

The release site was Meru National Park, located in Meru North District in Eastern Province of Kenya and about 208 km from the capture site. The park covers about 884 km^2 with a further dispersal area that increases animal range to 5500 km^2. The habitat of Meru National Park varies from woodland to open grasslands intersected by permanent rivers fringed with riverine vegetation. It was chosen as the release site because of its large size and because in the 1980s poaching almost wiped the elephants out. Increased security and intelligence surveillance have once again made this range safe for elephants.

Methods

Pre-translocation elephant monitoring

The elephants were monitored daily for four months to identify animals to be moved. They were selected using two criteria: 1) habitual fence breakers and 2) discrete family groups with preference given to small units because they could be relocated all at once.

Individual recognition techniques based on elephant fingerprints (Douglas-Hamilton 1972; Moss and Poole 1983) were used. The unique ear markings of each elephant with other features on the tusks and body helped distinguish one elephant from another. Fence-breaking animals were identified in night patrols along the fence, and any animal near any breakage point, in or out, was identified, with photographs and sketches of ear markings made of all. From the photographs and sketches shown to wardens and rangers the sanctuary authorities were able to identify the notorious fence breakers. Elephants associated with them were also marked for relocation.

When determining which family unit was ideal for translocation, it was necessary to know the entire population. Matriarchs and all other adults were first identified and then catalogued. These identifications were later used to recognize and distinguish family units. The age and sex of all members of each family unit were established. Associations existing among family units in the population were also recorded. Finally, small families and groups were selected for relocation.

During the monitoring exercise, 140 elephants were individually identified in the reserve. They made up 16 family units and groups of 20 lone bulls. Thirty of these elephants were seen only once in the reserve. Identified as ideal for relocation were 56 animals comprising 9 family units and 9 bulls. Among the bulls, 4 problem elephants and 5 others that associated closely with them were identified for relocation. Only one family unit of 5 animals was identified as being a problem.

The pre-translocation monitoring exercise also revealed that during the

Charles Ooro, KWS

Darted elephants fleeing before they fall.

Charles Ooro, KWS

A veterinarian takes details of two members of a family awaiting loading.

dry season, the group sizes were small, but as soon as the rains began, many family units merged to form large herds. One time a herd of 56 elephants was recorded. Two family units of 7 each that had been marked for relocation during the dry season showed very close association with each other after the rains. Apart from these changes, all the others continued to maintain their group sizes: three groups of 4 each, three groups of 5 each, and one group of 6.

Darting and monitoring anaesthesia

The translocation operation was carried out in July 2001. A Husky fixed-wing aircraft was used to locate the target elephants, assisted by the ground monitoring team. The Husky crew included the pilot and a spotter, who was a member of the pre-translocation monitoring team and familiar with the area. The helicopter pilot and two veterinarians (the darter and the loader) remained at camp while the rest of the team was directed by the aircraft to a suitable position where they would stand ready. This position, close to the area where the elephants were to be darted, allowed the team to respond quickly after the darting. Quick response is crucial to avert prolonged sternal recumbency or obstruction of the elephant's trunk, which can lead to death.

The elephants were herded to ground that would be suitable for recovery, allowing the helicopter to approach them closely, thus ensuring good dart placement and speedy ground follow-up. Family members were herded together so they would fall as close to one another as possible to facilitate loading.

Adult bulls and cows were immobilized using 18 mg of M99 (etorphine hydrochloride) mixed with 5000 IU of hyaluronidase, the latter to quicken absorption of the drug from the site of deposition. Subadults were darted with 15 mg of M99 mixed with 2500 IU of hyaluronidase and juveniles with 5 mg. One calf that was less than one metre in height was captured manually and immediately tranquillized with 30 mg of azaperone tartarate. Cap-Chur darts with 3-ml barrels and NCL1-3 needles were used to deliver the drugs using the Cap-Chur long-range rifle (Palmer Chemical Co., Atlanta, USA) with .22 green loads.

Bulls were darted and recovered individually. Each immobilized bull was recovered before darting the next one. Members of a family group were darted in

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The capture team turns a bull to lie in better position while he is awaiting loading,

quick succession starting with the matriarch, so that the rest stayed close to her. The other older females were darted next. Small calves were darted last, either from the helicopter or from the ground. Each immobilized elephant was assigned a veterinarian, a technician and a few rangers to monitor it.

Once the animals were down, the ground teams, directed by the helicopter, moved in quickly to ensure each animal was in a suitable lateral position and was in a stable anaesthetic state. Animals lying on their sternum were pushed over onto their side. The trunk was straightened to ensure good breathing.

Darts were removed and the wounds treated by infusing an antibiotic cream into them. A general physical examination was done and any ailment was treated appropriately. All injuries were treated conventionally.

An antibiotic cover of 20,000 mg of a long-acting oxytetracycline preparation was injected intramuscularly at five sites in all adult elephants. Juveniles were given the same antibiotic at reduced dosages.

Biological materials were collected for assessing animal health and for future studies. The sex and age of all animals was determined.

Doxapram (400 mg) was administered intravenously to animals that showed signs of depressed respiration. Membrane stabilizers such as corticosteroids and Flunixin Meglumine were given to animals frothing from the trunk. In recumbent elephants, this frothing, called pink foam syndrome, is a result of lung oedema, caused by high mean arterial pressure in immobilized animals. The high pressure leads to fluid and sometimes blood being forced out of the capillaries into the alveoli of the lungs. The fluid accumulating in the alveoli is pushed out through the trunk as the animal exhales.

Loading, transportation and release

The area around the elephant was cleared using a hand-held power saw. If an elephant fell deep in the bush, a passageway was made using a bulldozer to allow the recovery tractor and trailer to move to the site. Various recovery methods were used depending on the size of the elephant. Older calves that had been darted were lifted with a cargo net or ropes onto the recovery vehicle while the smaller ones that had been

physically restrained were walked into the crates. The subadults and adults were roped and rolled over manually onto a conveyor belt on which they were firmly secured. The recovery trailer was tipped backwards towards the elephant, which was then conveyed onto the trailer using a winch system and transported to a suitable loading site.

The older calves, lying on their sides, were transferred manually from the recovery vehicle into small crates. Once inside, the calves were given the reversal agent. The crates were closed and raised manually and gently to an upright position so that the calf was supported on its feet. The crate was then loaded onto the low-loader or Canter truck ready for transportation.

Subadults were directly transferred from the recovery trailer into family crates on low-loader trucks by being pulled from the recovery trailer onto the low-loader and then into the family crate using ropes. Once in the crate, the animal was revived using the appropriate antidote.

Adults were loaded into individual animal recovery crates as follows: The recovery crate was off-loaded from the Volvo Hannibal truck and placed on its side by hydraulic lift; its rear and front doors were opened. The recovery trailer carrying the elephant was reversed and tipped backwards towards the open front of the crate. The elephant was manually pulled down the trailer into the crate, the doors of the crate were closed and the animal given the reversal agent. The crate was raised hydraulically to an upright position so that the conscious elephant was supported on its feet. The Volvo Hannibal truck then loaded the crated elephant either onto the truck itself or onto a low-loader truck ready for transportation to the release site. Elephants loaded onto the Hannibal truck were either transported by the truck to the release site or transferred to family crates on the low-loaders.

The elephants were revived using M5050 (diprenorphine) at three or four times the dose of M99 used. It was administered through the middle ear vein. The elephants were also given an intramuscular injection with azaperone tartarate at 120 mg for adults, 80 mg for subadults and 40 mg for juveniles. This drug was administered just before the animals were revived to calm them during transportation.

Charles Ooro, KWS

A bull is lifted into position for loading.

Charles Ooro, KWS

The capture team loads an elephant onto a recovery crate.

Five crates were used to transport the elephants: two family crates on the Kenya Army low-loaders, two individual animal crates on the KWS low-loader and Hannibal trucks, and a small crate for calves on the KWS Canter. To minimize stress on the animals, they were transported as soon as possible after crating, and stops were avoided wherever possible.

A veterinarian and a team of rangers escorted the elephants to the release site in case an emergency arose. The problem encountered most commonly was that when the effects of the azaperone wore off, the elephant became violent, banging and shaking the crate. This behaviour could have led to self-inflicted injuries and vehicle instability. To calm such animals again, a low dose of azaperone tartarate was given intramuscularly through an opening in the crate.

At the release site, the trucks were reversed onto an off-loading ramp. For family groups, the doors of the crates were opened at the same time to allow the animals to move out together and join up. Bulls were released one at a time. Once the doors were opened, the elephants were given time to walk out voluntarily.

Results

A total of 56 elephants (9 individual bulls and 9 family groups) were translocated in 12 capture operations conducted over a period of 22 days. Table 2 summarizes the number of elephants captured per day. Five animals died. Four died during transportation: two from lung oedema as manifested by the pink foam syndrome; one of suffocation when it fell in the family crate and its tusks locked into the sliding partition, obstructing its trunk; and the fourth from a pyloric obstruction that was present before immobilization and was exacerbated by capture stress. The fifth, a small calf, lay on its trunk and suffocated before the veterinary team arrived. A calf that lost its mother during release was airlifted to the David Sheldrick Trust for foster motherhood.

Post-release monitoring

Both aerial and ground monitoring are ongoing. Six of the elephants were fitted with conventional radio collars to assist in the aerial monitoring. An initial post-release monitoring report indicates that most of

Table 2. Number of elephants captured at specific dates (2001)

Date	No. in family	No. of bulls	Total
2 July	—	1	1
4 July	—	3	3
6 July	4	—	4
8 July	5	1	6
10 July	5	—	5
12 July	5	1	6
14 July	4	—	4
16 July	6	1	7
18 July	4	—	4
20 July	7	—	7
22 July	5	—	5
24 July	2	2	4
Total	47	9	56

the elephants have settled close to the point of release at park headquarters and range within the Meru ecosystem.

Discussion and conclusion

The small number of recovery crates available was a major problem. Only two were available and therefore no more than two elephants could be recovered at a time. When dealing with the larger family groups, some elephants had to be kept down for a very long time while those already recovered were being transferred to transport crates. The speed of transfer was sometimes slow because some elephants refused to move out of the recovery crate into the transport crate despite being prodded. Some of the elephants that were kept down a long time developed lung oedema, manifested by frothing from the trunk. One of those that died passed the blood-tinged froth of pink foam syndrome. If there had been enough recovery crates so that all the animals could have revived in the shortest time possible, mortality would have been reduced significantly.

The family crates that were available were small, and each could take only two subadults or three juveniles. At least three more recovery crates and three bigger family crates are needed. The system of transferring the elephants into family crates also needs improvement.

We were short of vehicles to transport the veterinary teams to immobilized elephants when family units were darted. The teams had to rely on borrowed vehicles and those of volunteers. The capture team currently has only one serviceable field car. At least two more vehicles are needed for future operations.

The Hannibal truck burst a major hydraulic pipe just after the last three elephants in the operation were immobilized. The vehicle could not move. The pipe had to be dismantled and flown to a workshop in Nanyuki for repair and then brought back to fix the truck. Meanwhile the elephants were kept down for about three hours until the truck was repaired. One of these developed the pink foam syndrome a few minutes before being recovered. Another Hannibal truck is necessary if we are to carry out translocations at the present scale. This would also quicken the recovery of family groups and reduce mortality.

The amount of immobilization drug used during the exercise exceeded the amount anticipated by far. This problem arose because when dealing with family groups, many animals had to be kept immobilized for longer periods than anticipated. Top-up dosages of about a quarter of the immobilizing dosage had to be administered at intervals of about 30 to 40 minutes. In future, a better contingency arrangement should be made for the top-up drug when dealing with family groups.

All the objectives of the translocation were, however, achieved. The population of elephants in the sanctuary was reduced by half. The elephants removed were taken to Meru National Park, a more extensive and suitable habitat. The quality of habitat in the sanctuary is expected to improve drastically over the next decade because of reduced competition among elephants, rhinos and other large mammals. Elephant–human conflict in the surrounding community is expected to be reduced drastically since most of the elephants that broke out of the sanctuary and entered farms were taken away to a habitat where they are less likely to interact with human communities. This will safeguard human life as well as protect the elephants. KWS has a programme of restocking Meru National Park with various species of wildlife, including about 500 elephants, within the next five years. This translocation was a great contribution to the planned restocking.

Because this was the first time that KWS moved elephants in family units, the translocation team faced problems that were new to it but from which it learned valuable lessons. The mortality of 8.9% was attributable to various hazards, as discussed above. The mor

tality rate will definitely be reduced significantly with the acquisition of more and better equipment.

The success of the operation is attributable to many factors, among which donor support, good and timely planning, good background research, pre-translocation monitoring, and teamwork stand out.

The importance of translocation for managing wildlife in Kenya is increasing rapidly. Those who have a heart for conservation are urgently requested to give any support that can help equip KWS for present and future translocations. The organization does not have enough money to address all the country's conservation requirements and therefore donor support is greatly needed.

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Statut et tendances des effectifs d'éléphants dans les aires protégées de l'Est du Burkina Faso

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Résumé

Le Burkina Faso abrite l'effectif d'éléphants de savane le plus important de toute l'Afrique de l'Ouest, là où cette espèce jouit d'une protection intégrale. Un recensement aérien par échantillon a été mené dans le sud-est du Burkina Faso en avril et mai 2000. L'effectif total moyen atteignait 1.743 ± 648 éléphants, ce qui constitue la plus grande population d'éléphants de savane en Afrique de l'Ouest. La moyenne des groupes observés était de: 5,42 (Erreur standard = 11,68 animaux) (1 à 32 individus / groupe). La distribution des éléphants enregistrée confirme largement la distribution enregistrée les années précédentes.

Mots clefs supplémentaires: distribution, l'Unité de Conservation d'Arly, recensement aérien, échantillon

Abstract

Burkina Faso is home to the largest savannah elephant population in the protected areas of West Africa. An aerial sampling census was carried out in the south-west of Burkina Faso between April and May 2000. The estimated total number of elephants was 1743 ± 648. The observed mean group size was 5.42 (standard error = 11.68 animals) (range: 1 to 32 individuals per group). The spatial distribution recorded confirmed that of previous years.

Introduction

Le Burkina Faso abrite l'effectif d'éléphants de savane le plus important de toute l'Afrique de l'Ouest (Barnes et al. 1999). Les aires protégées dans ce pays couvrent 11 % du territoire national. Le plus grand complexe d'aires protégées est représenté par l'Unité de Conservation d'Arly qui se situe dans l'Est du Burkina Faso. C'est dans ce complexe que vit la plus grande population d'éléphants de savane de la sous-région.

Un recensement aérien a été mené dans l'Unité de Conservation d'Arly en avril et mai 2000. Celui-ci avait pour but de vérifier les tendances observées les années précédentes grâce à l'utilisation des mêmes techniques de suivi. L'éléphant est une espèce qui jouit d'une protection intégrale au Burkina Faso où il a vu ses effectifs augmenter régulièrement depuis les années 90.

Site d'étude

L'Unité de Conservation d'Arly couvre une superficie près de 7100 km^2 et est située entre 12°04' et 11°03' de latitude Nord et entre 0°30' et 1°51' de longitude Ouest.

Le complexe d'aires protégées est situé dans l'écosystème sahélo-soudanien. La pluviométrie moyenne annuelle dans la région atteint 677 mm. La région est couverte de savane arbustive à arborée. Des galeries forestières se répartissent le long des cours d'eau.

L'Unité de Conservation d'Arly est formée d'un complexe d'aires protégées (fig. 1). Elle est constituée :

- du Parc National d'Arly,
- du Ranch de Gibier Singou,
- de concessions de chasse (Koakrana; Konkombouri; Pama Nord, Centre Nord, Centre Sud et Sud; Pagou-Tandoudou, et Ouamou)
- ainsi que de l'enclave de Madjoari où vivent plusieurs milliers de personnes (Bouché et al. 2000).

Méthode

Un recensement aérien systématique par échantillonnage (Pennycuick et Western 1972) a été réalisé.

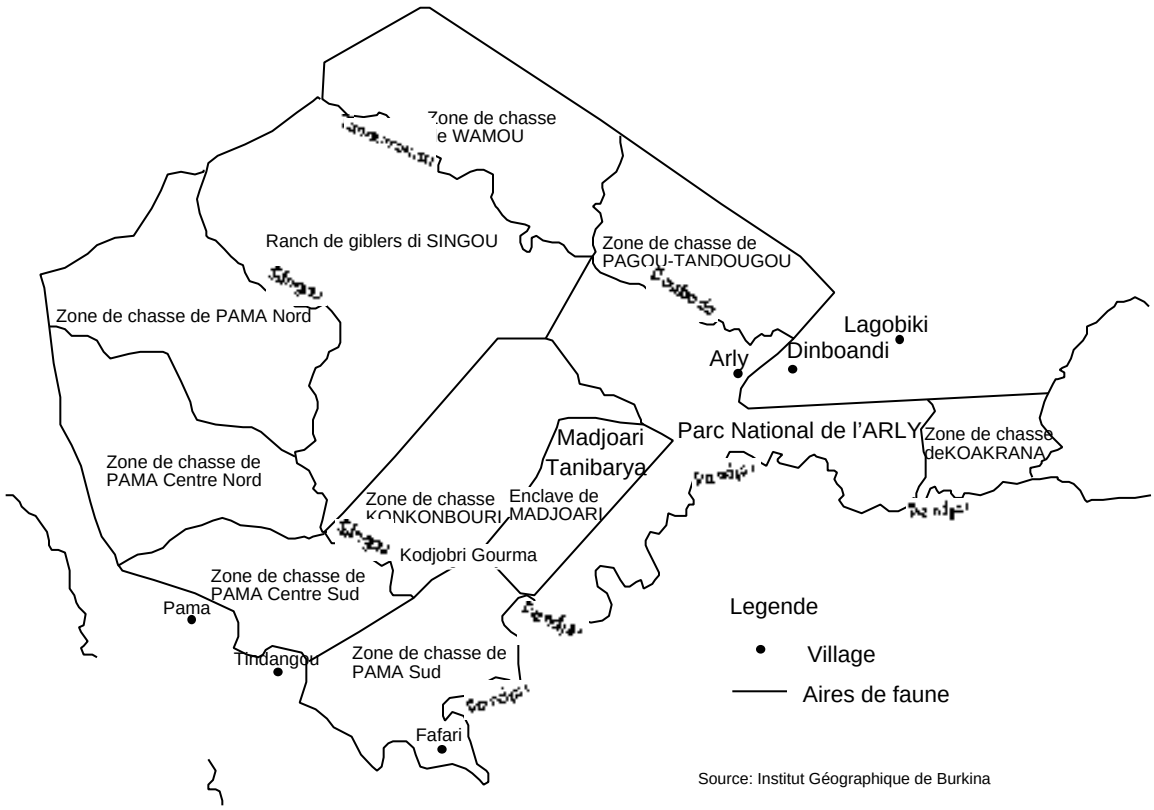

Figure 1. Localization de zones de chasse concernées par le recensement aérien de faune avril–mai 2000.

Ce type de recensement a tendance à fournir des résultats plus exacts (estimation proche du chiffre réel) mais moins précis (variance et intervalle de confiance plus larges) (Caughley 1977). Son grand avantage est de donner un aperçu de la distribution des animaux sur toute la superficie étudiée. Le terrain relativement peu accidenté de la région se prête bien à cette technique. Cependant l'éléphant étant un animal très grégaire, cette technique peut révéler ses limites pour recenser cette espèce. Idéalement un recensement aérien total serait plus adapté (Norton-Griffiths 1978; Jachmann 1991 ; Douglas-Hamilton 1996 ; Dejace et al. 2000; Bouché 2001).

Au cours de ce recensement, 66 transects ont été parcourus (tableau 1 et fig 2). Les transects ont été disposés à intervalle régulier de 3 km. Ils ont été orientés de manière à couper perpendiculairement les principaux cours d'eau (fig. 2). Le plan de disposition des transects est le même que celui utilisé en 1998 et 99 afin de pouvoir comparer les résultats d'une année à l'autre (fig. 4).

L'avion utilisé était un Cessna 172. Les recensements ont été réalisés entre 5h45 et 9h30. Vingt-sept vols ont été consacrées aux comptages. L'altitude choisie était de 300 pieds par rapport au sol, soit 91 m. La vitesse fut maintenue aussi constante que possible à 80 nœuds, soit 148,2 km/h. La taille de la bande-échantillon délimitée par des repères était telle que, pour une altitude de 300 pieds, les repères délimitaient au sol une bande de 200 m de large de chaque côté de l'avion. La largeur des bandes-échantillons a été calibrée avant le recensement. L'absence de radar-altimètre pour vérifier notre hauteur pourrait avoir causé certains biais dans le recensement. L'altitude a été contrôlée sur la base de l'altimètre atmosphérique. La différence entre la pression avant et à la fin du vol a permis de recalculer la taille réelle de la bande-échantillon.

L'équipe de recensement était composée d'un pilote s'occupant de la navigation par GPS, de deux observateurs chargés des recensements et d'un co-pilote chargé du contrôle de l'altitude et de fournir

Tableau 1. Superficie, nombre de transects, distance parcourue et superficie échantillonnée par zone

Zones	Superficie (km²)	Nombre de transects	Distance parcourus	Superficie échantillonnée en %
Arly	930	19	320.8	12.3
Koakrana	250	6	70.8	12.4
Konkombouri	650	18	228.5	14.1
Ouamou	644	15	265.2	16.5
Pagou-Tandougou	350	9	166.8	19.1
Pama Centre Nord	815	11	246.6	12.1
Pama Centre Sud	517	8	177.2	13.7
Pama Nord	815	13	282.2	13.9
Pama Sud	608	8	193.2	12.7
Singou	1518	30	521.8	13.8
Total	7097	66*	2473.1	

*Au total 66 transects ont été parcourus. Chaque transects pouvant traverser plusieurs zones, ceux-ci ont été subdivisés au niveau de chaque zone. Ceci explique pourqoui le nombre de transect efféctués ne correspond pas a la somme des parties de transects au niveau de chaque zone.

aux observateurs les coordonnées géographiques grâce à un autre GPS.

Ce recensement de saison sèche a été effectué entre le 26 avril et le 3 mai 2000, à une période de l'année bien plus tardive que les années précédentes. Le traitement des données a été réalisé par la méthode de Jolly 2 (Norton-Griffiths 1978). Les intervalles de confiance ont été calculés à 95 %.

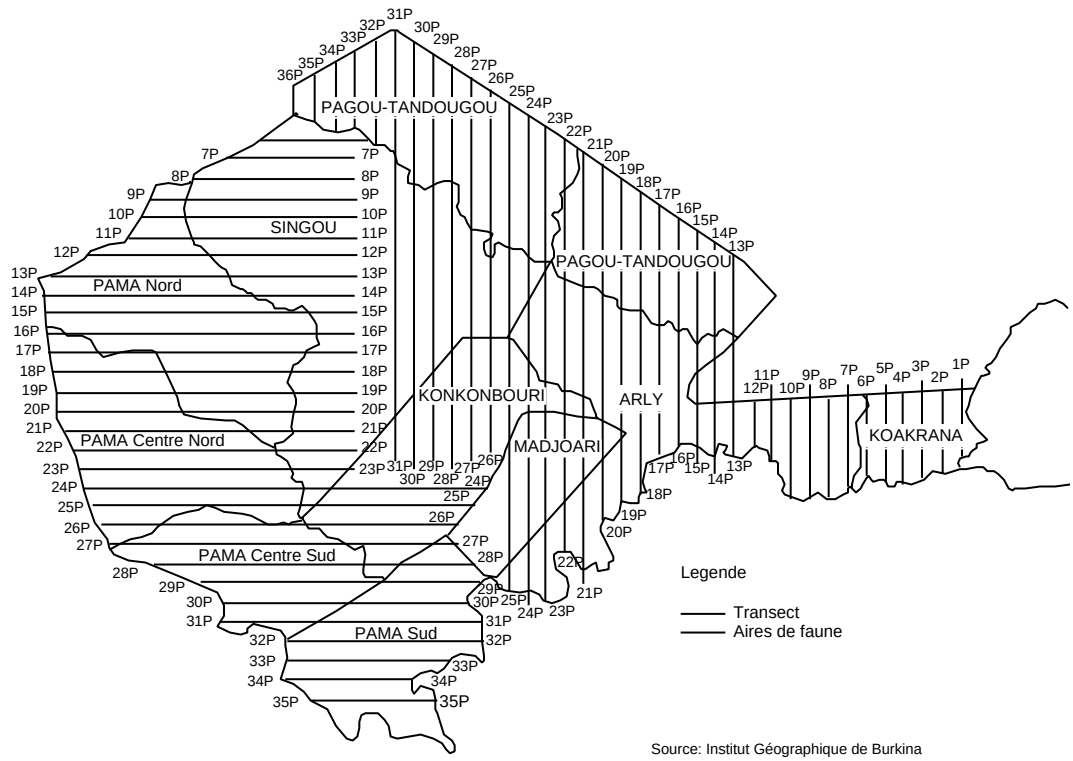

Figure 2. Carte des transects..

Résultats

Les effectifs d'éléphants obtenus par zone sont exposés dans le tableau 2. L'effectif total moyen atteindrait 1.743 ± 648 animaux. Cependant, cette espèce très grégaire se prête mal à ce type de recensement. Un recensement aérien total des éléphants serait nécessaire afin de mieux estimer la population réelle. La moyenne des groupes observés atteint 5,42 animaux (erreur standard = 11,68) (1 à 32 individus / groupe)

La distribution des observations et des densités de cette espèce est exposée sur le figure 3. Les concentrations les plus importantes se situaient au Nord entre la rivière Singou et la Tanouarbou, au Centre entre la Singou et la Konkombouri, ainsi qu'à l'Est à proximité de l'Arly et de la Pendjari.

Discussion

La comparaison avec les observations de Bousquet 1982 (in Chardonnet 1999), Lamarque 1992 (in Chardonnet 1999), Barnes et al. 1999, et Chardonnet 1999 (figure 4).

Généralement les recensements de saison sèche sont effectués au mois de février, soit deux mois plus tôt, tandis que les recensements de saison des pluies s'effectuent en juin–juillet, soit deux mois plus tard. Ces deux périodes sont stratégiques pour les comptages car à ces époques, pour chacune des saisons, le climat est plus ou moins constant d'une année à l'autre, et la température est plus basse qu'en avril–mai. A partir du mois d'avril, les premières pluies irrégulières influencent la distribution des animaux. La chaleur, plus importante au mois d'avril qu'en février, oblige les animaux à se mettre à couvert plus tôt dans la journée. Il y a donc plus de chance de manquer des animaux lors de recensements au mois d'avril qu'en février. Il n'est donc pas anormal de trouver des résultats quelque peu différents des recensements précédents.

Les effectifs obtenus au cours de cette étude sont peu élevés en comparaison avec les effectifs obtenus en 1999. Ceci est peut être dû au fait que la période de recensement n'était pas adéquate et qu'une sous-estimation peut être intervenue suite au fait que cet inventaire a été réalisé plus tard dans la saison. Cependant les données de 1998 (Barnes et al. 1999) indiquaient que 2100 individus vivaient dans ce même complexe d'aires protégées, ce qui est comparativement semblable à la limite supérieure de l'intervalle de confiance à 95 % (2391 individus) obtenus en 2000.

Même si les effectifs obtenus au cours de cette étude ont pu être sous-estimés, ces résultats confirment cependant que la tendance des populations d'éléphants dans l'Unité de Conservation d'Arly est croissante depuis 1992 (fig. 4). La chute des effectifs entre 1982 et 92 peut s'expliquer par une augmentation du braconnage de l'éléphant dans la région. A partir de 1992, les effectifs ont augmenté à la suite de trois événements importants pour la conservation :

- La décision de la CITES en 1989 de placer l'éléphant en Annexe I de la Convention ;
- Une migration provenant du Togo entre 1990 et

Tableau 2. Nombres d'observations et d'individus observés, effectifs intervalle de confiance à 95 % (IC 95 %), densité et biomasse moyenne/km^2 d'éléphants

Zones	Nombre d'observations	No. d'individus observés	IC à 95 %	Densité nombre/km^2	Biomasse moyenne/km^2
Arly	5	—	355 ± 486	0.38	763.44
Koakrana	—	—	0 ± 0	—	—
Konkombouri	8	69	490 ± 177	0.75	1507.69
Pagou-Tandougou	—	—	0 ± 0	—	—
Pama Centre Nord	4	10	83 ± 81	0.10	203.80
Pama Centre Sud	1	2	15 ± 31	0.03	57.98
Pama Nord	3	13	94 ± 140	0.12	230.73
Pama Sud	1	1	8 ± 19	0.01	26.33
Ouamou	4	12	73 ± 63	0.11	226.62
Singou	10	85	625 ± 417	0.41	823.45
	36	241	1743 ± 648	0.25	491.26

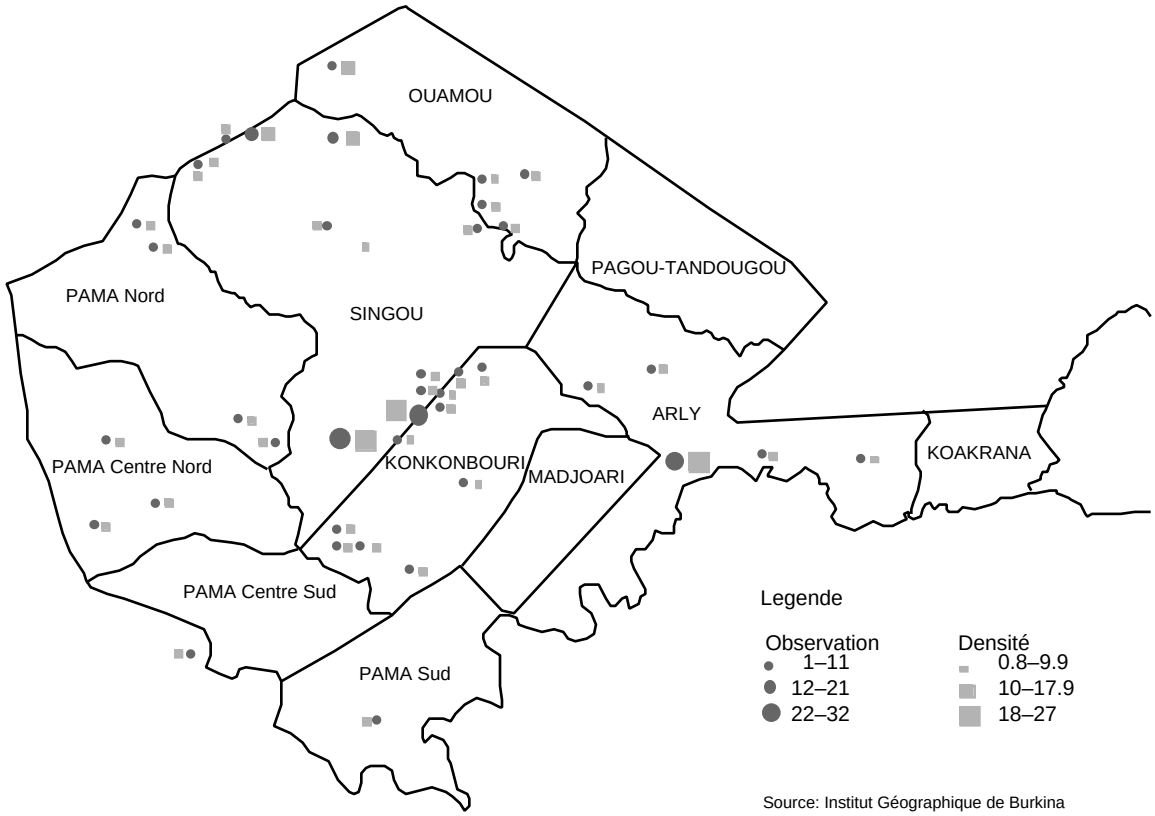

Figure 3. Distribution des observations et densité d'éléphants avril–mai 2000 (Recensement aérien de faune UICN).

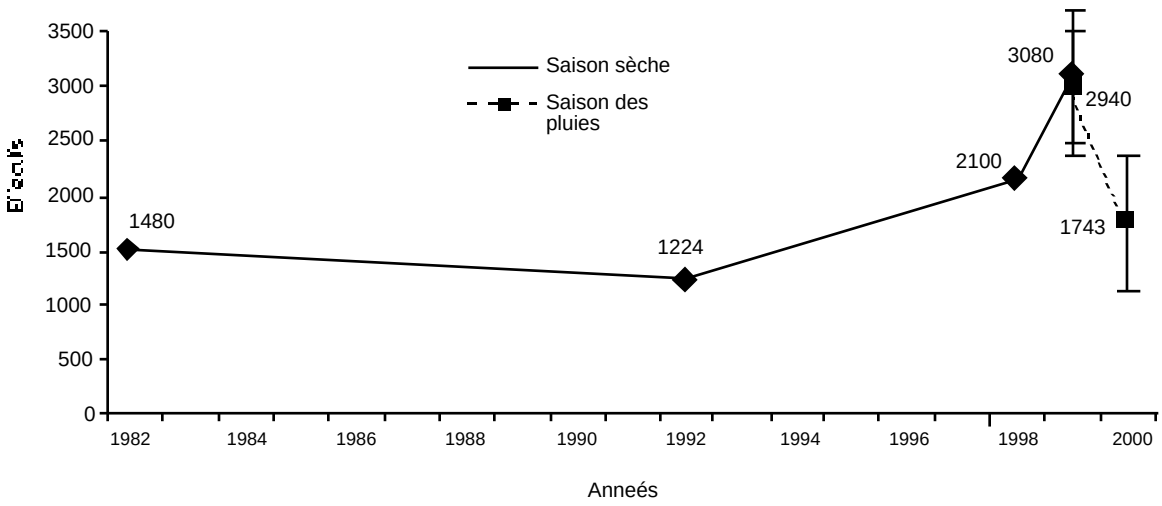

Figure 4. Evolution des effectifs d'éléphants entre 1982 et 2000.

1993 et concernant 200 à 300 individus (Yaméogo L. *in verbis*). Cette migration a eu lieu à l'époque où les recensements de 1992 ont été réalisés ;

- La mise en concession privée de larges espaces protégés a eu un effet bénéfique sur les effectifs de faune en général, ce qui s'est traduit par des tendances positives pour pratiquement toutes les espèces sauvages bien que les conditions de gestion ne soient pas optimales (Bouché et al. 2000).

La distribution des éléphants enregistrée en 2000 confirme largement la distribution enregistrée en juillet 1999 (Chardonnet et al. 1999).

Le braconnage, même s'il est limité, sévit encore dans l'Unité de Conservation. Un mois avant notre arrivée, un éléphant a été illégalement abattu à Pama Sud (Tapsoba L. *in verbis*.).

Conclusion

Les résultats obtenus ces dernières années confirment que l'Unité de Conservation d'Arly abrite la plus grande population d'éléphants de savane d'Afrique de l'Ouest. Malgré des effectifs peut-être sous-estimés dûs au fait que la période de recensement n'était pas adéquate, ces résultats, tout comme ceux de 1998 et 99, confirment une tendance positive des effectifs d'éléphants depuis les années 90 dans l'Unité de Conservation d'Arly. La distribution des éléphants observée en avril–mai 2000 confirme celle de 1999 pendant la saison des pluies.

Remerciements

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Aerial elephant count in the Shimba Hills ecosystem, Kenya

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Abstract

A total elephant wet count was conducted by helicopter in the Shimba Hills ecosystem in August 1997. The aim of the survey was to verify the estimated mean of 412 elephants obtained through dung counts, and thus ascertain if elephants in Shimba should be culled. During this survey, 464 elephants were counted, of which 150 were in Mwaluganje, giving a density of 6 elephants per km^2. Results from this count were similar to those from dung counts, which it complements. This survey clearly shows earlier gross underestimation of elephant numbers in the Shimba Hills. The solution to the problem in Mwaluganje caused by the high elephant density is to reduce the density. Translocation options are strongly suggested.

Résumé

On a réalisé un comptage total des éléphants par hélicoptère dans l'écosystème des Shimba Hills en août 1997. Le but de cette étude était de vérifier l'exactitude de l'estimation moyenne de 412 éléphants obtenue à partir du comptage des crottes afin d'être sûr qu'il ne fallait pas procéder à l'abattage d'un certain nombre d'éléphants de Shimba. Au cours de cette étude, on a dénombré 464 éléphants, dont 150 à Mwaluganje, ce qui équivaut à une densité de 6 éléphants au km^2. Les résultats de cette étude étaient comparables à ceux des comptages de crottes qu'ils viennent complémenter. Ils montrent clairement que les évaluations précédentes des éléphants de Shimba Hills étaient grossièrement sous-estimées. La solution du problème causé par la forte densité d'éléphants à Mwaluganje passe par une réduction de cette densité. On suggère avec insistance de penser à l'option de translocation.

Introduction

While the history of Kenya's elephants has been reviewed in detail by Poole et al. (1992), information is insufficient on elephants at the coastal strip. Unconfirmed accounts indicate that elephants were present in the Shimba Hills in the early 1900s (Poole et al. 1992), although they had been overexploited for the ivory trade between 1840 and 1890 (Spinage 1973).

Traditionally, elephants moved throughout Kwale District, migrating regularly from the Shimba Hills area to Mkomazi Game Reserve in northern Tanzania and Tsavo National Park, 40 km to the south-west and 60 km to the north-west, respectively (Stewart and Stewart 1963; Risley 1966; Ross 1981; Poole et al. 1992). Makin (1968) concluded that a game corridor should be established between Shimba Hills across the Ramisi River and west of Mt Jombo into Tanzania. Controlled shooting of elephants by the Game Department contributed significantly to migration decline. Also interfering with their migratory routes was the establishment of the Shimba Hills settlement scheme and the cultivation it brought. The recent construction of an electric fence has firmly curtailed the natural migration pattern.

Heavy elephant poaching occurred along some parts of the migration routes (Stewart and Stewart 1963; Risley 1966). Shimba elephants were also hunted for their ivory in the surrounding area. According to Game Department records, in September 1934 Pat Ayre, a professional hunter, killed 12 elephants near Mrima Hill (fig. 1) on control. Deliberate government action to eliminate them to settle people caused further elephant mortality. In 1961/62, for instance, the Game Department shot 250 elephants on control.

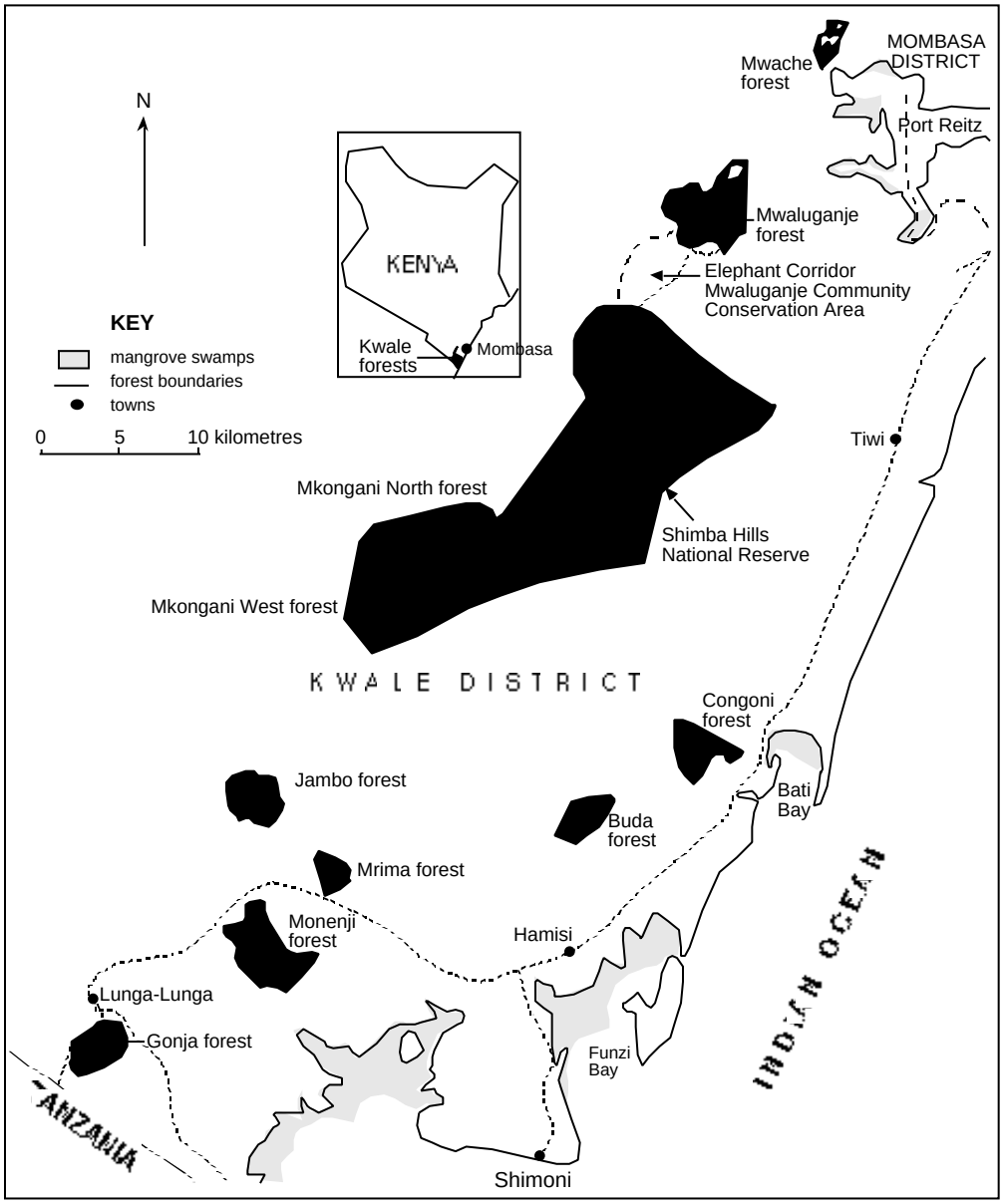

Figure 1. Location of the Shimba Hills ecosystem and Kwale forests.

Monitoring

No scientific monitoring of elephants took place in the Shimba Hills before the 1970s. The available data were those recorded by Jarman (1973), estimating 2000 elephants for the entire Kwale District. These elephants were intermittently monitored by district by the Department of Resource Surveys and Remote Sensing (DRSRS) from 1977 using sample counts. Surveys the department conducted after 1993 indicate that no elephants existed in Kwale, although they were confined within Shimba. This is probably because of the dense vegetation cover. In a forest ecosystem like Shimba, making an accurate count of elephants is extremely difficult because visibility is poor.

Dung count therefore appears to be the most practical method for calculating elephant numbers (Barnes and Jensen 1987). Although this method has inherent statistical uncertainty, it can give precise and accurate results, depending on how the data are analysed.

Using dung counts, studies in Shimba by Reuling et al. (1992) and Mwathe (1995) gave mean estimates of 412 ± 165 and 453 ± 181 elephants, respectively. In June 1995, 232 elephants were counted by using the total count technique with a high-fixed-wing aircraft (Kiiru 1995). Unlike the DRSRS surveys, which took in the whole district, these surveys focused primarily on the Shimba Hills ecosystem.

It is generally agreed that elephant numbers in the forest have increased since the 1950s. This is probably as a result of range compression brought about by agricultural development, and poaching pressure in the 1970s and 1980s (Poole et al. 1992), which caused ele-phants to move into the forest from the surrounding areas. The thick forest cover coupled with an elephant-tolerant attitude of the local people provided protection for elephants, enabling them to survive the poaching years.

Vegetation damage by elephants

Vegetation damage by elephants in the Shimba Hills ecosystem has reached critical levels in localized areas. The damage ranges from inhibiting regeneration through browsing in areas like Longomwagandi (Höft and Höft 1995) to causing death of mature trees through debarking and toppling them in Mwaluganje Forest (pers. obs.). Now that the reserve is nearly fully ringed with an electric fence, the destruction of biodiversity is likely to increase to crisis levels. This has caused concern for the Kenya Wildlife Service (KWS) and other conservation bodies, both locally and internationally. Previous studies in the Shimba Hills (for example, Schmidt 1991, 1992; Robertson and Luke 1993; Davis and Bennum 1993; Höft and Höft 1995) have expressed similar concerns. Results from these studies express the need to manage elephant intervention urgently to protect biodiversity. Additionally, in 1993 KWS initiated a study of the interaction between elephants and their habitat to investigate the impact of elephants on biodiversity. The objective was to help formulate management strategies suitable for maintaining a viable elephant population. Preliminary results from this study (Mwathe 1995) indicate that vegetation parameters such as tree height, tree density, mean stem diameter and forest openness were negatively correlated with elephant density.

What is at stake if the present level of elephant density is not reduced? Shimba Hills is probably the richest among the coastal forests for plant species (Davies and Bennum 1993). According to these authors, Shimba and Arabuko-Sokoke to the north account for most of the coastal forest biodiversity in Kenya. About 15% of the Shimba Hills plants are coastal endemics (Schmidt 1991), and 19 of the 159 rare tree species known for Kenya occur in Shimba (Beentje 1988). This makes Shimba Hills an important area for conserving the country's plant biodiversity. It is also a significant water catchment area, from which fresh water is supplied to Kwale and Mombasa towns and to the international tourist hotels along the south coast. This water catchment area must be protected through sound management initiatives for the benefit of coastal people. All these functions are at stake if the present level of ele-phant density is not reduced. At Mwaluganje Elephant Sanctuary there is additional conflict between developing tourism and conserving biodiversity. The challenge for KWS is to find the balance between the two.

Survey justification

In search of a solution to the elephant problem at Shimba, KWS convened a workshop at Tiwi in Kwale District in March 1997. The participants were drawn from KWS, local and international NGOs, conservationists, universities, community leaders and research organizations. The workshop resolved that elephant density must be reduced. Although it recommended culling as the immediate and short-term intervention management option, this option became the subject of much debate. The controversy intensified when results from a modelling exercise (Kamanga 1997) were presented, proposing culling 200 elephants to save biodiversity. This study was based on data by Mwathe (1995). However, some participants felt that since there is statistical uncertainty in dung counts, Mwathe's results, and therefore Kamanga's, should be treated with caution.

In view of this controversy and uncertainty, the Eden Trust and the Mwaluganje/Golini Community Conservation Company volunteered to raise funds for another elephant count if KWS would authorize it, to determine a more accurate number before taking any culling decision. The survey went ahead with KWS facilitating and coordinating it. Its purpose was to count all elephants and determine their distribution in the Shimba Hills ecosystem, test the efficacy of a helicopter count and compare the results of the helicopter count with those of the dung count.

Study area

The Shimba Hills ecosystem comprises the Shimba Hills National Reserve, Mkongani West and North Forest Reserves, the elephant corridor area and the Mwaluganje Forest Reserve (fig. 1). It is situated in Kwale District (south-eastern Kenya), stretching from 39°17' to 39°30' east and from 4°09' to 4°21' south. The climate is humid semi-hot equatorial (FAO/UNESCO 1977), with a mean annual temperature of 24.2 °C (Braun 1977). The Shimba Hills has two rain seasons, the 'long rains' from mid-March to the end of June and the 'short rains' in October and November. Jatzold and Schmidt (1983) have reported a mean annual rainfall of 1150 mm. Mist and fog contribute considerably to the total amount of precipitation.

The Shimba Hills Forest Reserve was first gazetted in 1903. Its size was increased to 21,740 ha in 1956. In 1967 the Shimba Hills National Reserve (19,250 ha) was gazetted and superimposed on the bulk of the Shimba Hills Forest Reserve. By this gazettement it became the responsibility of the Wildlife Conservation and Management Department, the predecessor of KWS, and the Forest Department to manage the reserve jointly. Mkongani West (1366 ha) and Mkongani North (1113 ha) Forest Reserves were not gazetted as national reserves. Mwaluganje Forest Reserve (1715 ha) lies approximately 5 km north of the Shimba Hills National Reserve.

The Shimba Hills rise abruptly from the coastal plain to form a table plateau, which is surrounded by an escarpment rising from about 120 m on the coastal plain to 300 m for most of the plateau. The plateau is generally flat but rises to 450 m at Marere and Pengo Hills. This plateau encourages precipitation from water-laden clouds blowing in from the Indian Ocean. The water flow during both wettest and driest months is stabilized by the forest.

The Kenya Soil Survey (1978) described the soils of Shimba as deeply weathered. They are made up of sediments derived from Shimba grits and Mazeras sandstone, which yield coarse-grained ferralitic soils. A cover of medium-grained Magarini sands deposited on top of Shimba grits in the centre of the reserve yields soils with a higher cation exchange capacity, base saturation and larger water storage capacity in some areas like Longomwagandi.

The vegetation of Shimba Hills has been described in detail by Schmidt (1991). Generally, it consists of a mosaic of tropical, seasonal evergreen rain forest,

Moses Litoroh, KWS

In a forest ecosystem like Shimba, making an accurate count of elephants is extremely difficult because visibility is poor.

woodland (eight forest types) and fire-induced grassland. An analysis of 1991 aerial photographs of the Shimba Hills/Mkongani reserves suggests that 48% is forest formations, 36% scrub formation and 13% grasslands. In Mwalunganje, 23% is forest and woodland and 76% thicket and scrub.

Such combinations of habitat undoubtedly provide for a varied fauna: 295 butterfly species (35% of Kenya's species), of which 13 are rare, 24 are forest dependent, 2 are endemic; 35 mammal species, which include elephant, giraffe, yellow baboon, Angolan colobus and Sykes monkeys, Grimm's duiker, bushbuck, ring-backed waterbuck, warthog, buffalo, leopard, spotted and striped hyena (plus small mammals such as bats, rats and mice). Shimba is known for its threatened population of the sable antelope, which is endemic to the reserve. One hundred eleven forest bird species have been recorded, 20 of which are coastal birds (Davis and Bennum 1993).

Method

The count was carried out in August 1997. The stand-ard technique of total aerial count was used. This technique aimed to systematically cover the entire surface of the defined census zone and to record every species of animals being counted and its geographical location. The pilot and observers were instructed according to the protocol described by Norton-Griffiths (1978) and improved upon by Douglas-Hamilton et al. (1994) and Douglas-Hamilton (1996). A six-seat Hughes 500 Jet Ranger helicopter, with doors removed to improve visibility, was used. The special advantage of the helicopter was that it could hover over big elephant groups and split them, allowing the observers to count accurately.

Census zone and counting blocks

As the study area was only 250 km^2, it would ordinarily have been treated as one counting block. However, because of its shape and the strong monsoon winds from the Indian Ocean, it was decided to divide the census zone into four blocks (fig. 2), numbered 1 to 4. These blocks were demarcated using a GPS (global positioning system) and easily recognizable boundaries from an electric fence and human settlements around the study area. Flight blocks were marked on 1:50,000 maps with universal transverse mercator (UTM) coordinates superimposed on them to facilitate navigation with the GPS.

The whole survey was done in one day. Approximately 250 km^2 were covered in 5.56 h of count time, giving a searching rate of about 45 km^2 per hour. This searching rate gives data quality of category 1 (best quality) as described in the *African Elephant Database* (Said et al. 1995).

Flight paths

The flight paths were determined by the pilot using the GPS and flown north–south because of strong winds. The transects were spaced at 500-m intervals

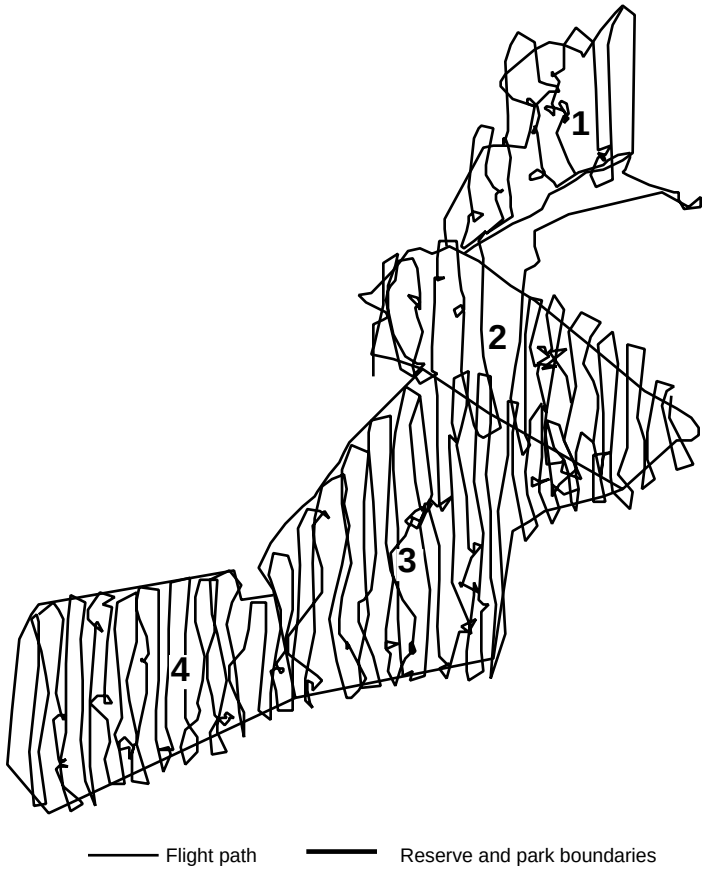

Figure 2. Counting blocks 1 to 4 and flight lines of helicopter 5Y-TOR.

but opened up to 1 km in areas where vegetation was not thick. Figure 2 shows the flight paths and relative intensity of the coverage, as recorded by GPS. Small circles in the flight paths indicate where the aircraft circled while elephants were counted.

Recording data

The front-seat observer (FSO) ensured that the data were recorded on a data sheet. Each observation was recorded in the GPS as a 'waypoint', and the waypoint simultaneously recorded on a data sheet. The rear-seat observers (RSOs) were responsible for spotting and counting. If RSOs spotted an animal, they called out to the pilot and the FSO, indicating if a diversion was needed to obtain a proper count. Every crew member and the pilot participated in the count. If the pilot circled, he ensured that the flight resumed on the transect at the point where the flight had broken off.

Table 1. Summary of elephant counts in the study area, 1997

Location	Counted (no.)	Area (km^2)	Minimum elephant density (km^2)
Mwaluganje	150	25	6.0
Shimba Hills Nature Reserve and forest reserves	314	217	1.4
Shimba ecosystem	464	250	1.9

Results

A total of 464 elephants (table 1) were counted in the study area. These include 452 elephants, which can be summed up from the GPS waypoints (fig. 4) plus 12 extra elephants that were not recorded in the GPS (see Discussion).

Mwaluganje elephant sanctuary had 150 elephants, while the rest were counted in the reserve. It was relatively easy to count elephants accurately in more open areas. However, in some instances elephants were spotted but their numbers could not be determined because of the thick vegetation. Hence the 150 is minimum.

Elephants were found in all habitat types, with large numbers in Mwaluganje, at Marere and along the southern border, where heavy cropraiding had been reported a week before the survey. Figure 3 shows their distribution and concentrations.

A qualitative observation made on elephant sex groupings revealed that the Mwaluganje forest area had many cow–calf groups, and only a few were associated with a few bulls. The corridor area had a number of groupings of bulls but few cow–calf groups. Marere area had many cow–calf groups and few bull groups, contrary to previous indications.

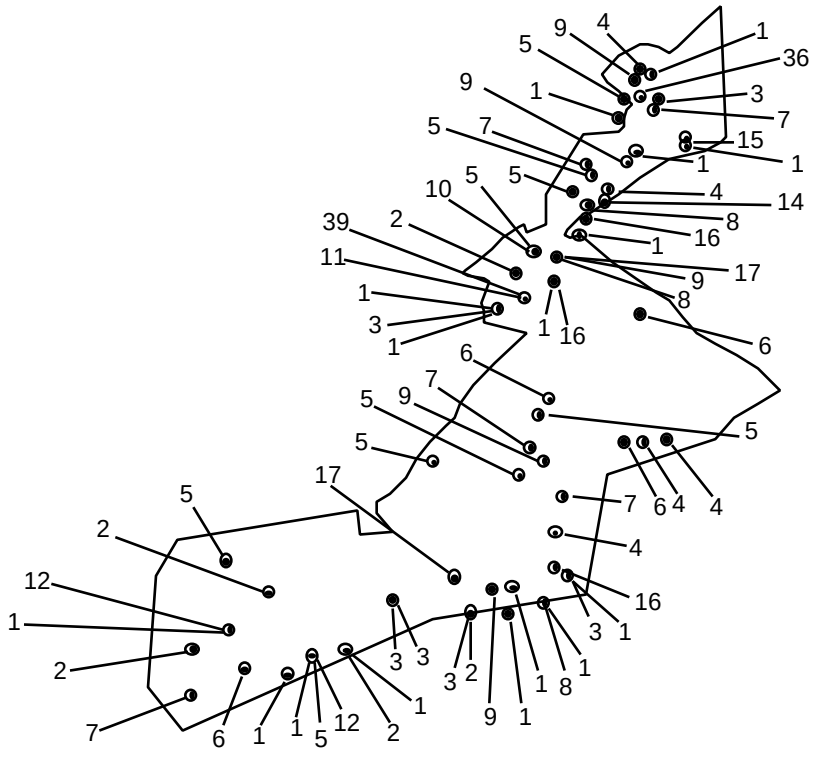

Figure 3. Elephant distribution.

Discussion

This aerial census counted 464 elephants in the study area, complementing the dung count surveys. This figure is similar to the mean estimates of 412 and 429 elephants from dung counts by Mwathe (1995) and Reuling et al. (1992), respectively, but twice the number counted by Kiiru (1995). The difference in elephant numbers between this study and that of Kiiru (1995) clearly cannot be due to natural recruitment because of the short time interval. Neither can it be explained in terms of immigration because there is no evidence to suggest that elephant migration to Tsavo and Mkomazi still exists. This difference probably lies in the different techniques used. Although both surveys were total aerial counts during the wet season, Kiiru (1995) used a Husky with transects spaced at 1-km intervals while the present study used a chopper flying on 500-m transect interval. This had the effect of increasing the scanning intensity. Additionally, a helicopter had the special advantage of being able to hover over big elephant groups and split them up, allowing observers to make accurate counts. The present study shows that it is possible to count elephants and obtain a reliable minimum number in the Shimba Hills using a helicopter, and future surveys, done seasonally, should involve the use of one.

In a total aerial survey, the most important source of bias is observer efficiency and the failure of observers to see all the animals in their counting blocks (Caughley and Goddard 1972). In this study, the significant bias was due to dense vegetation. Shimba Hills is essentially a forest ecosystem, unlike savannahs where elephant aerial surveys are popular. A thick forest impairs visibility. An example of poor visibility was observed when an area had been flown twice without spotting any elephants, but on the third flight to refuel, 12 elephants emerging from the forest were sighted in a glade. In addition, elephants were sighted in the forest during the survey but could not be counted because of poor visibility. As a result, a few elephants were uncounted.

The second bias resulted from the inexperience of some crew members who were surveying for the first time. In view of the above biases, the number of elephants from this survey should be treated only as minimum. The true mean estimate, based on dung counts (Litoroh et al. 2001) is 575 elephants.

Elephants were distributed all over the reserve including in the southern part where it was thought that elephants do not occur. The highest concentrations were around Marere and Mwaluganje areas. Kiiru (1995) recorded a similar distribution pattern. She found that elephants clearly prefer thickets and scrub. Such habitat with glades occurs at Marere and in the corridor, probably accounting for the high numbers of elephants occurring there. However, this distribution pattern probably does not reflect the true situation because ground surveys by Mwathe (1995) and Litoroh (in prep.) have recorded high elephant dung densities in high canopy forest where no elephants were spotted. Marere and the corridor area have low vegetation cover, which allows easy spotting and counting of elephants. Clearly, this survey alone does not tell the whole story about elephant distribution in the Shimba ecosystem. To form a true picture, we must consider dung counts, which cover areas of dense vegetation.

Kiiru (1995) postulated that Shimba elephants will number about 400 animals (1.7 elephants per km^2) in the next 10 years, by which time vegetation damage will have become critical. However, Mwathe (1995) contradicted this and said that elephants at an estimated mean density of 1.6 per km^2 were already causing considerable damage. He showed that tree height and density were negatively correlated with high elephant densities. Coetzee et al. (1979) studying elephants in Kruger National Park obtained an elephant density of 0.4 km^2 while Pellew (1983) found a bull elephant density of 0.2 km^2 in the Seronera area of Serengeti National Park. Both studies showed that even at such low densities, elephants were causing considerable damage. In the current study, the minimum overall elephant density for Shimba Hills is 1.9 elephants per km^2; the density in Mwaluganje was 6, which is probably one of the highest elephant densities ever recorded. The impact of such high elephant densities on vegetation cannot be overemphasized, as can be seen in the Mwaluganje Forest Reserve.

To maintain an ecological balance, the elephant density must be reduced. Translocation should be considered. In good terrain and open country, KWS commonly uses translocation to manage wildlife populations. Shimba Hills and Mwaluganje, however, present special difficulties because the terrain is rough and the vegetation relatively thick. Nevertheless, and based on the outcome of the Tiwi workshop, KWS should take a bold step and translocate elephants to reduce the population density. A density of 0.5 ele-phants/km^2 is probably suitable for the Shimba Hills ecosystem at the moment. To achieve this and have an effect, 200 el

ephants should be removed. Additionally, elephant immunocontraception should be considered as a means to stabilize the remaining population.

It is also important that KWS puts in place an elephant management policy to avoid emotional arguments against some management decisions even when the data are sufficient to support such decisions.

Acknowledgements

This survey would not have been possible without the sole financial support of the Eden Wildlife Trust. KWS authorized this survey and facilitated and coordinated it in collaboration with the Eden Wildlife Trust. I would like to thank Dr Ian Douglas-Hamilton, who provided assistance at the planning stage. Mr Halvor Astrup provided the helicopter, which was piloted by Captain Phil Mathews. Logistical support came from Ted Goss. Aerial observers in addition to myself were George Muriuki and Moses Omurambi, all of us from KWS. Paula Kahumbu, then a graduate student at Princeton University, Camilla Moore, a student from the University of Edinburgh, and Will Travers were observers with private interests. Claire Geddes helped with the cartography as well as downloading data to a computer from the GPS. Thank you all.

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FIELD NOTES

High incidence of elephant twin births in Tarangire National Park, Tanzania

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Twinning in African elephants is relatively uncommon. Evidence from population culls in Uganda (Laws 1969) indicates that on average, 1% of conceptions produce twins. Data from a long-term demographic study in Amboseli National Park, Kenya (Moss 2001), suggest that twinning may be rarer still; only one set of twins was recorded from 1192 births over 30 years. In Tarangire National Park, Tanzania, a group of 139 individually known adult females has been studied since 1993, with accurate demographic records kept. Among 291 recorded births, 14 (5%) have been twins. Of the seven twinning cases, five produced one male and one female infant, and in the other two cases both infants were females.

One remarkable female elephant, named Willow, has produced three consecutive sets of twins within a period of seven years. Her first set was born in mid-1992, the second set in the second week of April 1996, and the third on 21 April 1999. Interbirth intervals were therefore approximately four years between the first and second set, and exactly three years between the second and third set. On each occasion one of the infants was male and the other female. The male of the first set of twins died in unknown circumstances in 1997 at age five, and the male of the third set of twins died within six months of birth, again for unknown reasons. The twins born in 1996 have survived to date. A second female within the family group (assumed to be a close relative of Willow, possibly a sister) also produced twins, both female, in 1991. Her next calf, a single male, was born in May 1995—an interbirth interval of approximately four years. The birth dates and sexes of the seven twin births are summarized in table 1.

Evidence from humans suggests that twinning is genetically influenced, with some families and individuals being more predisposed than others (White and Wyshak 1964). While little research has been conducted in this field on non-domesticated animals, observation of multiple occurrences of twins within a family group suggests that a similar pattern might also occur in elephants.

Table 1. Data on birth date, sex and mortality of the seven twin births in Tarangire

Mother	Birth dates of calves	Sex of twins	Infant deaths
Willow	1992	female/male	male 1997
Whisper	1992	female/male	—
Fiona	1993	female/male	female/male 1993
Willow	April 1996	female/male	—
Willow	April 1999	female/male	male 1999
Eleanor	March 2000	female/female	female/female 2001[a]
Pandora	April 2000	female/female	—

[a] mother died June 2000

The 1996 set of Willow's female and male twins has been closely monitored over the past six years. Competition levels between the male and female infants were high during the weaning period, with the male directing all aggression towards the female. If the female attempted to suckle when the male was suckling on the other breast, the male would run over and push her away with his head and then suckle on that breast himself. The male was also seen preventing the female from suckling when not suckling himself, again by running up and ramming the female with his head. The female had to wait until the male was sleeping or playing before suckling. Despite these persistent feeding interruptions, the female infant remained in good physical condition, with fat covering the entire lumbar region and no lumbar depression visible (Albl 1971). There was very little competition between the pairs of female twins, and in both sets the infants were repeatedly seen suckling at the same time.

Despite monopolizing their mother's milk, Willow's male infants in the sets of twins proved to be the more vulnerable, with two of the three dying before age five. Mortality among all twins was high, with 6 of the 14 infants (43%) dying by the age of five. In two cases both the twins died (in one case following the death of the mother), and in two other cases, one twin died (table 1). This is a far higher mortality rate than the 13% (35 deaths among 277 infants) recorded for single infant births ($c^2 = 7.32$, $p < 0.007$). It is probable that mothers of twins are less able to meet their infants' nutritional requirements, and the fact that there are two infants may also increase the chance of one becoming separated from the family group. Male infants, with their higher growth rates and greater milk demands (Lee and Moss 1986), are likely to be particularly vulnerable.

In a highly unusual incident, one set of three-month-old female twins was adopted by their eight-year-old brother, following the death of their mother. The young male guided the infants, adjusting his travel speed to suit theirs. The trio of siblings spent most of their time apart from their family group. Remarkably, the male would allow the infants to allo-suckle. An infant would initiate the suckling by pushing the male's front leg forward with her head, causing the male to pause. In each case, the infant terminated the allo-suckling. On several occasions both infants were seen allo-suckling at the same time. The infants learned what to eat by feeding from the same vegetation as the male and remained in good physical condition throughout the dry season. This unusual group was seen for a period of six months, after which all three disappeared (November 2001).

It is unclear what underlying factors were responsible for the surge of twins recorded in Tarangire. The Tarangire elephant population has been growing extremely rapidly since 1994, with females and infants increasing at an average rate of 10% per annum. Two factors are probably responsible for this rapid growth spurt: first, the marked reduction in poaching following the ban on ivory trade in 1989, and second, a period of several consecutive extremely wet years. The elephants within Tarangire and the surrounding areas suffered heavy poaching during the 1970s and early 1980s (Foley et al. 2001). This caused the elephant groups to cease their traditional seasonal dispersal to areas outside the park and remain in the park year-round. In apparent response to the poaching, some elephant families formed large herds of 300 or more animals that moved as a single unit, presumably as a defense mechanism. When poaching ceased after 1989, the majority of the elephant family groups resumed their normal movement and aggregation patterns. With this release from the human-induced behavioural change, most external stressors that had contributed to restricting reproduction were removed, and the reproduction rate increased dramatically.

From 1996 to 1998 Tarangire experienced very heavy rainfall, linked in part to the El Niño phenomenon. During these three years, an average of 1000 mm per year fell, compared with the normal yearly average of 680 mm. The resulting abundant vegetation meant that females maintained excellent body condition year-round, and thus the time required to achieve post-partum oestrus was reduced. The average interbirth interval for non-twinning females in 1996 was 3.37 S.E. 0.14 ($n = 60$). This compares with an average interbirth interval of 4.5 years found in the Amboseli population (Moss 2001). There are no published records for interbirth intervals for females with twins, although these would probably be higher than the average interval for single offspring given the increased physiological demands on the mother. Of the seven twinning events, only four have been followed by another birth thus far. The interbirth intervals following the twin births were 3, 3, 4 and 6 years. While the abundant vegetation may have reduced interbirth intervals for twin-bearing females, the high incidence of twinning found in this study could not be attributed solely to rainfall. Four of the

seven sets of twins were born before or during 1996, before the females were able to take advantage of the good forage conditions.

Acknowledgements

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Clinical treatment of a leg problem in an adult bull elephant

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An adult bull elephant at Mikumi National Park, Morogoro, Tanzania, was reported to have a swollen left foreleg, which made it difficult for the animal to walk. The animal was emaciated, it could not feed and drink normally, and it did not put full pressure on the swollen foreleg when walking. We attempted to determine the cause of the problem through clinical and laboratory examinations.

The animal was immobilized using a combination of 12 mg etorphine and 40 mg azaperone administered using a Telinject® (USA) dart gun. Detailed clinical examination showed a stiff carpal joint that was permanently contracted. Manual flexing was im-possible. An attempt to aspirate from the joint produced bloody fluids. The left foreleg was grossly enlarged compared with the right foreleg with the circumference of the left carpal joint some 18 cm larger than the right carpal joint. Haematological values showed a marked leukopaenia (decrease of the total white blood cell count) with a relative neutrophilia, lymphopaenia and monocytosis (table 1). This would be consistent with an animal in poor condition suffering from nutritional stress with perhaps a severe chronic infection. Although definitive diagnosis was not possible, the case was tentatively considered as chronic arthritis based on the facts that the condition involved a joint and the joint movements were greatly altered.

Both antibiotics and anti-inflammatory drugs are indicated for treatment of foot pathology. Domestic animals having this type of ailment are usually treated using analgesics and anti-inflammatory agents for a considerable period, and rested (Fraser 1986). However, this is not possible with free-ranging wildlife. The elephant was treated using a combination of an anti-inflammatory agent (dexamethasone; Dexacotyl,® Coophavet, France) and a long-acting antibiotic (oxytetracycline; Oxyject,® Dopharma, Netherlands). The anti-inflammatory agent in this case was useful for reducing soft tissue swelling and providing analgesia. It has been shown that in an elephant, lack of mobility has serious consequences not only for the foot but on the animal's health in general. The compression and relaxation of the digital cushion serves an important function in pumping venous blood from the foot on its return to the central nervous system (Fowler 2001). Early ambulation for this elephant was therefore important.

Table 1. Haematological values of an elephant with swollen left foreleg compared with known reference values

Parameter	Case value	Reference values[a]
Total red blood cell count	2.4×10^6 cell/µl	$3.77 \pm 0.25 \times 10^6$ cell/µl
Total white blood cell count	1.95×10^4 cell/µl	$11.4 \pm 0.98 \times 10^4$ cell/µl
Packed cell volume	37%	—
Haemoglobin concentration	7.62 g/dl	7.04 ± 0.44 g/dl
	Differential leukocyte count (%)	
Neutrophil	33	20.2 ± 0.6
Lymphocytes	50	69.1 ± 1.9
Monocytes	16	8.2 ± 0.03
Eosinophil	1	1.3 ± 0.03
Basophil	0	0.1 ± 0.08

[a] After Debbie and Claussen (1975)

When using antibiotics on elephants, zoo veterinarians generally administer either an equine dosage extrapolated by a metabolic or allometric scaling technique or a dosage based on pharmacokinetic research (Mortenson 2001). The doses used in the present case were therefore empirically derived from manufacturer recommendation. A dose of 6 mg/kg (150 ml) of dexamethasone (recommended dosage for domestic animals ranges from 2 to 10 mg/kg) and 8 mg/kg (200 ml) of oxytetracycline (recommended dosage for domestic animals ranges from 10 to 20 mg/kg) was therefore administered. Dexamethasone was injected intravenously through the ear vein while oxytetracycline was administered by deep intramuscular injection below the base of the tail. Ten days after treatment, the animal's gait was reported to have improved, and it was foraging and had moved to a waterhole, which it had not been able to do before. We had planned to re-examine the bull's health status but it disappeared and we could not retrace it.

Leg problems are not uncommon in free-ranging elephants (Kenya Wildlife Service, pers. comm.), and when they occur they normally bring about death. They can result from being hunted—with bullets, spears and arrows, or snares—or from natural injuries such as from thorns. Young elephants appear susceptible (Richard Kock, pers. comm). As many cases likely go unreported, the incidence of leg problems in free-ranging elephants in Tanzania is unknown, although leg injuries are thought to be one of the more common causes of death in a population. We therefore recommend that the appropriate authorities collect data on this aspect of elephant health.

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MIKE implementation in Botswana

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Botswana currently holds Africa's largest population of elephants, and the present count of 120,000 (DWNP 1999) is increasing at 5% per year. They are mainly found in northern Botswana, occupying a range of approximately 80,000 km^2. A smaller population estimated at 800 in 1995 occurs in the Tuli Block in eastern Botswana. The total elephant range accounts for 14% of the country's surface area, but only 12% of the range is in protected areas.

As a signatory to the Convention on International Trade in Endangered Species (C1TES), Botswana is committed to implementing the resolutions and decisions that are made by the Parties to the Convention. At the 10th meeting of the Conference of Parties held in Harare, Zimbabwe, on 9–20 June 1997, Botswana, Namibia and Zimbabwe presented a proposal to downlist their elephant population from Appendix I to Appendix II, and to undertake a one-off sale for non-commercial purposes of government ivory stockpiles. The proposals were acceded to on condition that these countries would agree to and participate in an international reporting and monitoring system for legal and illegal international trade through an international database maintained by the CITES Secretariat and TRAFFIC International.

Monitoring the Illegal Killing of Elephants (MIKE) is the monitoring system that ClTES uses to assess the impact of its decisions on illegal hunting of elephants in range states. MIKE objectives as stipulated in Resolution Conf. 10.10 (rev.) are

- to measure and record levels and trends of illegal hunting in elephant range states and in trade entrepots
- to assess whether and to what extent observed trends are related to changes in the listing of elephant populations in the CITES Appendices and/or the resumption of legal international trade in ivory
- to establish an information base to support the making of decisions on appropriate management, protection and enforcement needs
- to build capacity of personnel in range states.

MIKE officially got under way in Botswana in September 2000. The official MIKE site for Botswana is Chobe National Park in the northern part of the country. With an area of 10,566 km^2, Chobe National Park accounts for about 45% of the district in which it is located. As more activities related to elephants are outside the protected areas than within, the Department of Wildlife and National Parks (DWNP) has extended the MIKE activities to other elephant range areas: Chobe East and West surrounding the park, the Okavango area north of the buffalo fence, and the northern Tuli Block.

To collect and record data, four forms are being used: elephant carcass report, ground patrol report, monthly report and annual report. Maps and reports have been produced and data compiled only for Chobe National Park, the official MIKE site. For the other areas, similar information has been collected from the field but is yet to be entered into the database.

The annual report for 2000 and reports for January to April 2001 have been submitted to the MIKE regional coordinator in Namibia and the CITES Secretariat. Reports for May to December 2001 and the annual report for 2001 are in preparation.

Progress in implementation

In accord with MIKE resolutions, Botswana has appointed a MIKE national coordinator, who is based at DWNP headquarters in Gaborone, and site coordinators at Kasane, Mathathane and Maun. Consultation and basic training through workshops have been extended to other patrolling units that are taking part in MIKE. Two training workshops were conducted for patrol teams in November 2000 and July 2001.

Patrol teams that come to Chobe District on rotation are briefed on MIKE and how to collect and use data. The briefings are conducted by the Kasane site coordinator. To date, the outside patrol teams have provided most of the data from the field while little has come from DWNP patrol teams, who are short of staff and resources. Currently there are 100 staff for the whole of Botswana and only about 18 are available for patrolling the Chobe District including Chobe

National Park, making a regular monthly patrol of the site impossible.

Information on elephant carcasses and patrols conducted in Chobe National Park has been presented to the CITES Secretariat and to the CTIES southern Africa regional coordinator in Namibia.

Twenty-four carcasses have been reported, 13 resulting from natural causes. The department was faced with poaching problems in April and May 2001 when 11 elephants were poached around Nogatshaa area and Maikaelelo Forest Reserve. An aerial patrol and more intensive ground patrols were conducted in the area.

A CITES MIKE delegation consisting of the newly appointed director of the MIKE programme (Africa-Asia), the MIKE subregional support officer for southern Africa, and four national coordinators from Eritrea, Kenya, Tanzania and Uganda recently visited Botswana to learn how MIKE was being implemented in the country.

After their visit the MIKE director made the following recommendations for the Botswana group:

- Establish and maintain subregional dialogue, to be handled by the subregional coordinator. Representatives should be selected for a meeting on data management and procedures to be held in 2002.
- Analyse and summarize MIKE data collected by Botswana and use this to develop a system for analysing the data.
- Establish an 18-month work plan incorporating the funding applied for from the Botswana Wildlife Conservation Trust Fund in conjunction with funds currently available for MIKE.
- Identify training needs for Botswana and the southern Africa subregion and plan a training schedule for 2002.
- Link Botswana's initiative on GIS development into the overall MIKE data management system.
- Find solutions to the human–elephant conflicts along the borders of Chobe National Park.

The director of the MIKE programme, Nigel Hunter, agreed to initiate a meeting with the CITES Secretariat for the elephant range states in September 2002 in preparation for the CITES (COP12) meeting in Santiago, Chile in November, but with MIKE progress as the central theme.

Problems faced implementing MIKE

Patrol team forms incomplete. Most of the information that is missing is because of the need for security. Other missing information, such as the coordinates and exact locations of the carcasses or patrol routes, is because of the lack of GPS. The information is crucial for plotting the patrols and carcass locations.

Shortage of GPS and cybertrackers for recording geographical positions of the patrol routes, carcasses and illegal activities. It is important to record these GPS coordinates as they show the department the areas where more continuous patrolling is needed. Presently, there are only a few GPS in use; most park staff do not have the equipment as funds for purchasing it are not available.

Lack of training in implementation of MIKE such as use of GIS ArcView mapping in plotting maps, and analysis of data using a spreadsheet. Staff should be trained in mapping and in using databases to compile and analyse the available data. Such training would guide management in assessing the project and enable it to see where more effort is needed. Also it is important to give the patrol teams the results of the data analysis to show them that their efforts are appreciated.

Shortage of vehicles for continuous patrol teams in the field. DWNP patrols lack vehicles to conduct patrols and must depend on vehicles from outside.

Shortage of manpower to conduct MIKE activities. As MIKE is an additional activity for the department, it was not budgeted for. Staff at Kasane can provide only three teams for patrolling the whole district. It is impossible for them to patrol the site area monthly as they have other areas to cover as well. There is also a shortage of manpower and resources to conduct aerial patrols, as emergency issues frequently arise that need to be covered urgently.

Data collection problems such as recording teeth, hind foot and shoulder measurements. There are problems in recording the teeth as it takes time for the jaws to rot and loosen so that measurements can be taken. Sometimes the carcass is found at a place so distant that it is not economical to go back just to measure the teeth.

Lack of current updating on MIKE issues and the implementation programme in other countries and regions.

Lack of feedback from the CITES Secretariat and regional coordinator for southern Africa on reports submitted to them. Staff are not sure if they are recording what MIKE needs. Since MIKE was implemented in Botswana, no feedback has been received

on quality or adequacy of data collection. This has discouraged the patrol units.

Recommendations

The Department has submitted a proposal to the Board of Wildlife Conservation Trust Fund requesting funds to purchase equipment needed for the implementation of MIKE and also for

- training in basic and advanced Arcview and Access in 2002
- training in the use of GPS and cybertrackers
- standardization and supplemental training of field staff in 2002
- development of practical ways to determine carcass age
- setting of guidelines on ivory storage and cataloguing

The Department should conduct quarterly aerial patrols in addition to the ground patrols in the site area. The aerial patrols should cover remote parts of the park not accessible by vehicle.

Data collected for the MIKE programme should be at the site and national levels Training in storing data and improving its analysis needs to be developed at the site area. Implementers will then be able to appreciate and value their own efforts.

Procedures need to be set up as a general MIKE guideline for testing carcasses for anthrax, using experience from Etosha National Parks, Namibia, as well as from Botswana.

Elephant status and conservation in the Upper Bandama Game Reserve, Ivory Coast

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In West Africa, elephant *(Loxodonta africana)* populations remain vulnerable because they are small and often isolated.

Once, Ivory Coast was considered the country where elephants were the most abundant in West Africa. Today less than 1200 animals are estimated to be living there. As in all of West Africa, elephants suffer from the loss of habitat because of people's need for land and the hunting pressure for trade in ivory and bush-meat.

The Upper Bandama Game Reserve, gazetted in 1973, is the largest game reserve in Ivory Coast.

The reserve, situated in the centre of the country (between 8° 13' and 8° 45' N and 5° 20' and 5° 30' W) (fig. 1), covers 1300 km^2. Vegetation, of the Sudan-Guinean type, is dominated by woodland savannahs. It was observed that 60 elephants lived in the reserve in the 1980s. However, it is highly unlikely that this number has remained stable.

During a reconnaissance flight carried out in 1996 with a Cessna 172 along flight lines 2 km apart, no elephants were seen. It cannot be concluded, however, that no elephants were present. Between 1995 and 1999 several people observed elephants when flying over the area. But as large forest patches remain inside the reserve, too thick to allow accurate observation from the air, ground observations are necessary. In the 1990s, the estimate was that there were 40 elephants. Today the figure of 20 is more realistic. It is possible that the elephants moved away from the game reserve, but it is not probable because the increasing amount of human settlement around the reserve make it unlikely that elephants could find sanctuary outside the reserve.

Hunting pressure is high in Ivory Coast, for both

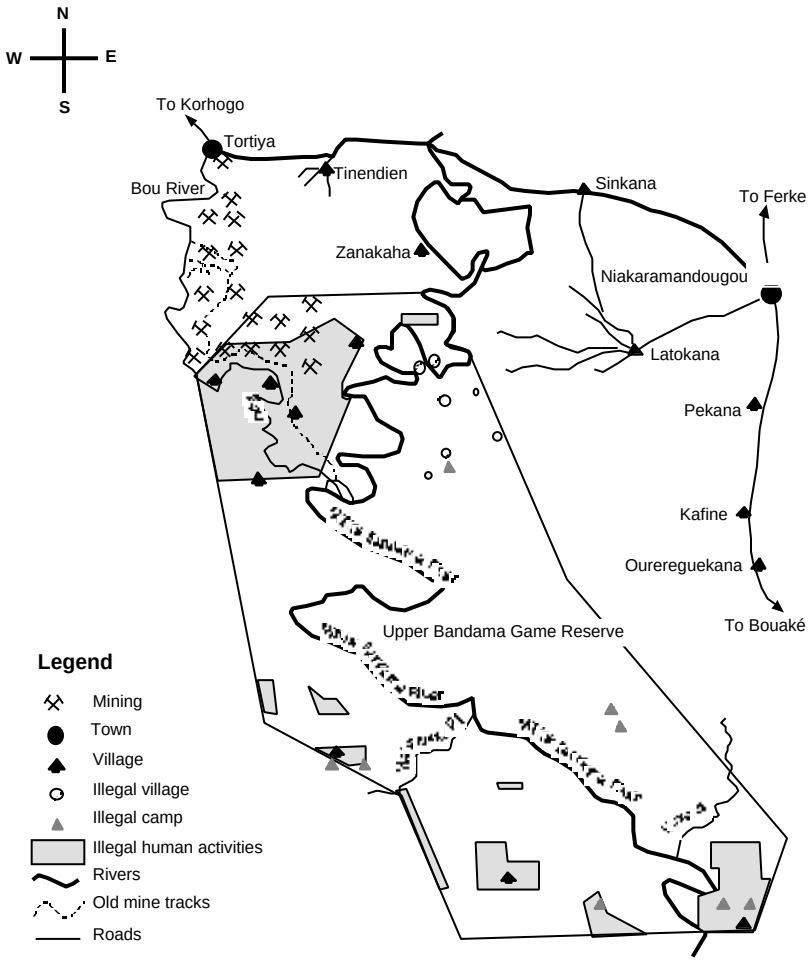

Figure 1. Map of Upper Bandama Game Reserve and environs.

ivory and meat. Game meat commands a higher price than does domestic meat. Rural people depend on bushmeat to supply their protein needs, and they also use it for medicines. For hunters and their well-organized bushmeat network that supplies town markets, hunting down an animal that weighs more than 1500 kg means good revenue, especially with the sale of ivory. Hunting is encouraged by the fact that 12-calibre bullets are freely sold in shops called 'cartoucherie' in each town. Local elephant hunters are able to kill elephants with home-made guns by loading the powder and the lead of several cartridges into one shot. Military guns are readily available because of the war in Liberia.

With increasing human population and the urge for more land for crops and cattle, elephants are increasingly confined to protected areas. However, even the protected areas are subject to poaching. The lack of logistical supplies and sufficient staff in many protected areas in West Africa prevents adequate conservation of wildlife in general and of elephants in particular. The consequence is that two-thirds of the elephants in the Upper Bandama Reserve have been lost in the last 10 years. Maybe this small population can still find some refuge inside the remnant forest patches of the reserve.

Upper Bandama, the largest game reserve in Ivory Coast, suffers, as do many other reserves in West Africa, from the lack of materials, logistical support and sufficient staff—but also from the lack of land and conservation management.

The situation is not favourable for elephant conservation in Ivory Coast unless the protected areas are better managed.

Erratum

Please note the following corrections in the paper in issue 31 'Elephant census in the Ankasa Conservation Area in south-western Ghana', by Emmanuel Danquah, Yaw Boafo, Umaru Farouk Dubiure, Nandjui Awo, Emmanuel M. Héma, Mildred Amofah Appiah. Corrected maps:

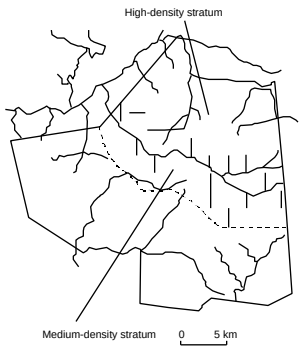

Figure 2. Ankasa Conservation Area showing the distribution of transects in the high- and medium-density strata.

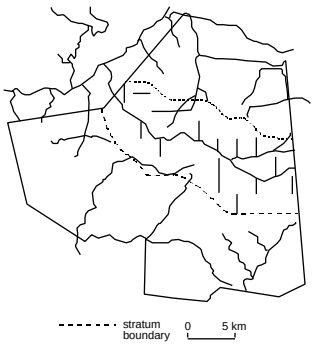

Figure 4. Ankasa Conservation Area showing the distribution of transects after the post-facto stratification.

The last paragraph under 'Post-facto stratification', p. 66–67, should read as follows, with the additions indicated in bold:

Elephant numbers were derived by using the steady-state assumption model of elephant densities: dung pile density as given in table 1, dung **decay** rates from Barnes et al. (1994) and defecation rates from Tchamba (1992). **The combined estimate was 27 with 95% confidence limits of ± 20, that is, 27 ± 20. The post-facto stratification gave an estimate of 21 ± 15.** Values were multiplied by the area of each stratum (table 1). Elephant numbers thus derived were 11 ± 15 in the high-density stratum and 16 ± 16 in the medium-denmsity stratum.

REPORT

Fifth meeting of the African Elephant Specialist Group

Leo Niskanen

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The fifth meeting of the African Elephant Specialist Group took place in Shaba National Reserve in Kenya from 28 January to 1 February 2002. The meeting was attended by 36 out of the current 48 AfESG members. It was made possible by funding from the European Commission, the United States Fish and Wildlife Service and the UK Department for Environment, Food and Rural Affairs.

The tightly packed agenda consisted of technical presentations and work sessions on a variety of issues relating to African elephant conservation and management. The main themes are summarized here.

Multiple species of African elephant

One of the main topics concerned the conservation and management implications of the fact that the African elephant appears to be not one but multiple species. The session began with presentations from three geneticists who had been invited to present the findings of their recent studies on the taxonomic status of African elephants.

The first presentations were given by Alfred Roca of the Laboratory of Genomic Diversity of the US National Cancer Institute and Nicholas Georgiadis of the Mpala Research Centre in Kenya. Evidence from their study, recently published in *Science*, suggests that Africa is, and has long been, home to two distinct species, one inhabiting rainforests and the other savannahs. Genetic data leading to these conclusions are based on single-copy nuclear DNA sequences and comes from several hundred samples from 20 populations in 10 countries. Additional data based on maternally inherited mitochondrial DNA sequences and nuclear 'microsatellite' markers from the same samples provide new insights about the history of hybridization between forest and savannah elephants.

Next, Lori Eggert presented as yet unpublished findings of another recent study by a team from the University of California at San Diego. In this study mitochondrial cytochrome *b* and control region sequences and four microsatellite loci extracted from dung samples were examined to investigate the genetic differences between forest and savannah elephants of western and central Africa. The data were combined with published control region sequences from across Africa to examine continental patterns. The analysis revealed three deeply divergent lineages that do not correspond with the currently recognized taxonomy: 1) forest elephants of central Africa, 2) forest and savannah elephants of West Africa, and 3) savannah elephants of eastern, southern and central Africa.

These presentations were followed by discussion about the potential conservation and management implications of such findings. The group concluded that although strong evidence exists to support the view that there is more than one species of African elephant, taxonomic status remains uncertain. Furthermore, some populations of high conservation value may consist wholly or partly of interspecific hybrids. Prematurely allocating Africa's elephants to two or more species could result in significant populations being left in taxonomic limbo. Therefore, AfESG strongly encouraged further genetic and morphological studies to resolve this situation and assisted with suggestions for further sampling. Until this sampling is done, AfESG will continue to refer

to the single species *Loxodonta africana* but as far as possible will distinguish between forest (*cyclotis* form), savannah (*africana* form) and to a lesser extent West African elephants. AfESG further recommended that

- nuclear DNA analysis of the existing West African samples be carried out
- additional genetic samples from a wider range of sites be collected and analysed

Consensus needs to be clear among scientists working on this issue on the significance of the genetic and morphological data before taxonomic changes are made.

The AfESG Chair has been mandated to advise the membership when these conditions have been met and will seek consensus among the membership before implementing the changes in the treatment of the genus *Loxodonta* as agreed by AfESG.

Listing of the African elephant by IUCN Red List Criteria

At the last AfESG meeting in Burkina Faso in 1998, the group agreed to re-examine the continental listing of the African elephant as soon as the new listing criteria, including the proposed regional and national criteria, were finalized.

The Red List criteria are generally poorly designed for species such as African elephants, which are long-lived and widely distributed and whose status differs across their range. There has also been much discussion about the time scale used for the listing by criterion A. To assess a taxon against criterion A, it is necessary to estimate the overall reduction in the last three generations. It has been widely felt that this time scale (approximately 60 years in the case of African elephants) is inappropriate as it is based solely on biological considerations and not on other important factors determining the status of the species. The members suggested that it might be more realistic to look at a shorter time scale over which there is more confidence about both changes in numbers and the factors affecting them. In addition, they expressed concern that some populations of high conservation value might end up being classified as interspecific hybrids under the proposed multispecies system, but the current Red List criteria have no way of dealing with this issue.

In spite of these reservations, AfESG agreed to become the IUCN Listing Authority on the African elephant and to carry out as a necessity the global listing for *Loxodonta africana* as it is now described. It was further recommended that separate listings be carried out for a separation between savannah and forest populations in anticipation of further clarification on African elephant taxonomy. Further analysis of West African savannah and forest populations should also be carried out if future studies lend additional support to the theory of a distinct West African species.

A new Red List task force was set up to take this process forward in close collaboration with the IUCN Red List programme. The task force is composed of David Balfour (head), Debbie Gibson and Nigel Leader-Williams. It is supported by the data review working group in compiling and considering population estimates and applying the Red List criteria.

Guidelines for reintroducing African elephants

As shown by the many case studies presented at the meeting, elephant translocation is a highly technical and expensive undertaking. Many animals have been translocated in recent years in Africa, often with little technical guidance from elephant experts. Over the past year, in an effort to fill this technical vacuum the AfESG Secretariat has been discussing with the IUCN SSC Reintroduction Specialist Group (RSG) the possibility of producing guidelines for reintroducing African elephants. A new reintroduction task force (RTF) has now been formally appointed to complete this task. The RTF will work with the secretariats of the two Specialist Groups during the next year to draft these guidelines. AfESG members Holly Dublin, Ian Whyte, Marion Garai, David Balfour and Moses Litoroh will be joined by Richard Kock, the vice-chairman of the IUCN SSC Veterinary Specialist Group, as the main technical experts in the new task force. Micky Soorae and Leo Niskanen, programme officers of RSG and AfESG respectively, will provide support from the two Specialist Group Secretariats.

During a special working session on this initiative, AfESG members provided worthwhile suggestions on a number of technical issues to be included in the guidelines. These recommendations will serve as a useful starting point for the RTF when it holds its first meeting to discuss a detailed work plan. If funding allows, this first meeting should take place before the end of 2002.

Illegal killing and trade issues

The session on illegal killing and trade began with several presentations on the CITES system for Monitoring of Illegal Killing of Elephants (MIKE). After a brief overview by Nigel Hunter, the MIKE director, John Hart described the results of the central African MIKE pilot project. This was followed by a presentation by Leonard Mubalama on the development of the MIKE pilot phase in the Ituri Forest in the Democratic Republic of the Congo.

From the pilot project a number of recommendations have emerged. The dung count method for population estimates has proved viable but calibration with defecation and decay rates needs further refinement. The use of other population survey methods that are emerging, such as the potential use of infrasound and 'camera trapping', should also be investigated. The movement patterns of radio-collared elephants may help to streamline further a stratified approach to work on population surveys. It was also felt that, as and where possible, monitoring of human–elephant conflict should be incorporated into data collection protocols at the MIKE sites. Finally, the pilot experience has emphasized the importance of intelligence networks, and it is recommended that information produced by such networks be incorporated into the overall analytical framework.

Thato Morule, the MIKE national officer for Botswana, gave an update on MIKE implementation in her country (see field note on p. 69). A MIKE national coordinator is now based in Gaborone and site coordinators have been appointed at Kasane, Mathathane and Maun. Consultation and basic training through workshops have been adapted and extended to other patrolling units outside Chobe National Park, the designated MIKE site for Botswana. To date, the annual report for 2000 and reports for January to April 2001 have been submitted to the CITES Secretariat and the regional MIKE coordinator for southern Africa. The need to have this information analysed was emphasized. Shortage of personnel, vehicles, field equipment such as GPS, cybertrackers and computers were mentioned as some of the problems encountered so far.

An update on the elephant trade information system (ETIS) was presented by Tom Milliken of TRAFFIC East and Southern Africa. After a brief explanation of what ETIS is and how it relates to the MIKE programme, he presented recent figures on illegal ivory seized, number of seizures by year and top countries in terms of seizures. The information flow of the ETIS system was explained and it was shown how implementing ETIS at the national level depends on teamwork between officials in several branches of government and other parties in the respective countries. The ETIS reporting mechanism was also explained along with the output in the form of the reports produced by ETIS. Delays in the submission of information by the authorities responsible have presented the system with some problems.

The session finished with a number of reports on illegal killing from specific sites and countries.

Human–elephant conflict

Richard Hoare presented the work that the human–elephant conflict task force has done over the past three years. He then made a number of presentations on various aspects of human–elephant conflict from across the continent, ranging from managing cattle for elephants in Ghana to the traditional deterrent methods used to mitigate human–elephant conflict in Kenya and Zimbabwe.

The human–elephant task force was reappointed and more appropriately renamed the human–elephant conflict working group (HECWG). Members for the current triennium are Richard Hoare (chair, Zimbabwe), Moses Kofi Sam (Ghana), Patrick Omondi (Kenya), Loki Osborn (Zimbabwe) and Cece Papa Conde (Guinea Conakry). HECWG will continue to field-test and improve methods for assessing and alleviating human–elephant conflict such as the new decision-support system designed to help plan effective mitigation strategies. Other plans include producing standardized maps from satellite images of human–elephant conflict zones.

African elephant status report and the data review working group

An update on progress towards completing the next African elephant status report was provided by Julian Blanc, the African elephant database manager.

At the meeting of the data review task force, which was held in Kenya from 30 November to 2 December 2001, a target date of mid-2003 was set for publishing the next African elephant status report. The data review task force also spent considerable time at the meeting on developing a revised data dissemi

nation policy, which was formally approved by the members at this meeting.

The membership of the task force, renamed the data review working group, was also reappointed. Members are Richard Barnes, Colin Craig, Iain Douglas-Hamilton, Holly Dublin and Chris Thouless. A member will be appointed to assist with central African data on status.

National and subregional elephant management strategies

The progress made in the development and implementation of elephant conservation strategies and management plans since the last meeting in 1998 has been truly astounding, particularly in West Africa.

In September 2001, Lamine Sebogo, the AfESG programme officer for West Africa, finished his tour of the range states in that subregion to introduce the West African elephant conservation strategy (WAECS) to governments, NGOs, donor organizations and other institutions involved in elephant conservation and management activities. Subsequently the Convention on Migratory Species adopted this strategy, and the Economic Community of West African States (ECOWAS) has given the initiative priority.

The promotion of WAECS has stimulated a flurry of activity on a national scale. Ghana is busily implementing its national strategy and is looking for additional funds to continue this process in the coming years. A workshop was held in Burkina Faso in January 2002 to discuss the development of a national elephant strategy, and similar workshops will be held in the near future in Benin, Ivory Coast and Togo.

In southern Africa the review and update of the Botswana elephant management plan has been put out for tender by the government of Botswana, and a proposal has been submitted to the United States Fish and Wildlife Service for implementation of the activities. A technical workshop, followed by a participatory stakeholder meeting, is now planned to discuss key management issues such as human–elephant conflict and utilization.

Unfortunately, progress on the development of the Central Africa elephant conservation strategy (CAES) has been less impressive. The coalition of non-governmental organizations and national wildlife authorities formed in the year 2000 with the mandate of moving the process forward got bogged down and lost direction soon after it was set up. While the political will of the national wildlife authorities remains strong, the process needs to be driven by committed persons, just as it has been in West Africa. AfESG will assist with this process but it was agreed that the most appropriate role for Elie Hakizumwami, the new AfESG programme officer for Central Africa, is likely to be to promote the strategy once the subregion is ready to take the next steps towards its development.

Technological advances working group

A new technological advances working group was formed at the request of several members. The new working group will start by examining the latest developments in the field of GPS radio tracking. The expected output is a series of desired specifications for these collars. Recommendations from the working group on this and future technological tools will be made available on the AfESG Web site. The new group will be chaired by Loki Osborn. Other members include Iain Douglas-Hamilton, Mr Charles Foley, Richard Hoare, Mme Andrea Turkalo and Ian Whyte.

New guidelines for dung counts

The development of a 'how-to' manual on dung counting methods covering such areas as stratification, sampling, counting and analysis was suggested. Richard Barnes will be working closely with the MIKE programme and the AfESG Secretariat in an effort to seek funding for this initiative.

The meeting, which turned out to be one of the most productive and enjoyable African Elephant Specialist Group meetings to date, was made all the more memorable by a visit on the fourth day to the Samburu National Reserve. After observing the resident elephant herds the members visited the Save the Elephants field station where they were introduced to the ongoing work on GPS tracking by Iain Douglas-Hamilton and the Save the Elephants staff.

BOOK REVIEW

The South and South East Asian Ivory Markets

by Esmond Martin and Daniel Stiles

Save the Elephants, PO Box 54667, Nairobi, Kenya, and
7 New Square, Lincoln's Inn, London WC2A 3RA, England
published 2002, ISBN 9966 9683 2 6
available from Save the Elephants without charge except for shipping

review by Kees Rookmaaker

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In a perfect world, we would be able to track down herds of elephants in the wilderness areas of Africa and Asia to study their behaviour, take photographs and enjoy the playfulness of their 'tiny' babies. People would also be able to use domesticated elephants for peaceful work without doing any harm to the animals. In a perfect world, some of the tusks could be traded and used by skilful ivory carvers to produce timeless pieces of art to be admired and treasured by rulers, gentry and their subjects alike. Reality mars this picture of relative equilibrium. The immense and endless herds have gone forever through human greed and encroachment of habitat and they are not likely to return in their old glory. Fortunately, elephants are still to be found in their original habitat, maybe half a million in Africa and 50 thousand in Asia, but this represents such a small fraction of former abundance that the decline of the past decennia has to be stopped or reversed. That requires an incredible international effort on all fronts.

The poaching of elephants in their natural habitat is an unquestionable threat. The animals are killed for their tusks, which are either carved for the local market or traded and sold elsewhere, all with large economic returns. The international trade is prohibited among countries that have acceded to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), while internal trade and sale are often restricted or forbidden under national laws. However, conventions and laws are not always easily enforced, and the impact of the policies must be monitored regularly to ensure their effectiveness or to pinpoint possible weaknesses. Esmond Martin and Daniel Stiles set out to provide the baseline data necessary for this assessment. Following their previous report, *The Ivory Markets of Africa* (reviewed in *Pachyderm* no. 29, p. 61), they now focus their attention on the countries of South and South East Asia, which have significant numbers of elephants and which sell ivory items. I am pleased that previous discrepancies in methods and questionnaires have been ironed out, resulting in a uniform and well-reasoned dataset.

From November 2000 to March 2001, the two authors individually studied the shops and markets of Cambodia, Laos, Myanmar, Nepal, Singapore, Sri Lanka, Thailand and Vietnam. The result of their investigations is laid down in this handsome book of 89 pages, with informative drawings by Andrew Kamiti and four pages of colour photographs of ivory for sale. Moreover, the book is available from the publishers without charge except for shipping. Ideally, this book should find its way to the desk and later the shelves of all those who are interested in elephants and their preservation.

A thorough investigation of eight Asian countries in five months is a daunting task, which the authors have tackled with their usual resourcefulness and ini

Esmond Martin

This elephant in Angkor Wat, Cambodia, has had its tusks cut off—in the region, a popular way of obtaining ivory to carve.

tiative. Usual, because especially Esmond (Bradley) Martin is no newcomer to this field, having monitored and explored the trade of ivory and rhinoceros horn in many incisive and crucial surveys. We would not have the knowledge about the reasons for the decline in elephant numbers without his continuous focus for over 30 years. All the information engendered by this research is still available as most of it has been published in a wide range of books, reports and papers, the latter mainly in *Pachyderm*, *Swara*, *Oryx*, *International Zoo News* and *BBC Wildlife*. The expertise gained over this long period of dedicated research is again evident in *The South and South East Asian Ivory Markets*. In planning this survey of ivory trade in Asian countries, the authors used their past experience to the full, which helped to make wise use of time and public funding.

It is valid to ask why the survey was limited to the eight countries mentioned above. The authors explain at length (p. 9) why India was excluded from their survey. With the CITES ban on international trade of ivory of 1990 and the total ban on the sale and display of ivory items in India from 1992, ivory items have disappeared from view in the shops. A few ad hoc observations in the 1990s showed that very few items were still available in Delhi and Bombay, which led the authors to conclude that India is no longer an important trading place of ivory. I wonder how the simple imposition of a few laws, even if combined with strict enforcement and heavy penalties, can result in such a total reversal of the trade. If shopkeepers can make money out of ivory items in Thailand, so can their counterparts in India.

It is a pity that India was not included in this comprehensive survey, because if the trade has disappeared, it would have been demonstrated beyond all doubt and it would have allowed a straightforward comparison with the results from other countries. The reduction or abolition of trade in ivory has been the focus of major international concern in many places. Possibly the Indian authorities have made the right policies and have achieved what has been a dream in many other countries. Others could learn from their example. Bangladesh, Bhutan, Brunei, Indonesia, Malaysia, Pakistan and the Philippines were excluded from the survey, because previous experience has shown that the number of ivory items for retail sale in these countries is in fact really small.

The practical knowledge of the two authors not only influenced the choice of countries to be surveyed but also greatly helped to limit the research to those towns and villages where there is a substantial carving industry or a lively market in ivory items. For instance, in Thailand one of the authors visited Bangkok, Chiang Mai and Phayuha Kiri, evidently because these are the main ivory centres of Thailand. I wouldn't know if the choices were correct and valid, but one may imagine that they are the best possible within the normal restraints of travel and limited funding. It is quite likely, therefore, that they selected the best places to be surveyed in order to gain insight into the current status of the trade and to provide the baseline data that are needed to shape future policy.

The detail of the observations and the accuracy of the statistics in this book is astounding. I can best illustrate this by picking one example. Martin was in Bangkok for 14 days from the end of February to the middle of March 2001. It is a city of 7.2 million inhabitants, which in 2000 had a large share of Thailand's 9.5 million foreign tourists. Obviously, the

number of small craft shops catering for this tourist market is almost impossible to count. Determined to get the correct data, Martin did his work and came up with incredibly detailed statistics. He found 164 shops selling ivory items, both antiques and new items. In total, they sold 38,510 objects. We gain an idea what these objects were, that is, 85% consisted of jewellery items like bangles, earrings, necklaces, pendants and rings; next were numbers of chopsticks, cigarette holders, ear picks and name seals. We also learn what they would cost, how old they could be and where they were carved. The statistics for the other towns in Thailand and for the other countries covered by the survey are equally detailed and carefully presented, both in tables and in the text. A few inconsistencies in the numbers were seen and the presentation of the same facts in both text and tables would not always have been necessary. Fortunately, these minor shortcomings do not detract from the usefulness of the book for both the details and the greater picture.

Daniel Stiles

In Myanmar these days ivory craftsmen are encouraging a movement towards a Burmese national style of ivory sculpture.

The summary shows that Thailand is by far the largest consumer of ivory items, selling 83.9% of the 105,081 items found across the region. The authors discuss the meaning of their observations and the trends in great detail. It is important to discover who buys the ivory, because there will always be a supply when the demand is lucrative enough. The authors found that the main buyers are tourists and businessmen from Europe (France, Germany, Italy), Japan, Taiwan, Thailand, Singapore and the United States, in order of importance. This shows that better enforcement of the laws in these importing countries combined with continued education can still have great impact on the survival of the elephant. It also shows the importance of regular standardized surveys across many countries to understand the trends and the trade routes.

Martin and Stiles achieved their primary objective by creating a database with details of the present state of the ivory trade in the major markets of the South and South East Asian countries. Within the multitude of figures and trends and statistics, it would be easy to lose sight of the larger picture. The authors carefully and confidently guide us through this forest. The Discussion and Conclusion at the end, together with the Executive Summary at the beginning, are required reading and especially useful for those who may not have time to study the details contained in the body of the text. They can read this knowing that the conclusions are based on careful investigation.

This report should be read by those interested in elephants, in nature conservation, in trade in wildlife products, and by everybody intending to attend the forthcoming CITES meeting [November 2002, Santiago, Chile], where once again, almost inevitably, the sale of ivory will be discussed. The outcome of the debate is important to many Parties. For all those concerned with ivory trade, the baseline data are now available in this carefully written and well-produced text.

NOTES FROM THE AFRICAN RHINO SPECIALIST GROUP

The Crown vs. Peter McIntyre and five others

with particular reference to the species argument and the importance of preventive rather than remedial legislation

Mickey Reilly

Swaziland Big Game Parks

Background

On 28 April 2001, seven men were arrested in a trap while trafficking in two white rhino horns at Lavumisa and Ndzevane in the Lubombo region of Swaziland. The seven comprised a Mozambican, a South African and five Swazi nationals. One of the Swazis was made an accomplice witness.

Notable among the arrests was Peter McIntyre, a South African businessman who had served as a policeman for 15 years and was an experienced Bantu administration commissioner (a type of magistrate). McIntyre owns properties on both sides of the Lavumisa border post between Swaziland and the Republic of South Africa (RSA), including houses, a hotel, a bottle store, a garage and a fast food outlet. McIntyre was well known to the border post officials as he regularly travelled between Swaziland and South Africa.

Significantly, McIntyre was represented in court by defence lawyer Louis Benn, who himself had been arrested in South Africa for illegal possession of a rhino horn by the Endangered Species Protection Unit of the South African police and had paid 5000 South African rand (approximately USD 500) to WWF in an out-of-court plea bargain with the attorney general.

All six accused pleaded not guilty to the charges of 1) possession of two white rhino horns and 2) trafficking in two white rhino horns. As rhino horns are categorized trophies of Specially Protected Game, they were charged under Sections 8(1) and 8(3) of the Game Act, which prescribes minimum mandatory imprisonment terms of five years for possession and seven years for trafficking, without the option of a fine. Furthermore, Section 8 of the Game Act, together with rape, murder, armed robbery, vehicle theft and certain other serious crimes, falls under the Non-Bailable Offences Order, and the accused were thus refused bail until their trial was completed. Additionally, the court does not have the discretion to suspend any part of the sentence.

The case was heard by the chief justice in the High Court of Swaziland. Four Big Game Parks rangers, four police officers and three expert witnesses from RSA gave evidence.

Species argument

The defence tried a variety of arguments, the most significant—and likely to be damaging to the prosecution—being the species argument.

Defence counsel initially argued that as the Game Act defined 'animal' as 'any vertebrate animal indigenous to Swaziland' the possibility existed that the horns before court could have originated from a white rhino beyond the boundaries of Swaziland; that the individual animal (specimen) itself would then not have been indigenous to Swaziland; and therefore the accused had no case to answer. This was a ludicrous argument and it was soon modified when defence learned of the existence of the northern white rhino (*C. s. cottoni*). They then argued that the possibility existed that the horns before the court were from a

northern white rhino and as this subspecies existed only in the Democratic Republic of Congo, it was not indigenous to Swaziland, and therefore if this possibility reasonably existed, the accused could not be found guilty on the grounds of reasonable doubt.

The Crown's response was formed around the following points:

The Game Act is specific in that it lists under *Specially Protected Game* in the First Schedule:

- rhinoceros—all species
- white rhinoceros—*Ceratotherium simum*
- black rhinoceros—*Diceros bicornis*

as well as other animals including elephant and lion.

In listing 'rhinoceros—all species' the intention of the legislation is abundantly clear, especially in view of the fact that this was introduced as an amendment to the Game Act in 1993, after a defence lawyer in a previous rhino horn case had 'invented' a 'brown rhino' and had thus created 'reasonable doubt' that the horn before the court was that of a white rhino. In that case, the accused (a bishop of the Zionist Church of Swaziland, Reverend Zitha) was acquitted, in spite of the Crown arguing that no such thing as a brown rhino existed.

In addition to the 'rhinoceros—all species' position, the act lists rhinoceros by genus and species. Rhino subspecies are not listed. The Crown thus argued that protection was offered to *C. simum* as a species, which automatically covered subspecies *C. s. simum* and *C. s. cottoni*, and thus the defence argument was flawed. Contention around this argument remained around the use of the word 'indigenous'.

Dr Richard Emslie, the scientific officer of IUCN SSC's African Rhino Specialist Group, gave evidence on this issue as an expert witness. He confirmed the Crown's arguments and went further to point out that international conventions such as CITES Resolution Conf. 9.14 (revised) deal with rhino protection at the taxon level, not at the genus or species level. He explained that reducing illegal trade in rhino horn was a problem of global concern as spelt out in the CITES resolution.

Dr Emslie used Bayesian statistics to establish that the probability of horns recovered in Swaziland being those of a northern white rhino was so small that the horns were almost certainly those of a southern white rhino. Dr Emslie also mentioned that trade experts Dr Esmond Bradley Martin and TRAFFIC's Simon Milledge had indicated to him that the known trade routes for northern white rhino horn did not include Swaziland. This evidence served to establish the overwhelming probability of the horns before court being those of a southern white rhino, in the event that the species argument was upheld by the chief justice in favour of the defence counsel.

The weight of evidence given by the Crown witnesses was consistent and impressive against all accused persons. Before the close of the Crown's case, the chief justice made a ruling that the defence's species argument was flawed in view of the fact that the Schedule of the Game Act listed 'rhinoceros—all species' and thus the issue of subspecies was irrelevant.

At the close of the Crown's case, three of the accused were acquitted on the grounds that the Crown had not proved its case against them beyond reasonable doubt. The remaining three accused were put to their defence and gave versions of the events, which were flawed. During submissions, the defence appealed to the judge to revisit the species argument and reconsider the ruling that had been made earlier in the case.

JudgementEffective legislation

This case has highlighted the most important aspect of no-nonsense legislation that is designed to be preventive rather than curative. As long as it is implemented as intended, it will serve to deter any potential poaching and trafficking. It is better to make an example of a few people, thereby creating awareness and preventing the extinction of a species, than to have a lot of people in and out of jail and not achieve the objective of stopping a species from becoming extinct.

The significance of the chief justice's ruling on the species argument is notable in that had the defence's argument been upheld, then this case heard by the chief justice of Swaziland would have served as an authority in all countries practising similar law and would in most cases have meant that those countries would have had to amend their laws preemptively in order to avoid manipulation of technicalities in favour of the quest for the truth and what is right. Invariably most countries would have been slow to amend their laws—if they had even become aware of such a precedent—and a large, serious loophole would have existed in the efforts for effective control of rhino poaching and trafficking.

Acknowledgements

Big Game Parks, Kingdom of Swaziland, would like to especially acknowledge the support and assistance of the Directorate of Public Prosecutions, Ministry of Justice, Swaziland; Mr Rod Potter, Ezemvelo-

Effective legislation

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The significance of the chief justice's ruling on the species argument is notable in that had the defence's argument been upheld, then this case heard by the chief justice of Swaziland would have served as an authority in all countries practising similar law and would in most cases have meant that those countries would have had to amend their laws pre-emptively in order to avoid manipulation of technicalities in favour of the quest for the truth and what is right. Invariably most countries would have been slow to amend their laws—if they had even become aware of such a precedent—and a large, serious loophole would have existed in the efforts for effective control of rhino poaching and trafficking.

Acknowledgements

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Black rhino crisis in Zimbabwe

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Zimbabwe's white rhino (*Ceratotherium simum*) population was gradually re-established through translocations from South Africa after this species had been eradicated in Zimbabwe during the colonial era. Translocations included a number of white rhinos that were purchased and imported by wildlife ranchers at considerable expense to themselves. White rhinos have been under sound management in South Africa and have been steadily increasing to a present continental total of about 10,500, while the continental total of black rhinos (*Diceros bicornis*) in Africa has declined drastically, bottoming out at only 2450 by the early 1990s. Continentally, black rhino numbers have increased slightly since 1995, reaching 2700 by 1999. The Zimbabwean focus of international conservation concern, therefore, has been the country's black rhino population. During the early 1980s, the Zambezi Valley within Zimbabwe held the largest remaining black rhino population in Africa (over 1000), but cross-border poaching by Zambian poachers began to cut down this population drastically in the late 1980s, and an urgent conservation strategy was implemented, with considerable international interest and support.

This national strategy for black rhino conservation was based upon the following two main rhino breeding initiatives.

- Intensive Protection Zones (IPZs) were set up in stateland areas, to concentrate available government anti-poaching resources on the few relatively high-density rhino populations that survived the waves of poaching in the late 1980s and early 1990s. These four IPZs received significant donor

support; thus the more effective patrolling that was achieved within them combined with an extensive dehorning campaign stemmed the poaching by 1995.

- A rhino 'custodianship scheme' was established, whereby about 190 black rhinos were captured in the heavily poached areas of the Zambezi Valley and were moved to private ranches, still remaining under state ownership but with the burden of their protection spread to the private sector. Not all these custodianship projects were successful: several suffered from poaching and from problems with their habitat. In recognition of the need to provide more space and better coordination of their anti-poaching efforts, landowners in several areas combined their properties into large conservancies within which viable rhino populations were consolidated. By 2000, the black rhino populations that had been introduced in several of these conservancies in Zimbabwe's lowveld region had doubled after achieving some of the fastest growth rates ever recorded for rhino populations.

The successful rebuilding of Zimbabwe's black rhino population from a low point, after the heavy poaching, of about 370 in 1993 to a current level of about 440, along with the establishment of innovative conservancy projects earned Zimbabwe considerable acclaim within the international conservation community. Almost 75% of Zimbabwe's black rhinos are on commercial farms and conservancies. Of the national total of about 200 white rhinos, approximately half are on private land.

Since early 2000, the rhino custodianship scheme has been greatly undermined by the large-scale invasion of subsistence farmers into areas of commercial ranching land throughout Zimbabwe. Peasant subsistence farming and rhino conservation are mutually exclusive activities. Hence the invasions into at least a third of the total area of the rhino custodianship areas in southern Zimbabwe, containing about 230 black rhinos, have displaced significant numbers of these rhinos out of their home ranges. The displacement has provoked fighting between the animals, leading to many injuries and the death of at least two. Habitats are being cleared for patchy settlement, and the extensive bush fires that have been set in this process have swept through conservancies, killing at least one black rhino calf.

The perimeter game fencing around conservancies has been torn down and the wire has been used to manufacture thousands of snares. These have been set mainly to kill antelopes for bushmeat, the offtake of which has now reached commercial proportions and has annihilated wildlife populations in many of the invaded areas. Several wild dogs have also died in the snares. Thus far, there is no evidence that snares are being set deliberately to catch rhinos, but a number of black rhinos have been trapped through indiscriminate snaring; over the past two years, at least 4 have died because of snaring, and a further 13 have required drug darting to treat snare wounds, most of which have been serious.

Horns have been stolen from at least two of the rhinos that are known to have died. Rhino monitoring by conservancy scouts has been disrupted, and invaders have severely assaulted several scouts. The international press recently publicized the aggressive invasion by 'war veterans' of Gourlays Ranch, which contains at least 30 black rhinos. The 'war veterans' have declared 'no-go zones' within larger conservancies such as Save Valley and Bubiana. This ongoing disruption of rhino monitoring means that not all the rhino snaring cases will have been detected. When poachers are arrested, they are generally given very minor or suspended sentences by magistrates who ignore the risk to rhinos and other endangered species that arises from the indiscriminate setting of wire snares.

Apart from the problems of law enforcement, rhino protection is increasingly compromised because of economic problems. The government provides no financial support for rhino monitoring or anti-poaching activities on private land, and the drastic decline in tourism in Zimbabwe is eroding the financial ability of private custodians to provide effective protection for the animals in their care. The establishment of conservancies was a holistic initiative that recognized the importance of developing community outreach programmes. However, the current loss of economic viability and the political friction that has been engendered are severely undermining some long-standing attempts to create mutually beneficial economic links between conservancies and their neighbouring communities. Proposals for resource-sharing projects involving viable community-based wildlife ventures linked to commercial wildlife operations have been suggested by three key rhino conservancies—Save Valley, Bubiana and Chiredzi River—as an alternative to dryland subsistence agriculture. But they have to await political endorsement and donor support before they can be implemented.

Concurrently, concerns have arisen over rhino protection in Zimbabwe's stateland areas. Monitoring systems within the Intensive Protection Zones have become less effective because of declining government expenditure, loss of expertise, reduced tourist operations, waning donor interest, weakened coordination among stakeholders, and so on. The fact that these areas may no longer be considered intensively protected was driven home when poachers entered a national park base at Matusadona IPZ (Lake Kariba) on 28 March 2002 and used an agricultural carbamate pesticide to poison two semi-tame rhinos in pens. They succeeded in killing one, then removed its horns, stole fuel and escaped undetected.

Recent press statements have suggested that some 50 rhinos, black and white, have been poached during the land invasions. As detailed above, the known losses (as of early May 2002) are considerably fewer than this figure and do not include any white rhinos, but there definitely must be rhino snaring cases that have not yet been detected. Although the press coverage may be somewhat alarmist, it is clear that the snaring problem is worsening. Zimbabwe's collapsing economy, food shortages associated with the current drought and decline of commercial agriculture, political violence, lawlessness and unemployment, particularly in rural areas as farm labourers lose their jobs, are all factors that obviously create the socio-economic environment for increased snaring and a potential flare-up of rhino poaching on an organized, commercial basis.

Because this rhino crisis is intertwined with the overall political difficulties that currently afflict Zimbabwe, the opportunities for intervention by local and international conservation agencies are very limited. The Zimbabwean minister of Environment and Tourism is receptive to the strong expressions of international concern that he regularly receives and has publicly expressed his own concern. But his ministry has thus far been unable to implement or influence any significant measures to reduce the level of poaching and habitat loss. WWF has been able to provide professional assistance and funding support for emergency veterinary responses when rhino snaring cases are detected, but this measure simply deals with the symptoms of the problem rather than its causes.

One step towards addressing underlying causes rather than symptoms is for conservation agencies to support options for communities to become involved in sound business ventures based upon the wildlife potential of the conservancies. Definite prospects exist for wildlife-based land reform in lowveld conservancies, but these options are being foreclosed by the current pattern of 'fast-track' dryland agricultural resettlement. Development of more sustainable wildlife opportunities entails ongoing technical assistance and must be backed up by significant outside funding. But these possibilities are stalled until official policies on wildlife-based land reform and on the role of conservancies become sufficiently clear and conducive.

Renewed threat to Kenya's rhino conservation efforts

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The illegal trade in rhino horn in the 1970s and 1980s that reduced the world's black rhino population to fewer than 2500 by the early 1990s remains a serious potential threat. This threat is especially ominous in Kenya, where in the last quarter of 2001, six black rhinos (about 10% of the estimated population) in Tsavo East National Park were slaughtered by poachers for their horns.

The Tsavo East free-release rhino population was established in July 1993, after the rhino population there had been virtually wiped out, when four rhinos were translocated from Nairobi National Park and five rangers and an officer were assigned to this new rhino unit. The objective of the free-release programme was to introduce black rhinos through experimental release followed by intensive monitoring of their movements and behaviour. The experiment was to test the feasibility of establishing large numbers of rhinos (> 20) without the need for electric fencing. More rhinos were moved in and by the end of 1994, 20

rhinos had been translocated in. The ranger force remained the same, only that there were between four and five additional rangers on attachment from other sections of the park. The rhinos were well monitored, with signals being picked up from 12 out of 19 transmitters, despite tracking from the air having lapsed between August and October 1994.

Although KWS went, to some extent, against recommended practice by free-releasing rhinos in such a huge area, it was believed that the rhinos would not widely disperse and the intent was to set up an IPZ. At the time, many argued that the rhinos were probably more vulnerable in the free-release area than in sanctuaries. But rhinos from other sanctuaries were performing well, especially in Nairobi National Park, and their surplus had to be put somewhere. Tsavo East was selected.

The effort to restock the free-release area was a costly investment, with 48 rhinos having been introduced by the end of 1999.

The population had settled well and adapted to new areas; 11 births and 4 deaths were recorded, the deaths unrelated to poaching. According to records since the free-release area was established, the population in November 2001 was estimated to be 53.

As is the case with most government institutions, resources for effective monitoring of endangered species have been dwindling. The aerial coverage in Tsavo East had become irregular, and the pressure on the monitoring staff continued with the expanding range of the free-ranging rhinos. The number of rhino monitoring staff fluctuated within the year, recording an annual average of 8 men between 1993 and 2001 with a peak of 10 men in 1996, including those on attachment, despite the fact that the rhino numbers were increasing. As part of regular monitoring, a census was done in October 2001 in which 47% of the estimated rhinos were physically seen, and much fresh rhino spoor and other signs were also recorded. No rhino carcasses were recorded during this census, although five relatively fresh elephant carcasses were seen.

The rhino monitoring team and the entire Kenya Wildlife Service (KWS) security network were put to test when four rhinos (three adults: one male, one female, one unknown; and a calf) were poached be-

Samuel Kasiki

Mariah and her calf: victims of the November 2001 poaching in Tsavo East. KWS rangers are seen in the background.

tween 24 and 29 November 2001. When the carcasses were found, the horns had been taken. Security was immediately intensified in the rhino range and in Tsavo East National Park as a whole. In early December 2001, the KWS intelligence team arrested one person in possession of three fresh-looking rhino horns in a Mombasa Hotel, presumably where he was arranging to sell the horns. His arrest led to that of another person in whose house the horns had been hidden. The coastal town of Mombasa is believed to be a major outlet for illegal trade in wildlife products.

The poachers appear to be well organized. In January 2002 poachers killed another two rhinos whose horns have not been recovered. This did not demoralize the determined KWS rangers. In mid-February, they killed one poacher, arrested a second, and recovered a pair of rhino horns plus firearms and ammunition. Security has been tightened in all the rhino sanctuaries, and KWS is taking all necessary measures to prevent further poaching of rhinos. The search for the poachers, suspected to be of Somali origin and using G3 firearms, continues.

The Tsavo East incident is the first case of rhino poaching in a national park in over eight years, although two rhino mortalities caused by poaching were recorded in 2000: one in Lelata/Naikara near Masai Mara National Reserve and the other in the Kitchich area, between Maralal town and Samburu National Reserve in northern Kenya. Community scouts monitor these rhino populations and managed to recover the horns.

Reintroduction of white rhinos to the Moremi Game Reserve

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During the 1980s and early 1990s the first and substantial reintroduced population of white rhinos in Botswana (95 animals moved from Natal Parks Board from 1967 to 1980) was affected by poaching to such an extent that rhinos nearly became extinct in the country for a second time. Against a background of increased cross-border poaching, the Department of Wildlife and National Parks decided to translocate all the remaining rhinos into a secure sanctuary. Between 1994 and 1996 seven rhinos were captured at Chobe National Park and Moremi Game Reserve and translocated to Khama Rhino Sanctuary near Serowe. Reinforced by further animals moved from South Africa, the Khama Rhino Sanctuary population has increased to 18 animals. Two other nature reserves stocked with rhinos have since been established in the south-east and west of the country. In the last year there have been reports of one or two white rhinos moving over large areas in the north-east of Botswana, remnants from the original reintroduction of the 1970s.

In collaboration with a private concessionaire, the Department of Wildlife and National Parks has now reintroduced white rhinos to Moremi Game Reserve. To date five rhinos have been successfully reintroduced. Three were purchased by the concessionaire from Mokolodi Nature Reserve, and a lonely single bull was relocated from Gaborone Game Reserve. The fifth animal was an isolated rhino captured from Chobe National Park and relocated in Moremi Game Reserve. The rhinos have adapted well to their new environment and have established territories. Currently the Department of Wildlife and National Parks is expecting 31 more white rhinos (19 females and 12 males) to be introduced into Moremi Game Reserve as part of an agreement to exchange roan antelope for white rhinos from South Africa National Parks. The addition of this second group of rhinos into Moremi Game Reserve will form a viable breeding population in the area, which has very good expansion potential for developing a large wild population. A critical area of concern to the Department of Wildlife and National Parks is the security of these reintroduced rhinos. Measures have been taken to ensure their safety: the rhinos are being accorded maximum protection through high-intensity ground monitoring and surveillance, in addition to daily routine water-borne and aerial patrols.

Tsavo East and Ngulia rhino populations counted

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A rapid census[1] to ascertain the numbers and distribution of rhinos in Tsavo East and Tsavo West National Parks in Kenya was conducted between 26 September and 22 October 2001.

Tsavo East

The rhino population in Tsavo East was free-released and currently is estimated to range over about 4000 km^2 of the park, making conventional monthly sighting of individual rhinos demanding. Based on the records available such as the number of known introductions and the recorded births and deaths since the population was established, the Tsavo East population had likely increased to 53 rhinos by September 2001. Six rhinos from this population were, however, lost through poaching between 24 November 2001 and 30 January 2002.

Ngulia Rhino Sanctuary (Tsavo West)

The black rhino population in Tsavo West is confined to the 65-km^2 Ngulia Rhino Sanctuary within the park. The population in the sanctuary is now thought to be 53, based on known introductions, removals, births and deaths since the sanctuary was established. Annual night waterhole counts have been done since 1992. Usually these counts are done for three consecutive nights during each full-moon period, about three or four times between July and October. The waterhole counts have provided much valuable data on individuals and population growth over the years (table 1).

Table 1. Waterhole count and estimated total numbers of rhinos in Ngulia Rhino Sanctuary, 1992–2001

Year	Counted	Estimated
1992	11	17
1993	22	23
1994	25	26
1995	27	27
1996	32	34
1997	36	39
1998	39	41
1999	38	46
2000	47	48
2001	51	53

Carrying out the census

Both aerial and ground census techniques were used. The census was planned to coincide with the regular waterhole counts, which were therefore a third census technique in Ngulia. Both Tsavo East and Ngulia Sanctuary were divided into counting blocks. Two-hour flights per day were carried out systematically from a fixed-wing aircraft. It took seven days to cover all the blocks by air in Tsavo East and one day to cover Ngulia; thus 14 hours were flown in Tsavo East and 2 hours in Ngulia, giving a search effort of 285.7 km^2/hr in Tsavo East and 32.5 km^2/hr in Ngulia. The coverage in Ngulia was therefore almost nine times more intensive than that in Tsavo East.

Ground census was done mainly by foot patrols with vehicles used only to carry the patrol teams to starting points at the beginning of the census and, when necessary, to collect them at end points. It took 31 men, divided into six patrol teams, 10 days to cover Tsavo East, and 20 men, in five patrol teams, 2 days to cover Ngulia. This translates to a search effort of 100 km^2 per patrol day in Tsavo East compared with 6.5 km^2 per patrol day in Ngulia, indicating a level of search 13.4 times higher in Ngulia. The area covered per man-day was 12.90 km^2 in Tsavo East and 1.08 km^2 in Ngulia, again with a search intensity in Ngulia 11.9 times that in Tsavo East. Throughout the census, the search effort expended per unit area in Ngulia was substantially higher than that put into the much larger area of Tsavo East. This further highlights the difficulty of monitoring Tsavo East, as mentioned above.

[1] Census, used here in its wider meaning, is synonymous with a count or survey of a population.

A general foot patrol was conducted without tracking spoor of individual rhinos. Night census using image intensifiers was conducted simultaneously from three fixed points (waterholes) for two consecutive full-moon nights in Ngulia. In this case, two additional night counts had been done as usual by the Ngulia staff in July and August. When the rest of the census team arrived, the Ngulia staff had already done one night of the September–October count. Thus the rest of the census team participated only in the remaining two nights of the count.

In Tsavo East, 25 rhinos were sighted and in Ngulia, 20 were counted. However, the two night counts done in Ngulia recorded 48 rhinos, almost two and a half times the number seen in the aerial and ground counts. The night waterhole count produced a number that was close to the expected population size. This means that a higher proportion of the population can be seen from the waterhole counts than by the ground or aerial surveys. But it should be noted that daytime ground sighting data if routinely collected over an extended period and analysed using mark-recapture statistics can be used to produce reasonably accurate population estimates (better than minimums seen) provided there are enough sightings.

Aerial counts of black rhinos are known to produce highly variable and significant undercounts of true population size. The minimum numbers seen on these aerial counts are therefore likely to be gross underestimates of true numbers, and in part reflect the search effort put in.

Although the distribution maps are still being processed at the Kenya Wildlife Service GIS section, rhinos in Tsavo East were observed to range the entire area south of the Galana River that is part of the Yatta Plateau.

One rhino carcass (the only known death in 2000), which had been reported, was picked up in the Ngulia count; five elephant carcasses were recorded in the Tsavo East counts and their GPS (global position system) locations recorded. No new rhino carcasses were sighted even after a thorough foot patrol in areas of high rhino density. Although only 25 rhinos were sighted in Tsavo East, numerous fresh signs distributed south of the Galana River indicated the presence of many more. However, while we could be confident that there were around 53 rhino in Ngulia, the exact number of rhinos in Tsavo East remains much more uncertain. More work is therefore required to produce improved population estimates for this park. However, the census did provide valuable information about the extent of the distribution of the Tsavo East population. Other animal species of interest counted in Ngulia Sanctuary included elephants (161), giraffes (32) and lesser kudus (11).

Table 2. Rhino numbers seen and estimated in counts in Tsavo East and Ngulia, 26 September–22 October 2002

Type of count	Tsavo East	Ngulia
Aerial count	21	16
Ground count (by foot and vehicle)	4	4
Night census (at waterhole)	not done	48
Rhino signs < 48 hr old	109	not recorded
Estimated	53	53

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We would like to thank the personnel from both Tsavo East and West Rhino Units, the Wildlife Protection Unit and KWS Headquarters (GIS and Ecological Monitoring Unit) for their participation. Comments from Dr Richard Emslie on the first draft of this note are greatly appreciated. Lastly we would like to thank the African Wildlife Foundation and Save the Rhino International for their financial support in carrying out this census.

SADC regional programme for rhino conservation—update

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The SADC Rhino Programme has continued to support rhino conservation projects for black and white rhinos (*Diceros bicornis minor, D. b. bicornis, Ceratotherium simum simum*) within the southern Af-

rican region. Although activity has been reduced because of a pause in funding from the Italian government for most of 2002, resumption of funding for a further two years is expected towards the end of this year. Since the last edition of *Pachyderm*, experts in the programme have worked towards improving management of the black rhinos in Liwonde National Park in Malawi (ecological and institutional evaluation) and have supported a study of ecological and human factors limiting the black rhino population of West Kunene Region in Namibia. Assistance has been provided in the development of new national rhino conservation strategies in Botswana and Namibia. The project to improve the security and management of rhino horn stocks in the SADC region, implemented by TRAFFIC, has developed a comprehensive rhino horn and product database/GIS on horn stockpiles in 41 countries. The latest version (1.31) of the site-level WILDb rhino monitoring database has been issued and is now in use for several rhino populations in Zimbabwe and Botswana. A national-level version of WILDb will be available shortly. This will include automated queries that can produce a number of standard SADC RMG (Rhino Management Group) indicators of rhino population performance. WILDb is also being modified to deal with clean animals, incomplete observations and observer rating and will be able to generate data input files compatible with RHINO 2.0. The inaugural meeting of the SADC Rhino Recovery Group (RRG) was held in May 2002, with membership from the six SADC countries involved in present or future projects to reintroduce rhino populations (Angola, Botswana, Malawi, Mozambique, Tanzania, Zambia). The support and coordination enabled by SADC RRG is expected to provide the basis for a sustained effort by member states in re-establishing viable rhino populations using resources and expertise drawn from the SADC region.

Horn fingerprinting technique update

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Validatory statistical research undertaken by Rajan Amin and an MSc student has provided a good test of how reliable different techniques and models are for predicting the species or source of new rhino horn samples (that is, ones not used in building the models). The result of this work, which was sponsored by the Italian-funded SADC Regional Programme for Rhino Conservation, confirmed that horn fingerprinting can reliably differentiate between species and horns from different countries or regions. However, jackknife validations of park discrimination models confirmed Richard Emslie's earlier suspicions—that sample sizes would need to be increased to more than the current four to five samples per park for reliable discrimination of source within a park or area (unless one was dealing with a park with very unusual geology such as Pilanesberg National Park). The next phase of research is to undertake an experimental analysis of additional samples to determine how many samples per park are required for reliable source discrimination at the finer spatial scale.

Dr Amin's research also found that Bayesian and probabilistic neural networks produced better discrimination models using fewer variables than the original models developed by Dr Emslie using classical canonical variates analysis (discriminant function analysis). Final horn fingerprinting models and the resultant user software will therefore be based on neural network analysis.

Other research planned includes investigating the use of novelty detectors to identify whether or not samples have come from areas not yet included in the continental horn-fingerprinting database.

Anglo-American Research Laboratories are also approaching the final stages of developing a standard multi-element analysis package that will be able to quantify the abundance of about 70 rarer elements and isotopes more cheaply and more accurately (Richard Holdsworth, pers. comm.). Using their Finnegan-Mat-element high-resolution magnetic-sector inductively-coupled-plasma mass-spectrometer, abundance measures can be calibrated against known standards and expressed in parts per billion. Using the same sample of horn, but at a different dilution, inductively-coupled-plasma optical-emission-spectroscopy can also be used to quantify a suite of the commoner elements. These

data are also calibrated against known standards and expressed in parts per million. In particular the new multi-element package is likely to produce repeatable results into the future. Thus the use of these two techniques together appears to offer a much cheaper and more efficient way to get reliable, calibrated and quantitative measures of the abundance of a whole suite of heavier elements and isotopes. Analysis may cost as little as 100 South African rand (approximately USD 10) per sample.

We will keep readers of *Pachyderm* informed of any future developments.

Training in radio collar assembly, telemetry and GPS for Tsavo ecosystem rhino staff

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The Kenya rhino programme has translocated numerous rhinos to Tsavo East National Park (Galana IPZ). The translocated rhinos are fixed with horn-implant transmitters or radio collars before they are released so that their movements and ranging patterns can be tracked. This has been found essential in rhino monitoring and surveillance.

To consolidate the security of the Tsavo rhinos, rhino staff from Tsavo East and Tsavo West National Parks (Ngulia Sanctuary) were trained in radio telemetry (rhino radio tracking) and the use of global positioning system (GPS) receivers. These skills are used for rhino monitoring and security. During this period, selected Kenya Wildlife Service (KWS) personnel in veterinary and animal capture units were also trained in assembling, using and recovering radio collars.

KWS procures radio collars as needed from abroad. The collars are costly and delivery usually takes a long time. This hampers the release of rhinos. The delay in delivery and the exorbitant prices are often attributed to collar assemblage processes involving skills that KWS personnel lack.

The training exercise for nine participants was held between 29 October and 3 November 2001 at Tsavo East National Park. Mr Gus van Dyk of North West Parks and Tourism Board in South Africa trained the participants in radio collar assembly and telemetry, and Mr George Muriuki, senior research technologist at KWS, trained them in the use of GPS.

Training in assembling, fixing and recovering radio collars

In this training exercise, focus was on two KWS personnel from the veterinary and animal capture units. The topics covered included

- general information on radio collar and implant transmitters
- introduction to radio collar parts
- procedures for fitting radio collars and related equipment
- practical hands-on training in radio collar assembly
- recovery of transmitters

Training in radio telemetry

Although the rhino staff at Tsavo East and West National Parks had undergone basic training in tracking radio-collared animals, a refresher course was necessary to improve performance. The focus was on four rhino officers and two veterinary staff. The two main topics covered by the training were the introduction to radio telemetry technology and application, and detailed training in rhino radio tracking techniques and equipment.

Training in use of GPS receivers

GPS receivers are currently being introduced into rhino sanctuaries in Kenya for use in routine surveil-

lance and monitoring. The correct and timely use of these receivers provides precise information on location of rhino sightings, carcass sightings, patrol movements and illegal activities. It is therefore important that the rhino monitoring staff are fully conversant with GPS technology and the correct use of the equipment. Focus was on the rhino monitoring officers. The topics covered included

- introduction to coordinate reference systems
- introduction to GPS, how it works and what it can do
- different GPS receiver models
- the Garmin 12XL, its operational features and setup
- Garmin 12XL GPS accuracy and interpretation of displayed data
- downloading of GPS data into a computer and display of patrol routes, sightings, incidents, and so on
- care, risks and troubleshooting of GPS receivers
- practical sessions and examination in using the Garmin 12XL

In all the training, theory lessons were accompanied by practical sessions. Detailed training manuals that were produced formed an important component.

Sustainability

It is expected that the rhino and veterinary officers in charge of radio collar operation from the two parks will train other KWS staff on a continuous basis. In this way, we will ensure that efficient monitoring standards are maintained. These subsequent on-site training courses will also serve to realize the maximum possible benefit from the original investment.

Main benefits

The training exercise has increased the capability of the KWS rhino staff and will lead to improved monitoring and security for the black rhino populations of the Tsavo National Parks, which are key to achieving the goals of the Kenya black rhino conservation strategy. Both aerial and ground monitoring of the rhinos will improve, and although costs might not be significantly reduced, the long delays in delivery time will be alleviated. KWS staff can now easily recover transmitters.

Funding

The US Fish and Wildlife Service–Rhinoceros and Tiger Conservation Fund funded this training exercise under a grant agreement with the African Wildlife Foundation, and we are grateful for this support.

The AfESG Small Grants Programme

Call for proposals

The IUCN/SSC African Elephant Specialist Group (AfESG) has been awarded funds by the European Commission **'to promote applied research and build capacity in African Elephant Range States, while promoting the mission and objectives of the African Elephant Specialist Group'**.

The purpose of this fund is to help AfESG build the capacity of **African students, researchers and organizations,** while also increasing the growing knowledge base for conserving the species. The funds will be made available through a competitive process to African researchers, students and wildlife management authorities (both within and outside AfESG membership).

Criteria

- The proposal must be aimed at results that are beneficial to conservation of the African elephant and address at least one of the broad priority issues as identified by AfESG, listed in the next column.
- The recipients must be African researchers, managers, students or organizations.
- The proposal must have clearly stated goals and objectives and a realistic budget and time frame.
- The proposed research methods must be scientifically sound.
- Each proposal should be in the range of USD 2000–10,000.

Priority issues

- Law enforcement and anti-poaching
- Illegal trade
- Habitat loss
- Local overpopulation of elephants
- Human–elephant conflict
- Elephant surveys (numbers, distribution and movements). Countries where up-to-date data are virtually non-existent are **Angola, Liberia, Sierra Leone, Somalia and Sudan.** Proposals aiming to survey areas in these countries may be given priority.

General

The grant recipient must provide a clearly written proposal together with a detailed budget for approval. All activities must be linked to the outputs with clearly stated time limits. Each activity should be given a cost. Each activity should have a corresponding budget line.

GUIDELINES TO CONTRIBUTORS

Aim and scope

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

Submission of manuscripts

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

Contributions should be sent to:
The Editor, *Pachyderm*
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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, Discussion, but not detailed results), 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 author or source of figures, maps and 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) edition 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.

References

Use the author-year method of citing and listing references.

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 as follows. List in alphabetical 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: M.E. Soulé, ed., *Conservation biology: The science of scarcity and diversity*. 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. 2001. [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 date and name of the person are cited in the text but not given in the reference list.