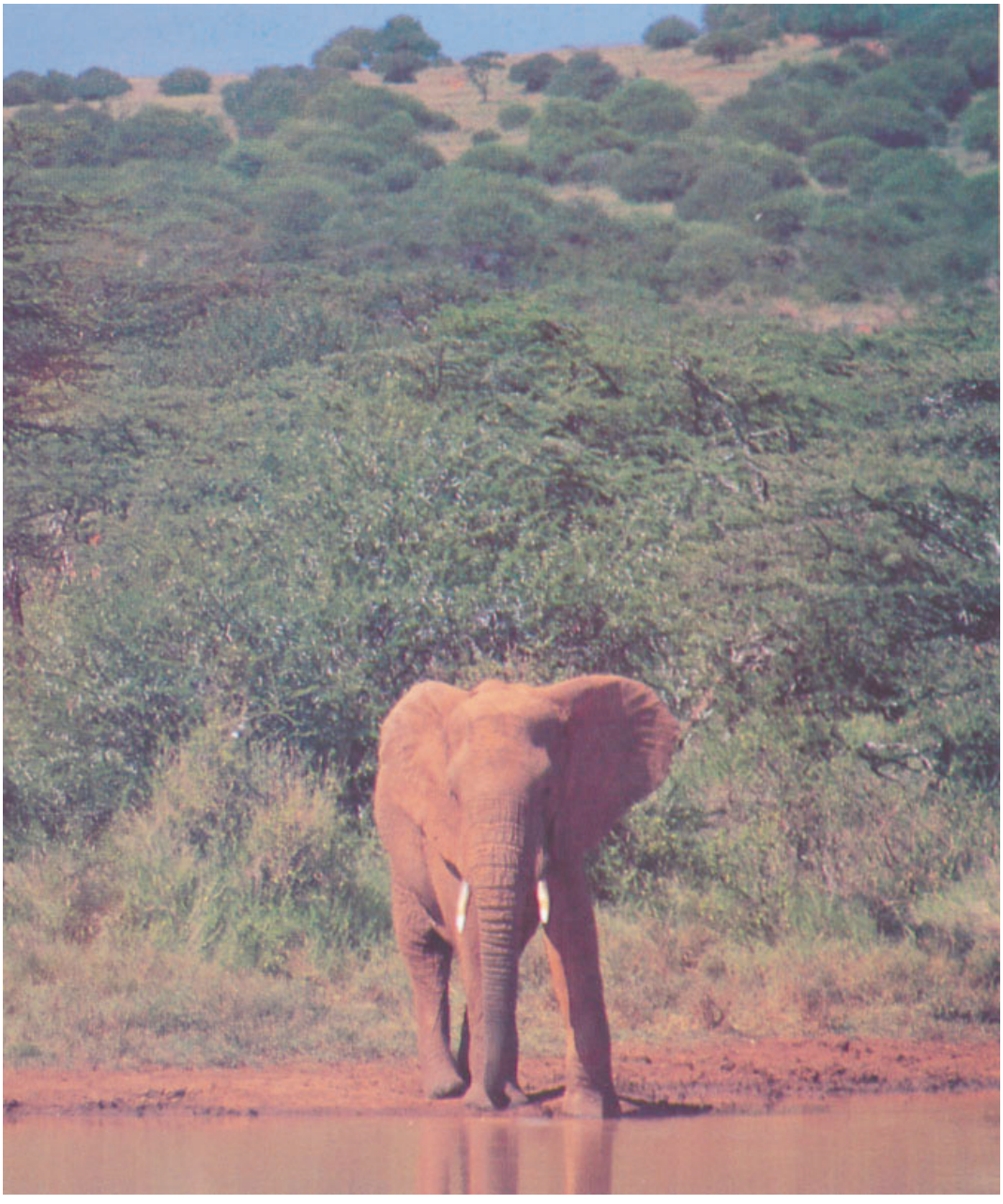
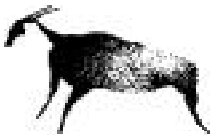
Pachyderm

1996 Number 22





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Contents

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Cover photo: An elephant in Laikipia District, Kenya
Photo credit: John Watkin

ERRATA

1. The following articles were referenced incorrectly in the article by Radcliffe *et al.* (1996) in *Pachyderm* 21:

   Miller, R.E. (1994) Diseases of black rhinoceroses in captivity: In: *Proceedings of a symposium on Game Ranch Animals.* Onderstepoort, Republic of south Africa, 9-10 september1994. (Eds. B.L. Penzhorn & N.R.J. Kriek.) pp. 180-185.

   Potter, D. (1994) Update on the current situation of rhinos in Natal. In: *Proceedings of a symposium on Game Ranch Animals.* Onderstepoort, Republic of south Africa, 9-10 September 1994. (Eds. B.L. Penzhorn & N.R.J. Kriek.) pp. 25-30.

2. In the African Elephant Specialist Group chairman's report in *Pachyderm* 21, it was mentioned that a survey was being funded in northern Ghana and southern Togo; the correct location for the survey was northern Ghana and northern Togo.

CHAIRMAN'S REPORT: AFRICAN RHINO SPECIALIST GROUP

Martin Brooks
Natal Parks Board P0 Box 662 Pietermaritzburg 3200, South Africa

Since the African Rhino Specialist Group (AfRSG) progress report in *Pachyderm* 21, further information has become available on the numbers of southern white rhinos, *Ceratotherium simum simum,* on private land in South Africa from a survey conducted by the African Rhino Owners Association (AROA) in early 1996. This survey indicated that numbers have increased from 1,200 to 1,475 over the past two years, bringing the total for Africa to over 7,800.

Some important initiatives discussed at the AfRSG meeting in February 1996 have seen considerable progress, the most significant being the African Rhinoceros Action Plan and the Technical Assistance Mission to Garamba National Park, Zaire. These and other developments are summarised below.

African Rhinoceros Action Plan

This document should be published by the end of 1996, given receipt of final comments from members. The plan is a comprehensive document dealing with the past and present status and management of rhinos, and the strategies required for their conservation. It examines the causes of past changes in numbers, reviews current status and performance of the six extant subspecies, outlines the range of protection and ownership/management models, summarises threats, and examines the framework for African rhino conservation from international (CITES, AfRSG cooperation with Asian Rhino Specialist Group), continental (key and important populations, rating projects for priority status), regional and national perspectives (regional and national conservation plans, and their implementation). It also recommends actions and approaches necessary to counter identified threats and to promote meta-population management and long-term viability, and lists AfRSG-rated projects which require funding.

The plan highlights the need to concentrate management and law enforcement efforts to ensure that, at the very least, the key and important populations of the six subspecies are protected. The use of intelligence networks as a cost-effective tool is promoted in this context. Apart from protecting our rhino populations, the plan emphasises the need for sound biological management to achieve and maintain high meta-population growth rates and to increase the number of viable populations. Maximising the benefits to people, especially communities neighbouring protected areas, is another important success factor.

Assistance Mission to Garamba

Three AfRSG members comprised the Technical Assistance Mission which visited Garamba National Park, Zaire, for ten days during April 1996 to advise on the rhino monitoring, law enforcement and monitoring programmes. A confidential 168-page report, including prioritised recommendations, was completed and submitted to the sponsor for consideration.

Other advice on rhino conservation

One fairly major initiative involved the AfRSGs Scientific Officer, Richard Emslie, visiting the Aberdares National Park, Kenya, at the request of the Kenya Wildlife Service (KWS), to advise on black rhino monitoring. This was followed by a small rhino research group from KWS being hosted by the Natal Parks Board and the AfRSG on a study tour of KwaZulu-Natal. Aspects covered in the tour included techniques for setting carrying capacities and how these are used in decisions regarding offtake, reporting on the status of populations, and rhino research and monitoring programmes.

Assistance has also been offered to a number of range states which need to determine the status of their rhino populations and develop appropriate action plans.

Information and advice were given on the survey of white rhinos on private land in South Africa, as well

as on CITES-related rhino issues, the Midlands black rhino controversy, and the economic values of rhinos.

Priority projects

Advice was provided to a number of agencies on the drafting of project proposals for priority rating by the AfRSG. A proposal was also drafted with the objective of holding a revised course for game scouts on identifying "known" rhinos. Requests from range states were received for rhino horn samples for use in the rhino horn "finger-printing" project, which aims to develop a means of identifying source areas for rhinos. Funds for this project are still being sought.

RAPPORT DU PRESIDENT: GROUPE DE SPECIALISTES DU RHINOCEROS AFRICAIN

Martin Brooks
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Depuis le rapport publié par le Groupe de Spécialistes du Rhinoceros Africain (GSRAf) dans le *Pachyderm* $N^0$21, on dispose de plus d'informations sur le nombre de rhinocéros blancs de sud, *Ceratotherium simum simum,* qui vivent sur des terrains privés en Afrique de Sud grâce à une étude réalisée par l'Association des Propriétaires de Rhinos Africains (AROA) au début de 1996. Cette étude montre que les chiffres son passés de 1,200 à 1,475 en deux ans, ce qui fait monter le total pour l'Afrique à 7,800.

Certaines initiatives importantes discutées à la réunion de février 1996 du GSRAf ont entraîné des progrès considérables, dont les plus significatifs sont certainement le Plan d'Action pour les Rhinos Africains et la Mission d'Assistance Techinique au Parc National de la Garamba, au Zaïre. Ceci est, entre autres, résumé ci dessous.

Plan d'Action pour les Rhinos Africains

Ce document devrait être publié fin 1996, aprés réception des derniers commentaires des membres. Le Plan est un document complet qui traite du statut présent et passé et de la gestion des rhinos, ainsi que des stratégies à utiliser pour leur conservation. Il examine les causes des changements d'effectifs, révise le statut actuel et les performances des six sous-espèces existantes, évalue le degré de protection et les modèles de propriété/gestion, résume les menaces et examine le cadre de la conservation des rhinos africains selon des perspectives internationales (CITES, coopération entre le GSRAf et le Groupe de Spécialistes du Rhinoceros d'Asiatique), continentales (populations clés et populations importantes, classification des projets par ordre d'importance), régionales et nationales (plans de conservation régionaux et nationaux et leur réalisation). Il recommande aussi les actions et les approches nécessaires pour contrer les menaces identifiées et pour encourager la gestion en métapopulation et la viabilité à long terme et enfin donne la liste des projets classés par le GSRAf qui requièrent un financement.

Le plan met en évidence le besoin de concentrer la gestion et les effort en matière d'application des lois pour s'assurer enfin que les populations clés et importantes des six sous-espèces sont protégées. Dans ce contexte, l'utilisation de réseaux d'investigation est reconnue comme un moyen rentable. En plus de la protection des populations de rhinos, le plan insiste sur la nécessisté d'une gestion biologiquement réfléchie pour assurer un taux de croissance élevé de toute la métapopulation et pour augmenter le nombre de populations viables. Un autre facteur important de succès est évidemment de maximiser les bénéfices particulièrement chez les populations voisines des aires protégées.

Mission d'Assistance à la Garamba

Trois membres du GSRAf composaient la Mission d'Assistance Technique qui a visité pendant dix jours le Parc National de la Garamba, au Zaïre, en avril 1996, pour donner des conseils en matière de surveillance des rhinos, d'application des lois et de programmes de contrôle. Un rapport confidentiel de

168 pages, contenant des recommandations plus ou moins urgentes, a été rédigé et soumis à la considération du sponsor.

Autre conseil pour la conservation des rhinos

Une initiative tout à fait importante concernait le Responsable Scientifique de GSRAf, Richard Emslie, qui a visité le Parc National des Aberdares, au Kenya, à la demande du Kenya Wildlife Service (KWS) pour donner des conseils pour la surveillance des rhinos noirs. Ensuite, un petit groupe de recherces sur les rhinos de KWS a été accueilli par des responsables des Parcs du Natal et du GSRAf pour un voyage d'études au KwaZulu-Natal. Ce voyage couvrait divers aspects comme les techniques pour créer des moyens de transport des animaux et comment utiliser ceux-ci lors de décisions touchant des déplacements, les rapports sur le statut des populations et les programmes de recherches et de surveillance des rhinos.

Un certain nombre d'états de l'aire de répartition se sont vu proposer une aide pour déterminer le statut de leurs populations et pour mettre au point les programmes d'action appropriés.

Des informations et des conseils furent aussi donnés à propos de l'étude des rhinos blancs vivant sur des terrains privés en Afrique de Sud, ansi que sur les questions touchant les rhinos dans le cadre de la CITES, la controverse des rhinos noirs des Midlands et la valeurs économique des rhinos.

Projets prioritaires

Un certain nombre d'agences reçurent aussi des conseils pour la rédaction de propositions de projets destinés à être classifiés par le GSRAF. Une proposition avait pour but la tenue d'un cours de recyclage, destiné aux gardes, sur l'identification de rhinos "connus". Des états de l'aire de répartition ont adressé des demandes d' échantillons de corne qui devraient servir au projet d"empreintes" de cornes, destiné à mettre au point un moyen d'identifier les régions d'où proviennent les cornes. On recherche encore un financement pour ce projet.

CHAIRMAN'S REPORT: AFRICAN ELEPHANT SPECIALIST GROUP

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Ivory issues are once again in the forefront with renewed, sometimes large-scale, poaching reported in parts of central and eastern Africa. Meanwhile, Botswana, Namibia, and Zimbabwe have all submitted proposals for the downlisting of their elephant populations. The CITES Panel of Experts process should present their report in advance of the Range States Dialogue Meeting in Senegal, scheduled for November 1996. The Secretariat has assisted in the technical preparations for this meeting, including the drafting of a briefing document entitled "Conservation of the African Elephant: Issues and Actions" and the design of a questionnaire for the range states. The discussions in the November meeting will be carried forward to the tenth meeting of the Conference of the Parties to CITES in June 1997, in Harare, Zimbabwe.

The release of the updated, published version of the African Elephant Database (AED) in January 1996 has stimulated much interest. The document has now been widely distributed and feedback has been very positive. The opinions of all AfESG members are now being sought on the future use and distribution of the primary data which comprise the AED. In this new age of computerised information "highways", the scope for dissemination of data compiled by the AfESG is almost boundless. What remains to be decided is what information should be shared and in what forms and formats it should be accessed by interested parties around the world. Since July 1996, the new AED manager has been preparing the database for potential dissemination as a "user-friendly" product.

Lamine Sebogo, the AfESG Programme Officer for west and central Africa, has been following up on a questionnaire he circulated which aims to collect views on priorities for elephant conservation in those two regions. Lamine has provided regular reports on his activities to date and in one such report, he highlighted the worrying rise in elephant poaching in the forests of southeastern Cameroon over recent months. The AfESG closed its triennium at IUCN's World Conservation Congress (WCC) in Montreal in October 1996. Staff of IUCN's Species Survival Commission (SSC) held a pre-congress workshop on networking opportunities within the SSC. I joined many other SSC specialist group chairs in presenting triennial reports, for the period 1994-1996, to a full meeting of the Commission which preceeded the official opening of the WCC. It was a sad occasion for SSC as we said farewell to the SSC Chair, Dr. George Rabb, who has held this post since 1989. Dr. Rabb has been a staunch supporter of the AfESG and our work at all levels throughout his tenure with SSC. I know that all members of the AfESG join me in thanking Dr. Rabb for his able and willing assistance over the years. I would never have agreed to take on the daunting task of being the AfESG Chair without his gentle, yet forceful, encouragement in 1991.

But even closer to home, there is a move which will have ramifications for all the members of the AfESG, the broader membership of the Asian and African elephant and rhino specialist groups and all those who have benefited from her work over the years. Ruth Chunge, the AfESG Programme Officer and my right-hand (and left, for that matter), has decided not to renew her contract at the end of December 1996. I could not have had any greater support, any more capable professional or any better colleague than Ruth. Ruth has chosen to go back to the field in which she received her formal training, medical parasitology. We have all benefited from her able contribution to the AfESG and *Pachyderm* which has become a regularly produced and widely distributed journal. I am sure you will join me in bidding Ruth "farewell", "bonne chance" and "thank you" for four years of truly excellent work on behalf of the AfESG. We shall all miss the balanced perspective and good will which are Ruth's trademarks.

RAPPORT DE LA PRESIDENTE: GROUPE DE SPECIALISTES DE L'ELEPHANT AFRICAIN

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Les problèmes concernant l'ivoire sont de nouveau d'actualité en raison de nouveaux cas de braconnage, parfois à grande échelle, qui on été relevés dans certaines parties d'Afrique centrale et orientale. Dans le même temps, le Botswana, Ia Namibie et le Zimbabwe ont soumis des propositions pour déclasser leurs propres populations d'éléphants. Le Panel des Experts de la CITES devrait présenter ses rapports avant la Réunion-dialogue des Etats de l'aire de répartition qui est prévue pour novembre 1996. Le Secrétariat a aidé à la préparation technique de cette réunion, notamment par la rédaction d'un document préparatoire intitulé "Conservation de l'Eléphant d'Afrique: Problèmes et Actions", et par la préparation d'un questionnaire les états de l'aire de répartition. Les discussions de la réunion de novembre seront poursuivies jusqu'à la Conférence des Parties de la CITES en juin 1997, à Harare, au Zimbabwe.

La parution en janvier 1996 de la version remise à jour de la Banque de Données sur l'Eléphant d'Afrique a suscité beaucoup d'intérêt. Le document a été largement distribué et ses retombées ont été trés positives. On demande maintenant que tous les membres du GSEAf donnent leur avis sur l'utilisation future et la distribution des données de base contenues dans la BDEA. Dans cette ère nouvelles des "autoroutes de 1'information", les possibilités de dissémination des données rassemblées par le GSEAf son presque infinies. Il reste à décider les informations qui doivent être partagées, sous quelle forme et comment les parties intéressées dans le monde pourraient y accéder. Depuis juillet 1996, le nouveau gestionnaire de la BDEA prépare la banque de données pour en faire un matériel aisément accessible.

Lamine Sebogo, le responsable des programmes du GSEAf en Afrique occidentale et centrale, a assuré le suivi d'un questionnaire qu'il fait circuler en vue de récolter les avis sur les priorités en matière de conservation des éléphants dans ces deux régions. Lamine produit des rapports réguliers sur ses activités, et dans l'un d'eux, il a insisté sur l'augmentation inquiétante du braconnage d'éléphants des les forêts du sud-est du Cameroun ces derniers mois.

Le GSEAf a clôturé son triennum au Congrès Mondial de la Conservation de 1' UICN à Montréal en octobre 1996. L'équipe de la Commission de Sauvegarde des Espèces (CSE) de l'UICN a tenu une réunion préliminaire sur Ia création d'un réseau à l'intérieur de Ia CSE. Avec beaucoup d'autres spécialistes des groupes de la CSE, j'ai présenté un rapport triennal pour la période 1994-1996, lors d'une réunion plénière de la Commission qui précédait l'ouverture officielle du Congrès Mondial de la Conservation. Ce fut l'occasion pour la CSE de dire hélas au revoir à son Président, le Dr. George Rabb qui a rempli cette fonction depuis 1989. Le Dr. Rabb a toujours été un supporter assidu du GSEAf et de notre travail à tous les niveaux depuis qu'il est à la CSE. Je sais que tous les membres du GSEAf se joignent à moi pour remercier le Dr. Rabb pour son aide compétente et généreuse pendant toutes ces années. Jamais je n'aurais accepté en 1991 cette tâche impressionnante qu'est la présidence du GSEAf sans ses aimables, et tenaces, encouragements.

Mais plus près de chez nous, il y a un changement qui va avoir des conséquences pour tous les membres du GSEAf, pour ceux aussi plus nombreaux des Groupes des Spécialistes des Rhinos et des Eléphants d'Afrique et d'Asie et pour tous ceux qui ont profité de son travail pendant des années. Ruth Chunge, la responsable des Programmes, mon bras droit (le gauche aussi probablement), a décidé de ne pas renouveler son contrat à la fin décembre 1996. Je n'aurais pas pu rêver un meilleur support, une collègue plus compétente ou meilleure que Ruth. Elle a choisi de retourner dans le domaine où elle a reçu sa formation, la parasitologie médicale. Tous dans le GSEAf, nous avons pu bénéficier de sa précieuse contribution, et gràce à elle, *Pachyderm* est devenu un journal produit régulièrement et largement distribué. Je suis sure que vous vous joignez à moi pour soihaiter à Ruth "Au revoir", "Bonne chance!" et "Merci" pour les quatre années d'excellent travail qu'elle a consacrées au GSEAf. Le point de vue équilibré et labonne volonté qui sont le caractéristique de Ruth vont nous manquer.

AFRICAN ELEPHANTS IN COASTAL REFUGES: POSTSCRIPT*

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*Postscript to Dudley's article in *Pachyderm* 21

Two years ago, while the manuscript by Dudley (1996) was in preparation, four Knysna elephants roamed the Gouna/Diepwalle forests and a translocation of additional elephants from Kruger National Park was pending. There appeared to be some hope still for the future survival of elephants in the Knysna forest.

As of February 1996, however, only three elephants have remained in the Knysna forests. All are female, and two are juveniles of exogenous origin. The translocated juveniles have failed to establish social bonds with the remaining resident elephants (M. Garai, pers. comm.), and the probability for the long-term survival of any elephants in the Knysna forest now appears minimal. The Knysna elephant population may now be considered functionally extinct.

The final extirpation of the Knysna elephants may be linked to a complex of cultural and ecological factors, each perhaps dominant only within certain periods but all contributing significantly to the final outcome. In view of its long, patently marginal status and now certain demise, why should the tiny Knysna elephant population merit such attention while there are still numerous African elephant populations numbering in the thousands and even tens of thousands roaming across large areas of the continent?

The significance of the Knysna elephant debacle is that this scenario may soon be replicated time and time again among isolated elephant populations in the Guinea rainforest region and elsewhere within the African continent. The precarious status of the Knysna elephants during the period 1950-1990 is typical of that experienced by Asian elephant populations within much of their current range (Santiapillai & Jackson, 1990).

African elephant populations will become increasingly fragmented and limited by the rapidly growing resource requirements of human populations, which are projected to at least double within the next 25 years throughout most of sub-Saharan Africa. Elephant conservation in the 21st century will require intimate experience with the management of small and isolated elephant populations, and the Knysna experience may provide valuable lessons for the conservation of elephants elsewhere.

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THE GREATER ONE-HORNED RHINO OUTSIDE PROTECTED AREAS IN ASSAM, INDIA

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INTRODUCTION

The range of the greater one-horned rhinoceros, *Rhinoceros unicornis*, once extended over large parts of the Indo-gangetic plains. However, the species is now confined to a few pockets of Assam, the northern part of West Bengal, Uttar Pradesh and Nepal. Numbering less than 2,200, the greater one-horned rhinoceros is a globally endangered species under continuous threat from poachers and encroachers. A detailed account of its distribution, including records of stray rhinos, was documented by Choudhury (1985) but no further reports on the status of the species outside protected areas have been published. This paper presents an account of the present status of the greater one-horned rhino outside the national parks and wildlife sanctuaries in different parts of Assam, as well as providing past records. It is extremely important to monitor the rhino population outside the network of protected areas in order to obtain a comprehensive picture of the overall status of the species.

PERMANENT AND SEMI-PERMANENT LOCALITIES

Burhachapori Reserved Forest: This 44km^2 grassy tract is located just north of Laokhowa Wildlife Sanctuary, in Sonitpur district. The habitat in Burhachapori and Laokhowa is contiguous and until the "massacre" of rhinos in the latter area in 1983, both areas formed an important rhino habitat. Since then, stray rhinos have appeared regularly, mostly from Kaziranga National Park. In 1989, the author found a lone animal in Burhachapori. At present, three to four rhinos make frequent visits to the area. Burhachapori is in the process of being declared a wildlife sanctuary (only the Gazette Notification is awaited).

Pani-Dihing: This is a complex of ox-bow lakes, marshes and channels with elephant grass, in Sibsagar district, covering about 40km^2 (21km^2 is reserved forest). Pani-Dihing was a known rhino habitat, and a small population was always present until the last animal was shot by poachers in April, 1987 (Choudhury, 1991). However, in 1993, two rhinos from Kaziranga travelled to this area and settled down. In about March 1993, one of the rhinos crossed the Burhi-Dihing river and entered the Dihingmukh Reserved Forest of Dibrugarh district.

Kuruwa-Mandakata: Kuruwa is a small grassy tract on the north bank of the Brahmaputra river in Darrang district while Mandakata is a village with an ox-bow lake, a marsh and some grassland in Kamrup district. Both the areas are adjacent to each other. The rhino was a familiar animal of the area until about the late 1980s. At present a couple of rhinos are reported frequently. The area is not far from Pobitora Wildlife Sanctuary and a few animals regularly move out of the sanctuary, often crossing the Brahmaputra river to Kuruwa.

Tatimora Chapori: This area is located north-east of Guwahati city and west of the Pobitora Wildlife Sanctuary. Rhinos in small numbers are seen regularly in the area and originate from the Pobitora Wildlife Sanctuary.

Matmora: Until the early 1980s, some seven to eight rhinos frequented the grasslands around Matmora, in Lakhimpur district. The last rhino of the area fell to poachers in 1985. This animal was born near Matmora and was reportedly habituated and very tame. A stray rhino passed through the area in early 1995 and was sighted in the Sisi-Kalghar area of Dhemaji district, north-east of Matmora.

Khatonibari Soil Conservation Area: This 4km^2 plantation of the Soil Conservation Department in Sonitpur district has no resident rhino population. But due to its location, just north of Kaziranga, across the Brahmaputra, rhinos are seen frequently. In November-December 1989, one rhino stayed in the area for more than a month. In September 1990, two rhinos, which strayed up to the border of Arunachal Pradesh, were chased by Forest Department personnel to this area where they remained for a few days. In June-July 1995, one rhino was seen in the area and it moved into the Monabari tea estate.

Kukurakata Reserved Forest: This is a hilly forest located west of Kaziranga (16km^2 in area). A few rhinos are located within the area. However, it is during the monsoon floods that more than 20 to 25 animals take shelter in the highlands of Kukurakata.

Bagser Reserved Forest: Also located near Kaziranga, towards the south-west, this reserved forest is located mostly on the hills with a patch of flat land towards the north-east (34km^2 in area). It is located in Nagaon district. Stray rhinos regularly move to the area from Kaziranga. The flat land, which is suitable for a resident rhino population, is heavily disturbed by man and hence there is no permanent rhino population.

STRAY RECORDS

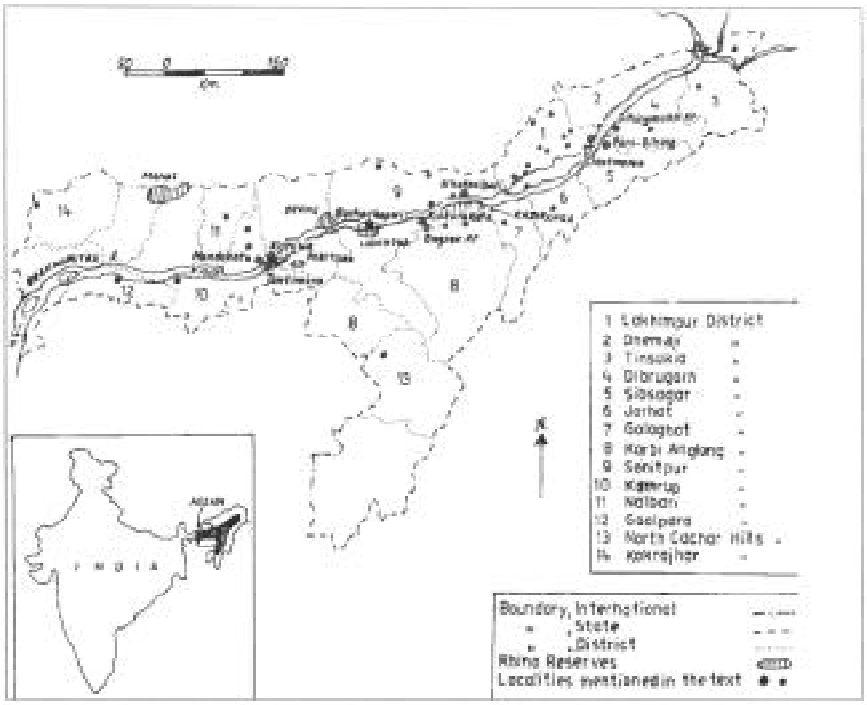
Lakhimpur District: In March 1966, a lone rhino was killed by Mising (tribal) poachers near Merbeel ("beel" means ox-bow lakes and depressions, also marshes) in Dhakuakhana Sub-division. In the late 1970s, one rhino was reportedly seen near Lamugaon, not far from Merbeel. Two rhinos were reported from the Bebejia area of Dhakuakhana in 1985-87. In 1987-88, these rhinos traveled eastwards but no further report was received of their whereabouts.

In about 1986, a female with a grown calf came to Pabha Reserved Forest. They traveled north-east to reach Dulung Reserved Forest from where they traveled south, then south-east. After crossing the Brahmaputra river, they entered Sibsagar district. In the same year, a lone rhino was seen in Kadam Reserved Forest by the locals and forest staff.

In 1987, a lone rhino was recorded near Joihing river in Kakoi Reserved Forest. It then moved up to Panir Reserved Forest of Arunachal Pradesh. In 1988, a lone rhino was sighted again by the locals near the confluence of Korha and Charikaria rivers in Dhakuakhana Subdivision. It traveled up to Thekeraguri.

In 1992, two rhinos appeared near Dhunaguri which were chased back to Kaziranga by the forest staff. A villager was injured in Borchapori in 1992-93 by a rhino. In the last week of January 1995, a lone rhino entered the Narayanpur area and travelled north up to Drupong Reserved Forest of Arunachal Pradesh. Then it traveled south to near Silikaguri where it was speared to death by Mising poachers when it was trapped in a small swamp. Near Silikarugi, a few rhinos are seen during almost every winter. For instance, on 30-31 December 1994, two adults with a calf each were seen in the area.

Tinsukia District: In the early 1970s, a lone rhino was spotted by the villagers in the Kochuoni Pather area near Dighaltarang. The animal had roamed about in the area covering Baghajan, Motapung and Dibru Reserved



A map of Assam, displaying the districts, protected areas and reserves of most localities mentioned in the text.

Forest (now part of Dibru-Saikhowa Wildlife Sanctuary). In 1971-72, a rhino had strayed up to the Nagaon village of Sadiya sub-division.

Dibrugarh District: In about the mid-1980s, two rhinos were seen in Namdang Reserved Forest. A lone rhino which had crossed over from Pani-Dihing area of Sibsagar, was still roaming in Dihingmukh Reserved Forest until mid-1994 (and may still be there).

Sibsagar District: One person was injured by a stray rhino in Putai village near Mathurapur in January 1979. The forest staff then chased the rhino to Diroi (Rangoli) Reserved Forest.

Jorhat District: Because of the close proximity to Kaziranga National Park, a few rhinos wander into the riverine areas of the Brahmaputra river, especially Majuli, every year. In January 1993, the carcass of a rhino was found in the Luit suti of Majuli. In January 1994, a lone animal appeared at the fringe of Jorhat town while three were seen in Majuli.

Golaghat District: Part of Kaziranga is located in this district and hence rhinos in small numbers regularly move out to the neighbouring paddy fields and tea plantations. In February 1993, a lone rhino entered a tea plantation near Ghiladari. In January 1994, one such stray animal was shot dead by poachers near Barua Bamungaon.

Karbi Anglong District: Since Kaziranga lies in the north of this district, a few rhinos often wander into the area, especially during the floods. The rhinos also climb to the hill-tops of the northernmost range of Karbi Plateau, while foraging.

Sonitpur District: Rhinos regularly cross the Brahmaputra river and enter different parts of Sonitpur District, especially Panpur Reserved Forest, Khatonibari and even Tezpur town (the latest to appear near the town was seen in July 1995). In 1978, a female with a calf were seen in Soni-Rupai sanctuary (not a notified protected area) by the forest staff (T. Nath, pers. comm.). In April-May 1990, a rhino traveled through Nameri Wildlife Sanctuary. In September 1990, two rhinos from Kaziranga traveled to Behali and Biswanath Reserved Forests along the Borgang river up to Arunachal Pradesh. Later on the forest staff chased them to Khatonibari, opposite Kaziranga National Park.

Kamrup, Nalbari, and Goalpara Districts: In December 1983 and January 1984, a lone rhino traveled from Pobitora Wildlife Sanctuary to near Nalbari town. Then it moved south-west and crossed the Brahmaputra river. The author observed the animal near Nagarbera, in Kamrup district, on 23 January 1984. After that, the animal moved west and reached the vicinity of Goalpara town from where it was captured in mid-March 1984, and flown to Dudhwa National Park under a translocation programme (Choudhury, 1985).

In March 1992, two people were killed by a rhino in Kamrup District, one near Kamalpur and the other near Rangiya. The rhino then moved towards Nalbari.

North Cachar Hills District: In the early 1970s, a stray rhino was spotted by the villagers in the northwestern part of the district. The site was in Sikilangso village, a Karbi (tribal) hamlet near Garampani (Umrongso). The animal apparently came from Nagaon District and had followed the Kopili river valley.

Kokrajhar District: E.P. Gee in 1964 had estimated that two to three rhinos were left in the Sankosh river valley (in the Kochungaon Reserved Forest). There has been no recent report from this area and perhaps no rhinos remain now.

CONCLUSION

Although the rhino population in Assam has increased in numbers since the beginning of this century, the population outside the protected areas has declined sharply. This is mainly due to poaching for rhino horn rather than habitat loss. Of the permanent and semi-permanent localities, it is only in Burhachapori and Pani-Dihing that rhinos can flourish again, provided sufficient protection measures are taken. While Burhachapori has already been declared a wildlife sanctuary, there is a proposal to develop Pani-Dihing as a wildlife sanctuary for water-birds.

As far as stray animals are concerned, it is very difficult to give adequate protection, since individual animals often wander as far as about 200km (Choudhury, 1985).

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THE IMPORTANCE OF PARK BUDGETS, INTELLIGENCE NETWORKS AND COMPETENT MANAGEMENT FOR SUCCESSFUL CONSERVATION OF THE GREATER ONE-HORNED RHINOCEROS

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INTRODUCTION

Since the late 1960s the greater one-horned rhinos in India and Nepal have been increasing steadily in numbers largely due to high park budgets and good management. Poaching increased in both countries, however, in the early 1990s. Subsequently, more funding for intelligence networks around some of the national parks and improved park management reduced poaching significantly in 1994 and 1995. This paper will examine methods used in India and Nepal to reduce the recent spates of poaching. It will also point out why some rhino areas in India are still insecure.

INDIA

The north-east state of Assam (see map) is home to 1,500 rhinos, 95% of India's total rhino population. Poaching was serious in 1992 and 1993 in Assam. This was due to a number of factors including political instability (especially around Manas and Kaziranga National Parks), inadequate intelligence funds, a cut back in funds for management in several protected areas, poor leadership in certain parks and wildlife sanctuaries, low morale of forest guards, and no arrests of rhino horn traders (Vigne & Martin, 1994). In Assam, 70 rhinos were poached in 1993, but in 1994 the situation turned around when only 31 rhinos were poached (see Table 1), while 35 were poached in 1995 (up until 1 November). The small rhino populations in West Bengal and Uttar Pradesh have also been secure recently. India's rhino conservation success is due to several reasons combined, including the arrest of some major traders. Until 1995 few such arrests had ever been made by the Indian authorities. Certain non-government organisations (NGOs), notably TRAFFIC India and the Wildlife Protection Society of India, have helped the government by providing information on the trading syndicates, largely through the help of informers. In June 1995, police officers caught five people in the town of Siliguri in West Bengal who offered to sell 60 rhino horns and were in possession of two. These two horns probably originated from Assam and would have been sent to Bhutan for export to eastern Asia. The leader of the smuggling syndicate was of Taiwanese origin who had trading connections in India, Bhutan, Nepal and Taiwan. This trader claimed to have supplied the 22 rhino horns which a Bhutanese princess carried from Bhutan to Taiwan in September 1993 (Anonymous, 1995). In August 1995 another businessman was caught in Calcutta with rhino horn, elephant ivory and tiger skins. Until the Siliguri-Bhutanese connection became important, Calcutta was the main entrepot for rhino horn from India. Since the late 1980s, however, the Indian authorities have intensified their efforts in this area so the Calcutta trade route is less significant. In October 1995 another horn was seized in Siliguri. This small town has become India's main entrepot for rhino horns, being near Assam, Nepal and Bhutan and being a junction for most transport routes in the region. Siliguri thus attracts many businessmen including those dealing in endangered wildlife products. It has been a major breakthrough that two big rhino horn traders in this town have been caught.

Photo credit: Lucy Vigne

Unlike ivory rhino hom deteriorates quickly if not properly treated.

Table 1. Number of known rhinos poached in Assam.

Year	Kaziranga NP	Manas NP	Orang WS	Pabitora WS	Other areas	Total
1992	49	11	2	3	2	67
1993	40	22	1	4	3	70
1994	14	4	7	4	2	31
1995*	21	1	9	2	2	35

* up to November
Source: Forest Department of Assam

A map showing the main areas referred to in the text.

Assam's Kaziranga National Park

Kaziranga holds 1,300 rhinos, nearly 90% of Assam's rhino population. The recent drop in rhino poaching in India thus relates closely to improved rhino conservation in and around Kaziranga.

First, money spent on information about poachers and middlemen around Kaziranga increased ten times from 1990/1 to 1993/4: from $199 to $2,108 (see Table 2). In 1994 12 rhino poachers were killed and 46 arrested compared with four killed in 1991 and only 25 arrested. However, the District Forest Officer at the Park headquarters in Bokakhat said he needed 200,000 rupees a year ($6,000 in late 1995) to pay for even more informers. In 1995 10-15 people were on the books as informers, and with more informers poaching would be reduced even further.

Table 2. Amount of money spent by the Forest Department of Assam in and around Kaziranga National Park for intelligence gathering operations.

Year	US$	Year	US$
1990/1	199	1993/4	2,108
1991/2	279	1994/5	1,224
1992/3	881		

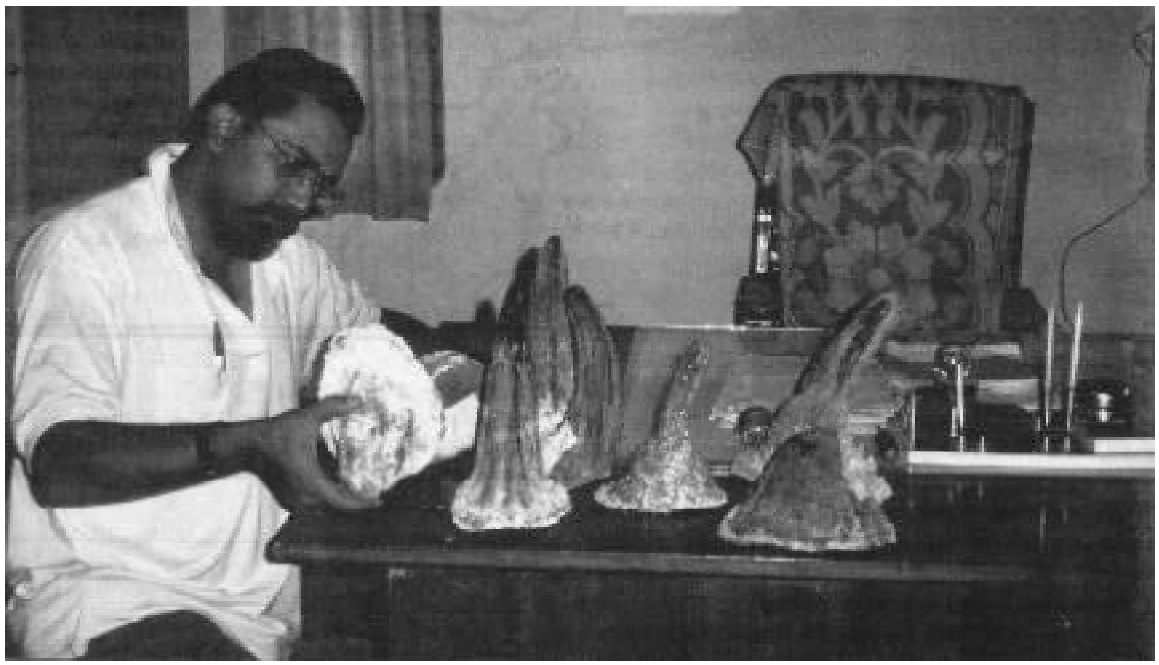
Source. Forest Department ofAssam

Second, the police around Kaziranga have become more involved in stopping the rhino horn trade. With the Park staff's new knowledge on poachers and traders, they have had greater co-operation with the police. The police have been also less preoccupied with terrorists recently. It is only the police who have the

authority to organise arrests in the villages, and in 1994 and 1995 the police and Forest Department staff carried out at least nine joint raids which resulted in the deaths of four poachers and the arrests of 20 men, while six firearms used to kill rhinos were confiscated (Assam Forest Department, 1995).

Third, Park management has improved. The Director of Kaziranga National Park has made efforts to ensure that he has the most competent and experienced three range officers who have motivated their men and improved patrol work. These range officers have been responsible for overseeing a number of encounters with poachers from 1993 up to November 1995 resulting in 116 arrested and 24 killed (see Table 3). The range officers supervise the 204 forest guards, 60 boatmen, 62 foresters, 56 game watchers and other men inside Kaziranga. There are 435 full-time staff involved in anti-poaching work based at 113 camps in the Park, which works out at over one man per km2, a very high concentration of manpower, and an excellent poaching deterrent, when managed correctly. The Forest staff put a lot of effort into their work, risking their lives in trying to catch poachers in the difficult terrain and often swampy conditions of Kaziranga. This is a great feat considering that the men are not trained in guerilla warfare, Because of this, poachers can still sneak inside the Park, shoot a rhino, and come out without being caught. In 1993 poachers often shot rhinos on moonlit nights, so patrol work was intensified at night. As a result, poachers in 1994 reverted to day-time shooting, which fortunately is easier to detect (Pankaj Sharma, Range Officer, Baguri, pers. comm., 1995). Some of the forest guards were re-positioned in camps along the Park's heavily human-populated southern boundary, and more patrol boats were put onto the Brahmaputra river on the northern boundary. In late 1995, however, six of the 12 boats with engines were broken as were 27 of the 110 small country boats (C.R. Bhobora, DFO, Kaziranga National Park, pers. comm., 1995).

Photo credit: Esmond Martin



Pankaj Sharma, Range Officer in Baguri for western Kaziranga National Park, examines rhino horns from his strong room.

According to S.K. Sen, Director of Kaziranga National Park, rhino poaching in 1995 has been occurring in the central part of the Park by gangs still entering either from the north side across the Brahmaputra river or from the vulnerable southern boundary. In 1995 (up to 1 November) six rhinos were caught by poachers in hand-dug pits and 15 were shot, mainly by gangs organised by traders from Nagaland, a neighbouring state (see Table 4). In 1995 gangs of four to six people earned about the same as the previous few years for a horn, working out at $885 to $2,556 per kilo of horn, a sizeable sum for a gang of poverty-stricken villagers. Nevertheless, it is an encouraging sign that the price of rhino horn has not gone up recently, although fewer new rhino horns are now on the market.

Table 3. Encounters and raids in Kaziranga National Park, Assam.

Year	Poachers killed	Poachers arrested	Arms recovered	Ammunition recovered	Horns recovered
1993	8	67	19	49	4
1994	12	46	9	60	1
1995*	4	3	1	22	2

* up to November
Source: Forest Department ofAssam

Table 4. Rhino mortality in Kaziranga National Park, Assam.

Year	Poaching methods			Poached	Death from natural causes	Total
	pit	gun	electrocution			
1992	2	45	2	49	66	115
1993	2	38	0	40	58	98
1994	3	11	0	14	37	51
1995*	6	15	0	21	47	68

* up to November
Source: Forest Department ofAssam

Fourth, there has been increasing NGO support. The Rhino Foundation for Nature in north-east India gave equipment to Kaziranga's field staff, the first NGO to do so for many years. The Rhino Foundation, which was established in 1994 and is supported by several tea companies in Assam and West Bengal, donated, in 1994 and 1995, 450 pairs of hunting boots, 250 raincoats and 50 water filters to the staff. The Foundation has also been helping the farmers around Kaziranga by inoculating their domestic animals in 1994 and 1995. In addition, the Tiger Link rewarded three range officers, one informer and one home guard in and around Kaziranga the equivalent of $312 each in 1995. These NGO contributions have raised morale of the Park staff, improving their patrol work, and have helped to reduce hostility from local farmers towards the Park.

Fifth, the Assam government budget of Kaziranga (a park of 430km^2) increased slightly in 1994/5 compared with the year before (after taking into consideration an 8% inflation rate) to $1,552 per km^2. This is one of the highest figures per unit area in Asia (see Table 5). This budget provides substantial benefits to the running of the Park, including salaries for a large anti-poaching staff. Nevertheless, more funds are needed if the Park is to be properly maintained and developed in future the years.

Table 5. Government budgets for rhino protected areas in Assam.

Year	Kaziranga NP	Manas NP	Orang WS	Pabitora WS
1992/3	$529,456	$441,476	$136,818	$232,669
1993/4	582,930	503,124	131,559	234,954
1994/5	667,374	515,119	152,521	232,678

Source: Forest Department of Assam

Assam's Manas National Park

Unlike in Kaziranga, rhino poaching has remained a serious problem in Manas National Park. From 1990 to 1995 Manas lost most of its rhinos (see Table 1). The main reasons are due to serious political disturbances in the area, a lack of adequate funding and manpower, and security problems.

First, continuing since the late 1980s there has been a break down in law and order, until very recently, due to the political disputes. As a result, many rhinos were poached. For example, in March 1993 one gang leader from the Bodo tribe organised the killing of at least 13 rhinos. The man lived only a few kilometres from the area headquarters of Bansbari in the village of Khabsinpara (Ajoy Brahama, Range Officer, Bansbari range, pers. comm., 1995). From 1990 to the end of 1993, perhaps just over half of the estimated 90 rhinos had been killed. In 1994 at least four more were killed in the central Bansbari range. Bhuyanpara (the eastern range) and Panbari (the western range) were rarely patrolled from 1989 onwards due to the fear of Bodo terrorists hiding in the forest. It is likely that virtually all the rhinos in these two areas had been eliminated by 1994. There is information on only one poaching gang operating in 1994 in Manas. This gang of four from Nalbari District, all armed with rifles, shot a rhino and cut off its horn which weighed about 625 grammes. It was bought by a man from Guwahati, Assam's capital, for the equivalent of $2,555 a kilo (Brahama, pers. comm., 1995). In 1995 up to early November, another rhino was known to have been shot in the Bansbari range.

Since it has not been possible to carry out a census nor even to patrol large parts of Manas due to the political upheavals, the number of surviving rhinos is a guess. Two females with calves were seen in the Bansbari range in 1995 and its range officer believes that perhaps 20 remain in the entire Park (Brahama, pers. comm., 1995).

Manas Park has been facing additional problems since 1989 due to the political problems in the area. In 1994 and 1995 seven wild elephants were killed for their tusks (Brahama, pers. comm., 1995), and in 1995 two domesticated elephants had their tusks removed while their mahouts were held at gunpoint (Rajendra Agarawalla, Field Director, Manas Tiger Project, pers. comm., 1995). Furthermore, a considerable number of trees has been cut down for timber, while rhino horns and firearms have been stolen from the Forest Department, and six Forest staff have been murdered (Deb Roy, 1994).

Second, throughout this difficult time, Manas staff did not receive adequate funds nor equipment to maintain a strong presence, and many camps were evacuated as areas were unsafe. By November 1995 only 20 of the 43 forest guard camps were occupied and the morale of the remaining field staff was low with little incentive to patrol (Deb Roy, 1994; Menon, 1995). Funding for Manas has still not been sufficient for its rehabilitation. The government budget, when corrected for inflation, dropped slightly in the financial year 1994/5 compared with the year before (see Table 5). The budget of the core area (520km^2) of Manas was $515,119 in 1994/5 or $991 per km^2, much lower than Kaziranga's $1,552.

Third, Manas has several security problems. The intelligence network around Manas is ineffective. A group of informers needs to be re-established urgently, for which only a small sum of money would be required.

Further aggravating the security problem, a new road in the adjoining Royal Manas National Park in Bhutan has been built. Construction commenced in 1994 to allow easier access into the area. This will benefit poachers and traders also, and is of concern to the Park staff.

The Park could face an additional security threat due to the fact that Manas re-opened to the public on 1 October 1995, making it difficult to distinguish between poachers and legitimate visitors. It had been closed to all Indian and foreign tourists since 1989 as it was not then safe, but now the area is relatively stable. It is essential to protect the rhinos, whose whereabouts will be known once more by the public. Whether or not the Park is now revamped properly is critical to the future of this World Heritage Site, which is home to many endangered and several rare, endemic species.

Assam's Orang Wildlife Sanctuary

One other important rhino area in India has suffered recently, Orang (or Rajiv Gandhi) Wildlife Sanctuary. In 1992 only two of its hundred or so rhinos were poached, and 1993 witnessed only one rhino poaching incident, due to very good park management at the time. In 1994 seven rhinos were illegally killed, however, while in 1995 (up to 1 November), the figure reached a record nine, representing about 10% of the population. Again, reasons are similar as for Manas.

First, in 1994 there was a breakdown in law enforcement due to local agitation. The main radio set in the Sanctuary was stolen and not replaced as the Forest

Department feared it would be stolen again. Therefore, communication with the forest guards in the field broke down. Guns were also stolen, apparently by Bodos, and senior Orang officials have been reluctant to release more guns to the forest guards. Deprived of their radio network and firearms, the morale of the forest guards has suffered and patrolling has been far less intense than in 1992 and 1993.

Second, there have also been financial constraints in Orang. Its government budget declined by over 12% (adjusted for inflation) from 1992/3 to 1993/4, but in 1994/5 it was increased to $152,521 or $2,018 per km^2, higher than for Kaziranga. Despite this, some of the camps are poorly maintained. Orang needs better management and stronger, more enlightened leadership to make available radio communications and firearms once more and to increase staff morale.

West Bengal

The state of West Bengal (see map) was once rich with rhinos. Today, two small, but growing, populations remain. In 1995 there were 35 rhinos in Jaldapara Wildlife Sanctuary (216.5km^2) and 18 in Gorumara (expanded from an 8.5km^2 wildlife sanctuary to a 79.52km^2 national park in 1995). There was no poaching in either area in 1994 or 1995 (up to November), but there were four natural deaths: an old male died from fighting, a female calf was killed by a tiger, one drowned in a wallow, and a male died of lung congestion.

There are two main reasons for the lack of poaching. First, in 1995/6 the government budget for Jaldapara was $105,422 or $487 per km^2 and for Gorumara, $24,096. Out of these budgets a small (but adequate) amount is paid to gather information on potential poachers, and it is obviously a good deterrent as there has been no rhino poaching since 1993 (S. Roy, Chief Wildlife Warden, West Bengal, pers. comm., 1995). Second, informal eco-development committees have recently been established, 10 next to Jaldapara, and four around Gorumara, consisting of local families who help protect and manage the wildlife.

Uttar Pradesh

There are two other, even smaller, rhino populations in India and there has never been poaching in either of them. Dudhwa National Park (see map) had 11 animals in 1992 and 13 in late 1995. These rhinos were translocated into this area in 1984 and 1985. The rhino sanctuary has remained safe from poachers, mainly because it is entirely electrically fenced. The other rhino population was kept secret by the Indian authorities until late 1995, the main reason, no doubt, for its survival. This population of at least five rhinos occurs in the Katerniaghat Wildlife Sanctuary, about 40km east of Dudhwa, close to the Nepal border. The origin of these rhinos has fascinating political overtones. In 1986 13 rhinos from Nepal's Royal Chitwan National Park were translocated to Royal Bardia National Park in western Nepal, near India's border, to start a new population. Soon afterwards, three wandered out of Bardia and into India (Martin & Vigne, 1995). In 1991 25 more rhinos were moved from Chitwan to Bardia. From 1986 to 1994, 17 calves were born in Bardia while two or three more rhinos moved into India in and around the Katerniaghat Wildlife Sanctuary. At first, India's Forest Department staff fenced in the rhinos for the animals' security, but later a part of the fence was taken down to allow them to move wherever they wished (S.C. Dey, Addl. Inspector General of Forests and Director of Wildlife-Preservation-for India, pers. comm., 1996). The Nepalese complained to the Indian authorities for not sending the rhinos back to Nepal. However, the official Indian policy remains as follows: "Wild rhinos do not understand international political boundaries; these rhinos are free to go back to Nepal, [but it would] be inappropriate to take any step to drive them back to Nepal, as that would be against the concept of trans-border movement of animals and trans-border species conservation (Dey, pers. comm. 1996). Fortunately, rhino poachers do not exist in the area and for the moment they are relatively safe.

NEPAL

The early 1990s were the worst years for rhino poaching in Nepal (see map) for over 20 years. In 1992 17 rhinos (from a population of over 400) were killed illegally in Royal Chitwan National Park and one was shot dead which had wandered out of the Park (Martin & Vigne, 1995). Royal Bardia National Park, Nepal's only other protected area for rhinos, which had a population of nearly 40 animals in 1992, lost four to poachers in the fiscal year of 1992/3 (Martin & Vigne, 1995). In contrast, in 1994 and 1995 not one rhino was poached inside Chitwan and only one outside up to November (see Table 6). Similarly in Bardia, no rhinos were poached in the fiscal years 1994/5 and 1995/6 up to November 1995, although six had been poached in the previous two years (source: Department of National Parks and Wildlife Conservation). The decline in poaching is thus even more dramatic than for India. As for India, there are several reasons for this success in Nepal.

First and most importantly, by far, has been the larger budget allocated to intelligence gathering in 1994 and

Table 6. Number of known rhinos poached in and around Royal Chitwan National Park, Nepal.

Year	In Royal Chitwan NP	Outside Royal Chitwan NP	Total
1992	17	1	18
1993	5	4	9
1994	0	1	0
1995*	0	1	1

* up to mid-November
Source: Department of National Parks and Wildlife Conservation

1995 for Royal Chitwan National Park than previously. From 1991 to 1993 the annual average amount of money spent paying individuals on a regular basis to collect information and for rewards to informers around Royal Chitwan National Park was $1,359; the figure for the following two years was $6,041 per annum, over four times as much. Most of this money came from donations from foreign tourists who visited Chitwan's Tiger Tops Jungle Lodge. This money was collected by Nepal's branch of the International Trust for Nature Conservation (ITNC) (Charles McDougal, tiger researcher, pers. comm., 1995). The money was given to three people: the Chief Warden of Royal Chitwan National Park and the District Forest Officers (DFOs) of Chitwan and Nawalparasi (which both border the Park) to pay the informers (McDougal, pers. comm., 1996). The National Parks Department does not have a budget for intelligence funds due to the difficulties that would be involved in accounting for the money officially. From 1991 to November 1994, 1TNC raised $15,884; about two-thirds was handed out as reward money and one-third for regular salaries to informers. These funds helped the authorities make many arrests. In 1994 14 rhino poachers and two tiger poachers were caught. In 1995 there were 10 seizures of tiger bones and skins along with 28 arrests of poachers and traders. There were also two rhino horn seizures with about six people arrested in 1995 (McDougal, pers. comm., 1996). Additionally, four people were arrested in 1995 for selling fake rhino horns (Ramprit Yadav, Chief Warden, Royal Chitwan National Park, pers. comm., 1995).

Second, the District Forest Officers, who have jurisdiction over wildlife outside the parks, have become more active against the rhino horn trade in some key areas. The DFOs around Chitwan, Bardia and in Kathmandu have been using intelligence information more effectively and have been more aggressive against rhino poachers and traders. Chitwan District's DFO, Y.B. Thapa, even arrested a former Assistant Minister attempting to sell a rhino horn in Bharatpur town, just north of Royal Chitwan National Park, in 1995. After extensive bargaining, when the former Assistant Minister was going to accept the equivalent of $2,000 for his 350g horn (the equivalent of $5,714 per kilo), he was arrested and put into jail for three months (Thapa, pers. comm., 1995). In late 1995 the Chitwan District DFO had 54 armed guards, 60 forest guards, 25 rangers and four assistant forest officers to protect the forests and wildlife in his district. In November 1995, there was a shortage of staff, however, as eight armed guards were sent on training exercise, three were transferred, and a further three resigned. Poachers then shot a rhino 10km north of the Park boundary, the only poached rhino in 1994 or 1995. The DFO found the carcass a few days later with the horn removed. Staff took the nails and seven sections of skin for storage. The DFO then allowed local people to help themselves to the carcass, an important measure to improve Park relations with neighbouring villagers. About 45 men and women took the meat, blood, urine and remaining skin, and eventually everything was taken. A few days later, however, a villager ended up in hospital with food poisoning from eating the decaying meat (Thapa, pers. comm., 1995).

Photo credit: Esmond Martin

Just outside Royal Chitwan National Park in Nepal are community tree plantations for furniture-making and for fodder To pre vent rhinos from entering this particular plantation, a boundary trench 75cm deep, supported at intervals with wooden beams, has been constructed.

Third, there has been increased police help. The DFO in Kathmandu with the police intercepted many illegal wildlife products in 1994 and 1995, including 11 leopard skins, a tiger skin, a rhino head and one rhino horn.

Two fake rhino horns made out of water buffalo horn and a fake tiger skin made in India from cow and goat skins were also impounded. Several arrests were made (G.P. Bankota, DFO for Kathmandu, pers. comm., 1995).

Fourth, harsher sentences have been introduced. Penalties for rhino poaching increased in 1993 to a maximum of 15 years in jail and a 100,000 rupee fine (about $1,850 in late 1995). Unlike in India, these penalties are enforced and poachers are often jailed for a long period.

Fifth, park management in Chitwan and Bardia has improved, with a significant increase in patrol work. NGOs helped to establish two anti-poaching units in Chitwan and one in Bardia from 1993 to 1995. 1TNC donated $5,365 to Chitwan's units and WWF Nepal gave $11,435 for all three units during this period (Ukesh Raj Bhuju, WWF Nepal, pers. comm., 1995). As well as these new anti-poaching units, the army based inside Chitwan and Bardia has been patrolling more frequently, and both patrol now at night, as well as in the day, concentrating their efforts on areas susceptible to poachers, such as the western side of Chitwan.

Sixth, there has been adequate funding for the parks. In 1993/4 Chitwan's total government budget was the equivalent of $804,457 with the army receiving 65% of this. However, the full costs of the army are not covered by the Department of National Parks and Wildlife Conservation and therefore the real Park budget is higher. For 1995/6 Chitwan's estimated government budget was $879,620, including the army's share presumed to be still about 65%. If one adds contributions from NGOs, the total budget for Chitwan comes to about $900,000 or $966 per km^2. This is quite adequate for the Park which is more than twice the size of India's Kaziranga National Park. With competent senior officials to manage Chitwan and its finances, it was possible in 1994 to buy new anti-poaching equipment such as vehicles, radios and tents. However, with the growing human population around Chitwan and Bardia, poaching pressure will probably increase, and more effort will be needed to protect the rhinos in the future.

CONCLUSION

The conservation of the greater one-horned rhinoceros in India and Nepal has been a success for many years with the total population steadily growing. The main reason is that government budgets for rhino areas have been over ten times higher on average than those in Indonesia, Malaysia and Vietnam. The large budgets have enabled sufficient manpower for patrol work, up to one man per km^2, one of the highest for a rhino protected area owned and managed by a government anywhere in the world. The park budgets for India and Nepal's rhino areas have remained on average stable from 1993 to 1995 when corrected for inflation. On the other hand, there has been a recent big increase in the amount of money spent on intelligence gathering. This is therefore the main reason for the sharp reduction in poaching in 1994 and 1995 in both India and Nepal. Combined with this, Park management in the key rhino areas has improved and government officials have been more active in arresting poachers and traders. By contrast, Indonesia has essentially no intelligence system and officials know extremely little about Sumatra's poachers and the rhino horn trade to the detriment of the rhinos which have been steadily decreasing in numbers in recent years.

Nepalese and Indian wildlife officials have demonstrated that the most cost-effective method of saving rhinos is to spend money on an efficient intelligence network. In Royal Chitwan National Park less than one per cent of the total budget was spent on informers in the mid-1990s, yet this tiny amount was effective in catching and deterring rhino poachers. Officials trying to protect rhinos in other countries should also allocate money for an efficient intelligence gathering network and for more manpower with good leadership in the field. It would be encouraging if other countries could follow Nepal and India's example.

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MODERN TECHNOLOGY FOR RHINO MANAGEMENT

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INTRODUCTION

As rapid advances are being made in the "high-tech" fields of military surveillance, telemetry, satellite position-fixing systems, transponder devices, etc., a frustrating situation arises for those who are involved in rhino conservation programmes in Africa. While it is known that this smarter technology includes many tools which are of immediate or potential applicability to the protection and monitoring of free-ranging rhinos, there is only a vague understanding of relevant technological advances. Generally, the time needed to investigate them is limited, as are the lines of communication. The gap in communication between First World technocrats and Third World conservationists is often worsened by the confidentiality that pertains to military technology. As an attempt to narrow this gap and to stimulate lateral thinking on potential technological applications, this paper presents some hopeful ideas which stem from rhino management experience in southern Africa. Other rhino managers in Africa can, and should, add many more ideas to a "wish list" of cost-effective and efficient technological aids for field efforts in monitoring rhinos, detecting poachers, protecting the former and eliminating the latter.

RADIOTELEMETRY

Conventional VHF radiotelemetry will have a significant role in rhino monitoring for the foreseeable future, although the problem of attaching transmitters to rhinos has yet to be satisfactorily resolved. Horn implant transmitters (e.g. Pienaar & Hall-Martin, 1991) have limited operational lives because their antennae become damaged due to the combination of horn growth and horn wear. Ear tag transmitters have inadequate signal range and soon tear out. Surgically-implanted transmitters (of the size required to achieve adequate range and battery life) are probably too risky for use in rhinos, which subject themselves to much physical abuse and are prone to subcutaneous abscesses. No researcher can yet claim to have perfected a neck collar design, but this appears to be the most promising approach towards achieving a target of 90% certainty of a transmitter staying on for over one year.

The main problems with neck collars are, firstly, the rhino's wedge-shaped neck pushes a collar down onto its ears where the collar can cause serious abrasion if it is not designed appropriately. Rhinos are known to have lost their ears due to the effects of crude radiocollars. Secondly, the tendency of rhinos to push through dense, woody vegetation means that, on the one hand, if the collar is not tough it will be cut by sharp sticks and will rip apart if snagged, but on the other hand, if it is too strong a rhino could be strangled if the collar is firmly snagged. Thirdly, rhinos tend to cover their collars with slippery mud when they roll in wallows, and thereafter rub against trees or rocks to the extent that the lubricated collars are pushed over their jawbones or ears and come off. (The loss rate of radiocollars in Zimbabwe has shown a marked increase during the rainy season because of greater muddiness.) Fourthly, the snuggly fitting collars that are required to reduce these problems must be able to stretch in order to allow for neck expansion in growing rhinos. Fortunately, health-related changes in rhino body condition, and therefore in neck girth, do not appear to be significant in the portion of the neck immediately behind the ears, where the collar invariably rides.

Various designs of radiocollars have been tested in Zimbabwe but none has proved to be entirely suitable. Although some collars have stayed on for over two years, the loss rate within the first month of fitting has remained over 20%. Unfortunately, ongoing trials in Zimbabwe are subject to recent political constraints on rhino research and management, but further prototypes are being developed in the firm belief that a suitable collar design will eventually be found.

Some suggested specifications for a rhino collar are as follows: collar material(s) should have a breaking strain of about 200kg and a stretching capability of at least 5% but less than 10%, when subject to a strain of 30kg on a collar length of about 150cm. Greater elasticity may be permissible within an insert section of a collar which is made up of two or more different materials, provided the stretch characteristics of the complete collar remain approximately as suggested; the collar must not stretch too much or it

will soon come off. If the collar has a cylindrical cross-section, the diameter should not exceed 40mm (otherwise the collar is so protrusive that it will be rubbed off easily). If it is in the form of a strap then this should be no more than 60mm wide (to fit between the rhino's ears and the skin fold on its neck) and it must have a soft, yet tough, surface (or pass through a sleeve such as flattened fire hose) for a length of at least 50cm behind the rhino's ears, so it does not cut them.

Provision must be made to attach the transmitter in a hermetically-sealed container. This will probably have to go under the neck, as with all existing collar designs. The transmitter must be shock-protected, with streamlined housing. One model which has proved to be suitable is the MOD-555 transmitter produced by Telonics (932E Impala Aye, Mesa, Arizona 85204-6699, USA). This model is cylindrical, with a diameter of 38mm and a length of 105mm. Battery life is about three years. It has a di-pole antenna consisting of lengths of wire braid that protrude about 450mm from each end of the transmitter. The antenna must be encased within the collar and must not be close to metal clamps, bolts, etc., unless these are made of non-magnetic stainless steel or brass.

For black rhinos, the entire collar must be of adjustable length to fit snugly (before stretching) around neck diameters of 135 - 160cm, with the final fitting and trimming on a drug-immobilised rhino being a quick process (15 minutes at the most). The collar material must be resistant to ultraviolet rays as well as to the very severe impacts and abrasive forces that rhinos create.

There are various transmitter models that perform well enough to justify the risk and expense of immobilising rhinos, as well as the ongoing financial and manpower expenditure required to radio-track the rhinos. Activity (mortality) sensors can be incorporated at little extra cost. These sensors change the pulse rate of the signal from an "active" rate (e.g. 60 beats per minute [bpm]) to an "inactive" rate (e.g. 30 bpm) if the rhino remains still for a predetermined period. Some rhino managers have specified a delay time of several hours in order to avoid false alarms when a rhino is resting. However, problems may be experienced when a rhino dies and the transmitter goes back into "active" mode for long periods after being agitated by scavenging animals.

A short delay period (one or two minutes) may be more appropriate. Firstly, this will conserve battery life because the transmitter will reduce its pulse rate as the rhino rests, but the faster pulse rate (which makes radiotracking easier) will be triggered when the rhino is mobile. Secondly, it becomes useful initially to detect an "inactive" pulse rate when a rhino is resting (as rhinos often do in the midday hours) and then to hear the signal change to an "active" phase as the rhino lifts its head when disturbed by the search party's voices, footsteps, aircraft engine, etc. This means that a rhino in thick bush need not actually be seen (which may take a long time, and a lot of fuel if an aircraft is being used) or disturbed further in order to verify that it is alive. If the delay period is too long, the sensor will never "go inactive" while a healthy rhino is following its normal, diurnal behavioural pattern. Research has been underway in Save Valley Conservancy to determine how long a rhino typically "goes inactive" when it rests, in order that an appropriate alarm period can be specified for the reception of the "inactive" signal. This period varies greatly, with bulls "going inactive" for much longer (several hours) than cows with suckling calves.

A hypothetically useful type of rhino poaching alarm - not presently available in Zimbabwe - would be some passive (i.e. not battery-powered, or having only a small battery) electronic device that could be embedded in one or both of the rhino's horns. It would be capable of influencing the signal from the neck-collar transmitter, such that removal of the horns would change the signal as the modulating device is moved away from the main transmitter. Such a horn implant should be no larger than a domino, and should be cylindrical, if possible, in order to make it easier to drill a hole, within which it would be embedded using dental acrylic. Since poachers in Zimbabwe have invariably cut radiocollars off rhinos which they have killed, another option may be some circuitry which also changes the signal when the collar is severed.

VHF signal ranges of 10km or more, as are presently achieved from high points in typical bushveld areas, are satisfactory for routine monitoring. However, the receivers that are now available in Zimbabwe are not robust enough or cheap enough (reputable models are each over US$700) to be used in typical anti-poaching contexts. They have been developed for wildlife research purposes rather than for law-enforcement purposes and would have short lives in the hands of game scouts.

For the field monitoring situation, the most appropriate radiotracking system would probably involve radio receivers at two levels of sophistication: the scouts

should have simple, rugged, single-frequency receivers which need not have direction-finding capability, while centralised reaction units would use the typical, multi-channel receivers with Yagi antennae (e.g. the Telonics TR4 unit). In this system, it would be desirable for each collar to be capable of propagating signals on two frequencies, instead of only one as is presently the case. In Zimbabwe, the legal frequency range for animal radiotelemetry is 146.83 - 147.23MHz, thus giving plenty of available channels to deal with monitoring needs in any particular area (where it is unlikely that more than 50 channels would be required).

One frequency could be assigned as a common "alarm channel". All collars should be capable of transmitting on this frequency when their mortality sensors operate after a predetermined inactive period (possibly two hours for cows and three hours for bulls). Each collar should also be capable of transmitting on a frequency that is uniquely assigned to each rhino, as is the case in conventional wildlife telemetry. The unique channel should be subject to signal pulse variation in accordance with an activity sensor which has a short delay time (e.g. one minute), for the reasons outlined above. Ideally, instead of having two, completely separate transmitters in each collar (which would be expensive, since a pair of commercially available transmitters would probably cost over US$600), some circuitry, the antenna or at least the battery unit should be shared so that, in effect, the dual frequency transmitter would be enclosed within a single housing unit. There are probably technical constraints to simultaneous transmission by one unit on two frequencies, but these constraints appear to be overcome in, for instance, aircraft emergency beacon transmitters. Perhaps transmission could alternate between two minutes on the unique frequency and two minutes on the alarm frequency, once the latter is activated by the mortality sensor. The alarm transmission circuitry would not require much battery power, since it would not be in continuous operation.

The receivers carried by game scouts could thus be very rudimentary, with only an on/off switch (no channel selection required) and a simple omni-directional aerial. An alternative to portable alarm receivers would be a network of stationary receivers fixed on high points throughout the rhino range and operating off 1 2V lead-acid batteries charged by solar-voltaic

Photo credit: Holy Dublin

A black rhino with her caff in Kenya.

panels. Scouts could regularly monitor these receivers to check for alarm signals. If they hear such a signal, they will not know which rhino has died or where it has died (or lost its collar), although they should have a good idea, from their knowledge of the rhinos' home ranges and through the overlap of reception of the alarm signal by other receivers. The scouts would then radio for a reaction unit to come with a conventional, directional-finding, multi-channel receiver and Yagi antenna (ideally mounted on an aircraft), to track the collar via its uniquely assigned frequency and to establish the cause of the alarm.

It may be worthwhile to set the alarm signal of each transmitter at a different pulse rate (e.g. 30, *45*, 60, 75 and 90bpm). Obviously, some collars will have to share the same pulse rate, but if collars are being fitted to resident rhinos within reasonably well defined home ranges, an attempt can be made to ensure that collars with the same alarm pulse rate are put on rhinos which are out of the signal range of each other. If this can be achieved, then game scouts will have a good chance of determining which rhino has died or has lost its collar, even before the reaction unit arrives.

Since anti-poaching patrols already carry rugged, military specification, fully synthesised radios for voice communication (the eight-channel Motorola GP300 model is widely used in Zimbabwe), a desirable alternative would be to make the alarm frequency compatible with a receive-only channel on these Motorola transceivers, which can be programmed to operate anywhere in the 146.0 -174.0MHz band. However, preliminary trials in Zimbabwe suggest that the attainment of a reasonable reception with these Motorola radios requires that the radiocollars transmit alarm signals with a greater pulse width than is presently the case (about l4mSec). Also, more sensitive antennae may be required for the Motorola radios (although not as sophisticated or as cumbersome as Yagi antennae). Regular switching between the standard voice-communications antennae and any new radiotelemetry antennae raises the problem of the durability of the antennae connectors on these radios.

With the lithium batteries that are used in standard radiocollars, long periods of non-use can result in "passivation' which means that the batteries may not work when they are required to send the alarm signals. This problem can be overcome if the circuitry for the transmission of the regular signal on the unique frequency is connected to the same battery unit as the alarm circuitry. Alternatively, the alarm circuitry could be designed to transmit not only in the inactive (alarm) mode but also at a slow pulse rate (e.g. 6bpm) in the active mode. This would verify whether the alarm circuitry is actually working. Another advantage with continuous transmission at a very slow pulse rate is that the strength of reception of these signals would enable scouts to judge their proximity to a collared rhino.

The use of satellites for radiotracking is often suggested, particularly by laymen who are convinced that "eye in the sky" technology is now so advanced that this must be the most effective way to meet out rhino monitoring objectives. However, the limitations of satellite tracking (using the ARGOS system) remain much as they were a few years ago when Thouless *et al.* (1992) tried this technology in a study of elephant movements in Kenya. Satellite transmitters are considerably more expensive than conventional transmitters, as well as being heavier and having a shorter battery life owing to greater power consumption. Unless considerable investment is incurred in establishing a "local user terminal", satellite position "fixes" have to be relayed (e.g. via telefax) from ARGOS data processing stations (such as the one at Toulouse, France), and service charges are entailed in this indirect transfer of data. For various reasons, including the limited passing over of tropical areas by ARGOS satellites in their polar orbits, locational inaccuracies of 500 - 5000m are the norm.

Despite the present constraints of the ARGOS system, satellites will undoubtedly play an increasing role in wildlife radiotelemetry, but through the very different Global Positioning System (GPS). Most readers will be familiar with the abilities of this system, which include 10 – l00m accuracy in position-fixing using signals which are received by the radiocollar (from a constellation of satellites) rather than from the radiocollar. A GPS receiver in a radiocollar can store locational data in memory, for periodic transfer via the ARGOS system (in this case merely used as a data transfer system rather than as a position-fixing system) or via direct FM transmission to a ground receiver within radio range of the animal. Present configurations entail fairly bulky collars and require a GPS antenna mounted on top of the collar (i.e. above the neck), which would be problematic with rhinos, owing to the need to avoid pressure against their ears. However, the GPS "receiver engines" are steadily decreasing in size and require smaller batteries as they evolve from 5.OV, 200 - 2S0mA versions to 3.3V, l50mA versions (Tomkiewicz, 1996). Downloading of GPS data via local radio receivers, rather than via ARGOS, will probably be the most cost-effective

option as GPS technology becomes ever more applicable to rhino monitoring needs. GPS collars will each require a conventional VHF back-up beacon and power supply so that the rhino or its shed collar can be located directly.

TRANSPONDERS

Over the past decade, there has been increasing use of implantable, inductive transponder microchips to enable accurate identification of individual animals throughout their lifetimes. A transponder consists of an integrated circuit, combined with an antenna which transmits a signal when activated by an appropriate low-frequency electromagnetic or infrared stimulus from an external source. This transmission may be achieved without any internal power source (i.e. the transponder is "passive") if the reception distance is short. Typically, transponders which are used for animal identification are very small (about the size of a grain of rice), sealed in bio-compatible glass, and can be injected subcutaneously or intramuscularly. Simple transponders transmit a unique alphanumeric code when activated, but the receiving devices generally have to be within 5 - 20cm of the transponder, thus requiring that a wild animal is immobilised or dead. These readily available devices have been used whenever possible to "tag" rhinos in Zimbabwe. They are generally injected into the forehead between the ears and the eyes, in the hope that this gristly tissue will remain on the skull of a dead rhino for some time, whereas softer flesh will slough off or be removed by scavengers. Transponders should also be inserted in each horn base, by drilling a small hole and using epoxy resin to plug the hole after the transponder has been pushed in.

While this technology is extremely useful for rhino identification at this basic level, there are many possibilities for increasing transponder applications. The major constraint is that of reception range. The power emitted by most commercially-available readers is apparently restricted to a very low level (of the order of 0.05 watts) in order to ensure that there is no risk of human radiation. The reflected signal of a passive transponder is therefore weak. Nonetheless, coin-sized passive transponders used in the USA for monitoring vehicle traffic on toll roads have a range of about six metres, while ranges of 20 - 30m are claimed for domino-sized passive transponders which have been developed in Australia (originally for transport and mining applications). Range can be increased by including batteries with the transponders, but the devices may then become too large to be safely implanted. The size limit is probably the Australian "domino" model; a cylindrical shape would be more convenient for implantation in rhino horns.

Two potential applications of small implantable transponders with extended signal ranges are immediately apparent. The first is an automatic monitoring system, whereby tagged rhinos which visit waterholes, middens or other localities that they frequent, have their identity numbers recorded and stored by concealed readers. A range of at least five metres (preferably 20m or more), and a waterproof reader operating on long-life batteries would be required for such a system to be worthwhile. The second application would be identification of rhinos by game scouts, particularly in thick vegetation where the visual identification features such as ear notches cannot be readily ascertained. Here, a reader with a range of at least 50m would be ideal to enable the scouts to approach downwind and to obtain the identification signal without disturbance of the rhino and without risk to themselves.

The Natal Parks Board worked with a South African military electronics firm to develop a proposal for "Operation Radio Rhino" in 1993. This envisaged the use of battery-powered transponders which could be regularly interrogated via a system of direction-finding (DF) hilltop repeater stations, automatically relaying information on the location of each rhino to a central computer processing facility. The proposed system would have been expensive (over US$300,000 to establish a system for about 150 rhinos using 12 DF stations and two control stations) and raised the problem of implanting battery-powered transponders (each about the size of a cigarette box) in rhinos. A similar project was planned subsequently in Zimbabwe, but using battery-powered transponders on collars rather than implanted devices. The advantage of such transponders was their longer battery life (over five years) compared to conventional radiotransmitters, but as mentioned above, this is largely negated by the current lack of collar design to keep a transponder on a rhino for this length of time. For various reasons, these projects have not been implemented but their concept is still being refined by electronics experts who are associated with the South African initiative.

GLOBAL POSITIONING SYSTEM TECHNOLOGY

Apart from the use of GPS devices in radiocollars (where they can be combined with transponder

plications as well as convcntional transmitter applications), GPS technology has a potentially major role in the computerisation of monitoring law enforcement effort, poaching activity and wildlife abundance. It is a matter of common sense that routine anti-poaching work should be quantified in standardised units (e.g. kilometres patrolled or manhours on active duty) in order to enable spatial and temporal comparisons of, for instance, rhinos seen per kilometre or poachers' snares found per hour. This standardised monitoring approach would in turn allow for the systematic evaluation of animal population trends and of the effectiveness of anti-poaching or management strategies for the species of concern. Basic principles of recording patrol effort and thereby deriving "catch per unit effort" indices of poaching activity and wildlife abundance are outlined by Bell (1984) and Leader-Williams (1996).

While the theory is clear, the fact that such approaches have not been widely implemented in field programmes (Leader-Williams, 1996) is primarily because their requirements for data recording and data analysis become impractical in terms of the constraints of time and expertise that generally pertain to manpower within protected areas. Standardised technological aids are needed to facilitate the recording of relevant data and the subsequent manipulation of these data to yield outputs that are of immediate use to field staff. A combination of advanced hardware (in the form of GPS devices and personal computers) and advanced software (in the form of GPS data transfer systems and Geographical Information Systems [GIS]) must be obtained for time-effective and cost-effective patrol reporting at a useful level of detail.

GPS devices should be obtained which meet military specifications for humidity, dust, shock, etc., and which have inbuilt antennae, instead of external antennae on swivel mounts which are prone to snapping off. These devices need not have as many functions as are typically provided by commercial handheld GPS models; the basic requirements are the storage of positions at the push of a button and at fixed time intervals (e.g. every six or 12 minutes), together with a data transfer capability to allow post-patrol downloading of the locational and time data into a personal computer at a base station. Software must be developed to input these GPS data into a GIS so that map displays of patrol routes, sightings, incidents, etc. can be automatically generated. The protected area could be divided into geographical cells (a grid system, e.g. two by two kilometres or five by five kilometres) so it would become possible to say, for instance, "in cell D8, patrol coverage in June consisted of 27km of patrolling; three rhinos were seen (i.e. 0.11 rhino/km patrolled); 20 elephants were seen (0.74 elephant/km); seven poachers' snares were found (0.26 snares/kin)", etc. GIS mapping could then show spatial gradients in patrol effort, animal abundance and poaching activity, and trends over months or years could also be investigated.

Literate game scouts would be able to record sightings (animals, poaching signs, etc.) in notebooks together with their positions as displayed on their GPS devices for later debriefing and input of this information into the GIS database. An even simpler system could be based upon a non-display GPS similar to that in a radio collar, with only an on/off switch, a data storage and downloading capability, and a timer function to store positions at pre-determined intervals automatically. Scouts could then be issued with inexpensive digital watches to allow them to record the time of any sighting/event. The grid cell location of the sighting! event from the patrol chronology/route, which would be downloaded from the GPS, can be estimated later using the computer programme. This chronological approach would allow patrol effort to be quantified in terms of time in the field as well as distance covered, thus allowing trends based on sightings per hour to be cross-checked with trends based on sightings per kilometre.

With this customised technology, debriefing would be reduced to downloading the GPS data into a personal computer along with the entry of scouts' notebook records of times and/or GPS positions of sightings/ events during the patrol. This would obviate the need for maps to be consulted by scouts and their commanders in order to record manually patrol routes and the positions of sightings/events, thus saving time and improving locational accuracy, which would make patrol reporting far more practical. User-friendly software could be developed to enable middle-level managers to derive indices of relative wildlife abundance, poaching activity and patrol effort, together with trends in these indices, and to plan anti-poaching and wildlife management accordingly.

FURTHER POSSIBILITIES

Various additional technological possibilities are being investigated by rhino managers in southern Africa in terms of field performance and cost-effectiveness.

One example is a gunshot detector (T. Conway, Natal Parks Board, pers. comm.), which transmits a

dio signal alarm to a control station if it is activated by the shock-wave of a firearm discharge or if it is tampered with. The claimed range for gunshot detection is one kilometre, which would constitute radial coverage of about three square kilometres. Depending upon their purchase and maintenance costs, these devices might be positioned systematically throughout the range of a rhino group, or they could be confined to likely sites of rhino poaching, such as waterholes.

Another example, which is of potential applicability to biological monitoring of rhinos rather than anti-poaching, is a device which can produce an odour spectrum from a sample of rhino dung or urine. Since rhinos rely heavily on their olfactory senses for intraspecies communication, to the extent of recognising other unseen rhinos and determining their reproductive status merely by sniffing their dung middens or urine sprays, there is obvious potential for the development of some apparatus which rhino managers could use to "tune into" the rhinos' olfactory communication system. Researchers and commercial agencies in UK (and probably elsewhere) are developing "electronic noses" for use in security systems, pollution control and even monitoring blood oestrogen levels in women who merely breathe into such devices. It is hoped that this technology for individual recognition and pregnancy/oestrus determination will be tested on free-ranging rhinos in Zimbabwe.

Among other important technological requirements in the biochemical field are the need for DNA "fingerprinting" of rhinos to facilitate parentage analysis (which is not as straighfoward as in humans), and the need for a urine analysis technique to monitor the extent to which black rhinos are ingesting plant secondary compounds in the form of phytotoxins, which are produced by plants to protect themselves from herbivory. As a black rhino population density begins to exceed the level of "maximum productivity carrying capacity" it can be expected that the rhinos will be forced to feed upon a greater proportion of chemically-defended plants. Analysis of phenolic metabolites in urine (or ideally in dung) may become possible as a way of checking that rhino populations are being kept safely in balance with their browse resources.

CONCLUSION

Further elaboration of perceived technological requirements, however naive these might prove to be, can only help to facilitate some adaptive research and development efforts with relevant agencies. Perhaps a regular "technology forum", in *Pachyderm* would be appropriate, to include other ideas, together with suggestions for technical agencies that might be able to help but which may have to be approached directly (since they are unlikely to subscribe to *Pachyderm).* Many conservationists view rhino conservation as a race against time. While end-markets for rhino horn are being tackled, it is probably more realistic to keep the rhino species alive by tipping the balance against the poachers through the introduction of some "high-tech" aids for field protection and management.

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ELEPHANTS OF THE MASAI MARA, KENYA: SEASONAL HABITAT SELECTION AND GROUP SIZE PATTERNS

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ABSTRACT

This study ascertained that habitat selection and group formation by elephants in the Masai Mara National Reserve (the Mara) fit the general pattern observed in other African elephant populations. Both sexes preferred habitat types with large quantities of nutritious grasses during the wet season and both tended to select browse vegetation in the dry season. In addition, average group size was larger in the wet season for most habitats. Seasonal differences in herd size were not the result of random aggregations in preferred habitats, but were more likely because bulls joined cow-calf herds to breed during the rains. The formation of larger groups in the wet season, when food is not limited, probably allows elephants to interact, to determine dominance hierarchies and to re-establish bonds.

INTRODUCTION

The differential use of habitats by elephants can alter significantly the structure of affected plant communities (Laws, 1970; Field, 1971; Thomson, 1975). Utilisation patterns are influenced by forage preference and availability (Leuthold & Sale, 1973; Western & Lindsay, 1984; Thouless, 1995) as well as by external factors such as extreme weather conditions (Corfield, 1973), human settlement and cultivation (Lamprey *et al.*, 1967; Laws, 1970; Western & Lindsay, 1984; Lamprey, 1985), and poaching activity (Dublin & Douglas-Hamilton, 1987). Over the past 25 years, these external factors have led to the concentration of the majority of Africa's elephants in protected refuges in many parts of their range (Cumming, *et al*, 1990; Said *et al.*, 1995). It is necessary to know the habitat utilisation patterns of elephants within parks and reserves, such as the Mara, in order to understand their impact and to make decisions on local management.

This paper describes the seasonal changes in habitat selection and group size of the elephants within the Mara. Habitat selection is discussed as it relates to changes in feeding patterns between the seasons. The possible functions served by elephant aggregations are examined as well as the constraints placed on group size by food availability.

STUDY AREA

The Mara lies on Kenya's southwestern border with Tanzania and forms the northernmost extension of the 2S,000km^2 Serengeti-Mara ecosystem. In 1974, over 1,700km^2 were formally gazetted for the Reserve but, following more recent boundary modifications, only 1,510km^2 remain. The area to the north and east of the Mara is now permanently settled by pastoralists and large-scale agricultural schemes (Douglas-Hamilton *et al.*, 1988). To the west, the Mara is bordered by the Siria Escarpment, which rises 100-300m above the plains below, which have a mean elevation of approximately 1 ,600m. To the south lies the Serengeti National Park in Tanzania. The Mara river, the largest perennial river in the Serengeti-Mara ecosystem, drains the northern Serengeti and Mara region and flows into Lake Victoria some 100km to the west.

In the late 1970s the Serengeti provided elephants with a safe refuge from poaching pressure which was high at that time both inside and to the north of the Mara. Throughout the 1980s, the situation was reversed and poaching pressure mounted on the Serengeti side, thus cutting off this escape route to the south. Throughout the 1980s and early 1990s, elephant seasonal movements in and out of the Mara were curtailed severely. Today, approximately 1,500 elephants utilise the Mara and its adjacent pastoral lands all the year-round and their impacts on the remaining woodland habitats are pronounced (Dublin *et al.*, 1990; Dublin, 1995).

Climate

Rainfall in the Mara is bimodal, with short rains falling in November-December and long rains occurring from April-May (Masai Mara Ecological Monitoring Programme reports, 1982-1995). The Mara also has a pronounced east-west rainfall gradient with the east

side averaging approximately 800mm/year and the west side approximately 1,200mm/year (Norton-Griffiths *et al.*, 1975; Epp & Agatsiva, 1980; Stelfox *et al.*, 1986), with an overall average of 1,000mm/year. Minimum and maximum daily temperatures in the Mara average 14.8˚C and 28.l˚C.

Habitat types

In addition to the differences in annual rainfall patterns, the east and west sides of the Mara are also characterised by differences in habitat types. The eastern portion of the Mara has more area covered in woody vegetation along river courses and on hilltops. All trees and shrubs were classified according to Dale and Greenway (1961) and all grasses and herbs according to Edwards and Bogdan (1951).

Relict thickets are widespread and diverse, containing seedlings of trees and shrubs and coppicing rootstocks of many species. These include: *Acacia brevispica, A. gerrardii, A. hockii, A. senegal, Albizia amara, A. ptrersiana, Boscia angustifolia, Commiphora africana, C. trorhae, Cordia ovalis, Dichrostachys cinerea, Grewia spp., Lippia javanica, Ocimum americanum, Ormocarpum trichocarpum,* and *Solanum incanum.* The majority of plants are less than one metre high. Standing dead trees are commonly seen in this community.

The *Acacia gerrardii* woodlands occur as highly clumped stands frequently found in association with the relict thickets mentioned above (Herlocker, 1976). Although Trump (1972) did not distinguish this as a distinct community type, Lamprey (1985) documented the rapid increase of A. *gerrardii* woodlands in many areas of the Mara over the past decade. This proliferation is largely attributed to its fire-tolerance (Glover & Trump, 1970; Spinage & Guinness, 1972; Dublin, 1995). Individual plants persist through time by sprouting new shoots from underground rootstocks following burning or browsing; it is, therefore, difficult to assess their true age. A variety of seedlings and root coppicing species are commonly found in this community. These include: *Acacia senegal, Commiphora spp., Dichorostachys cinerea,* and *Ormocarpum trichocarpum* which all remain under one metre high in areas where burning is frequent or severe.

Many ridge tops, small hills, and seasonal drainage lines in the Mara are covered by discrete islands of *Croton* thickets which are unique to the northern Serengeti and Mara region. Though *Croton* dominates the species composition in these thickets, species diversity remains high. While most species fall below the four to five metres *Croton* height class, species such as *Haplocelum foliolosum, Olea africana, Tarenna graveolens,* and *Teclea rrichocarpa* attain heights up to six and seven metres. In the lower layer *Acacia brevispica, Cordia ovalis, Grewia trichocarpa, Rhus natalensis* and *Strychnos henningisii* are found. This community is frequently marked by one or more adult *Gardenia jovis-tonantis* trees which occur 10-15m from the thicket edge and are never found inside the thickets proper.

Balanites aegyptiaca woodlands occur only in the far western section of the Mara. This community, also referred to as *Balanites - Acacia seyal* woodland (Herlocker, 1976; Lamprey, 1985), is prevalent on the open, grassy, park-like expanses of the Mara 'Triangle" area. A reported decline in the density of *Balanites* stands in this area was attributed to heavy browsing by giraffes (Glover & Trump, 1970; Pellew, 1981) and still is apparent today. The majority of remaining adult trees are well above the browsing reach of giraffes and elephants and regeneration may be limited both by seed predators (Lamprey *et al.*, 1974) and browsers (Belsky, 1984).

The Mara comprises of a combination of edaphically-derived and fire-induced grasslands dominated by the perennial grass, *Themeda triandra,* "red oat grass". Following the long rains other tall grasses such as *Digitaria macroblephara, Hyparrhenia filipendula, Pennisetum mezianum,* and *Setaria phleoides* also flower in these grasslands. The overall grass productivity is high, ranging from 7,000 - 8,000kg/ ha/yr (Sinclair, 1975). The migratory zebra and wildebeest may remove 80-90% of the standing crop biomass (McNaughton, 1976; Stelfox *et al.*, 1986; Onyeanusi, 1989) each dry season. The short-cropped plains they leave behind then permit the growth and flowering of other, less competitive grasses such as *Aristida adoensis, Eragrostis tenuifolia, E. racemosa, Harpachne schimperi* and *Sporobolus stapfianus.*

METHODS

Habitat selection by elephants was determined using two independent techniques. The first, total aerial counts, was used to distinguish selection only on a wet and dry season basis, whereas the second, monthly census circuits, allowed an analysis of habitat selection both by season and by sex.

Wet and dry season total counts of elephants

Two aerial total counts of elephants, one dry season and one wet, were conducted in the northern Serengeti National Park, and the entire Mara, in 1984 and 1985. Herds were counted and mapped by habitat type. Densely wooded areas were searched more intensively than open areas to correct for the relative visibility of elephants in different habitats.

To test the hypothesis that elephants were randomly distributed in the available habitats, the total number of elephants observed in each habitat type was compared to an expected frequency distribution. This expected frequency distribution was derived from a photo mosaic produced from an aerial survey of the area in early 1982 by the Kenya Rangelands Ecological Monitoring Unit. These photographs, at a scale of 1:50,000, were large enough to distinguish habitat types. All habitat types distinguished on the photographs were checked on the ground using a :50,000 topographic map of the Mara to re-locate the areas. Thirty line transects were drawn on the photographic mosaic and analysed for the proportions of different habitats. These proportions provided the theoretical random distribution for elephants showing no habitat selection (Table 1). For the purpose of analysis these expected distributions were converted to numbers, based on the observed sample size. Chi-square analysis was then used to compare the observed versus the expected numbers across all habitat types.

Table 1. The percentage of each habitat type measured from aerial photography of the Mara flown in 1982 and monthly census circuits. These percentages were used to calculate the number of elephants to be expected in each habitat under a random distribution.

Habitat type	Aerial photography (%)	Monthly circuits (%)
Grassland (GR)	41	43
Relict thicket (RT)	29	34
Acacia woodland (AW)	8	4
Croton thicket (CT)	6	6
Balanites woodland (BW)	4	7
Swamp (SW)	4	0
Other (OT)	8	6

Monthly census circuits

A 152km circuit was established in the Mara. Initially, the entire circuit was driven and the habitat types which intersected this circuit were mapped to the nearest 0.1km. The cumulative length of each habitat type was then expressed as a proportion of the total circuit length. From these proportions a random frequency distribution for elephants by habitat type was produced (Table 1). Using the observed sample sizes of elephants, this frequency distribution was then converted to numbers which allowed a comparison of expected with observed numbers of males and females in each habitat type for each month.

This circuit was driven once each month over a two-year period (from 1983 to 1985) comprising two dry seasons and two wet seasons. All elephants observed from the vehicle were recorded by age, sex, and the habitat in which they were seen. Visibility from the circuit was excellent and the chance of sighting elephants in the different habitats was assumed to be equal. Chi-square analysis was again used to compare the observed numbers of males and females by habitat types to the expected numbers for both the wet and dry seasons and to compare the sexes within each season.

These same circuit data were used to calculate mean group sizes for all-bull herds, mixed-sex herds and cow-calf herds both by season and by habitat. These means were then tested against one another between seasons, habitats and herd type using a Kruskal-Wallis analysis-of-variance test.

RESULTS

Habitat selection

Seven hundred and eighty-five elephants were counted in the dry season and 912 in the wet season. Elephants surveyed during the aerial counts were not distributed randomly with regard to habitat type in either season (seasonal c^2 values: wet = 126.3, dry = 347.7, d.f. =6, P<.001). They showed distinct habitat preferences (Figure 1): in the wet season elephants selected grasslands, *Croton* thickets and swamps more than expected by random use, with 48.3% frequenting grassland. A substantial proportion of elephants (27.7%) were also found in relict thickets in the wet season but less than expected by chance alone. In the dry season *Croton* thickets were selected significantly more than expected. Although frequency of habitat selection remained relatively high for grassland (33%) in the dry season, there was a clear shift in habitat preference, with 39.9% selecting *Croton* thickets as opposed to only 8.8% in the wet season.

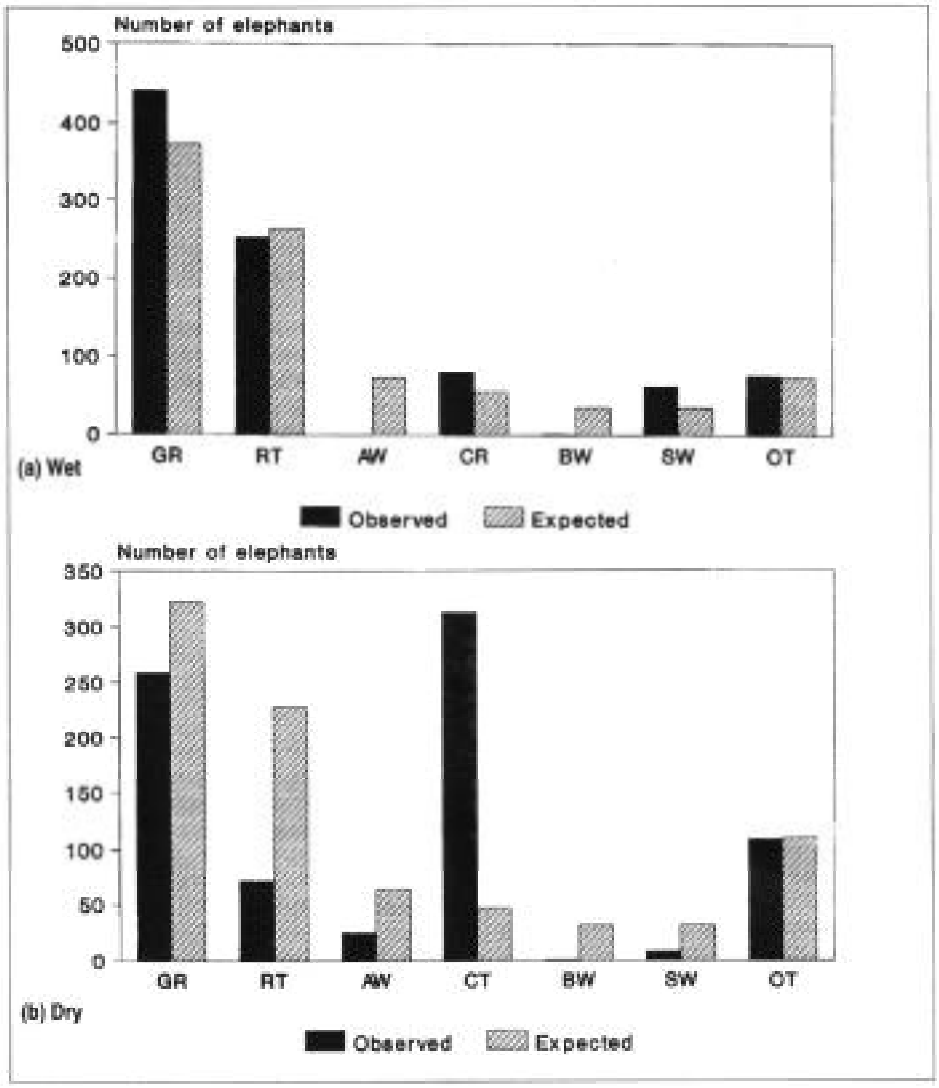


Figure 1. The habitat preferences of elephants in the Mara in the (a,) wet season and (b) dry season. The xpected values are calculated from a breakdown of the Mara by habitat type using the 1982 aerial photography. The observed numbers were taken from aerial counts flown in both seasons.

These patterns were similar to those recorded on the monthly census circuits. Both sexes showed non-random use of habitats in both seasons (c^2 values for males: wet = 11.5, number of males (n) = 111, P<.05, dry = 14.3, n = 25, P<.025, d f = 5,c^2 values for females: wet = 13.9, n = 247, P<.025, dry = 38.9, n = 116, P<.001, d.f. = 5). Females selected grasslands and *Croton* thickets in the wet season more than expected whereas males selected grasslands and relict thickets (Figure 2). In the dry season males and females both selected *Croton* thickets more than expected **by chance alone** (Figure 3) Males and females did not differ significantly in their distributions in either the wet (c^2 = 8.0, d.f. = 5. n.s.) or dry season (c^2 = 4.9, d.f. = 5, n.s.). Seasonal differences were significant for males (c^2 = 33.2, d.f. = 5, P<.001) and females c^2 = 58.7, d.f. = 5, P<.001).

Group size

Seasonal variation in group size was calculated from aerial count data, excluding all-bull groups. The average herd size seen from the air was 19.0 individu-

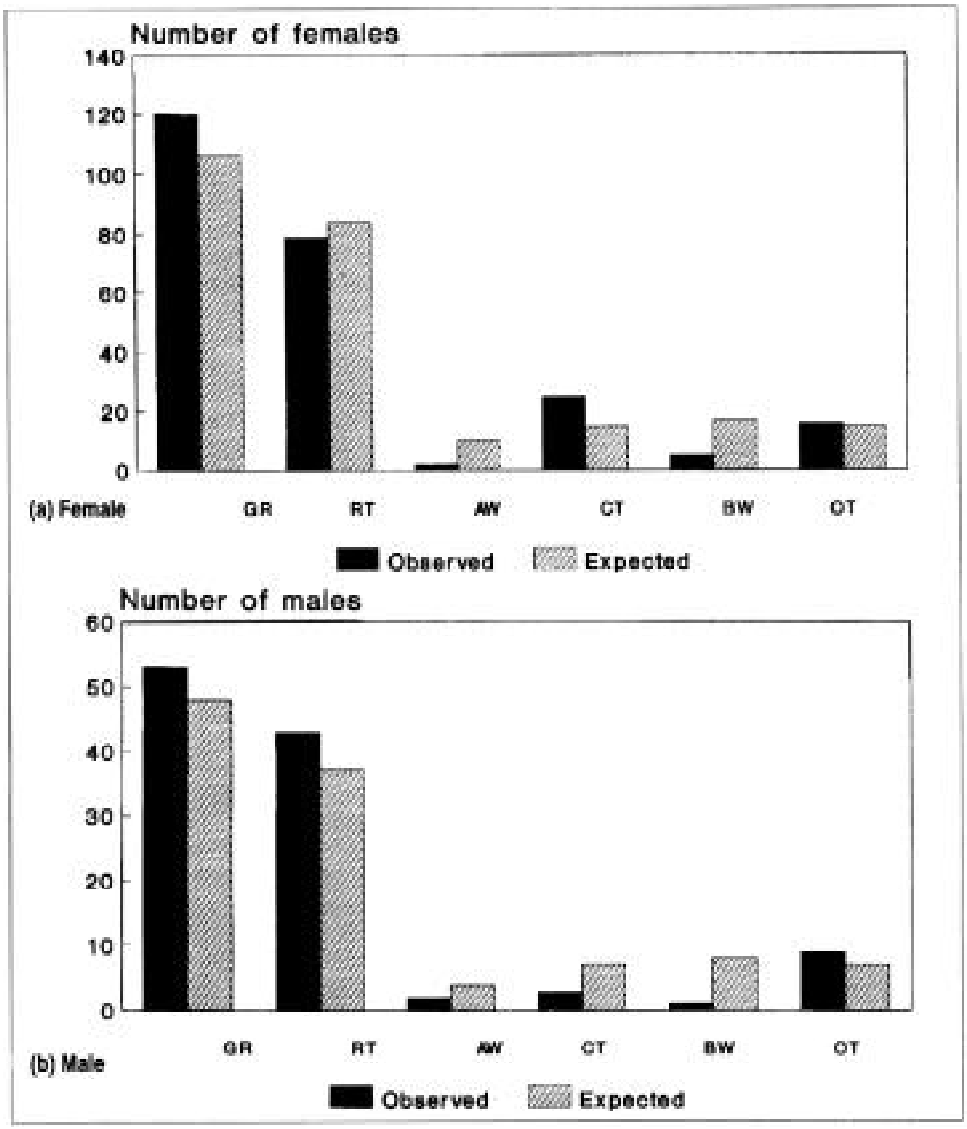


Figure 2 Wet season habitat preferences of (a) female and (b,) male elephants in the Mara. The expected values were calculated from a breakdown for the monthly. circuit by. habitat type. The observed numbers were derived from censuses driven on this circuit each month.

als/group in the wet season and 13.2 individuals/group in the dry season. These seasonal averages differed significantly (t = 2.58, d.f. = 107, P<.0l). The monthly circuit data allowed a further comparison broken down by the three diffetent herd types (Table 2). This analysis compared favourably with the results of the aerial-count data. Cow-calf groups accompanied by males (mixed-sex herds) were significantly larger than cow-calf herds in both the wet (t = 4.68, d.f. = 215, P<.0005) and dry (t = 3.34, d.f. = 172, P<.001) seasons. Mixed-sex herds further showed significant increases in mean size between the seasons (t = 2.77, d.f. = 111, P<.005) with wet season aggregations being larger than dry. Cow-calf and all-bull herds did not differ significantly in mean size between seasons. Even the largest wet season herds in the Mara never reached numbers such as the 700 recorded in seasonal aggregations in Tsavo (Laws, 1969) or the 400 in Amboseli (Western & Lindsay, 1984) National Parks. The largest wet season aggregation recorded during this study was 158 animals and the largest dry season group only 40.

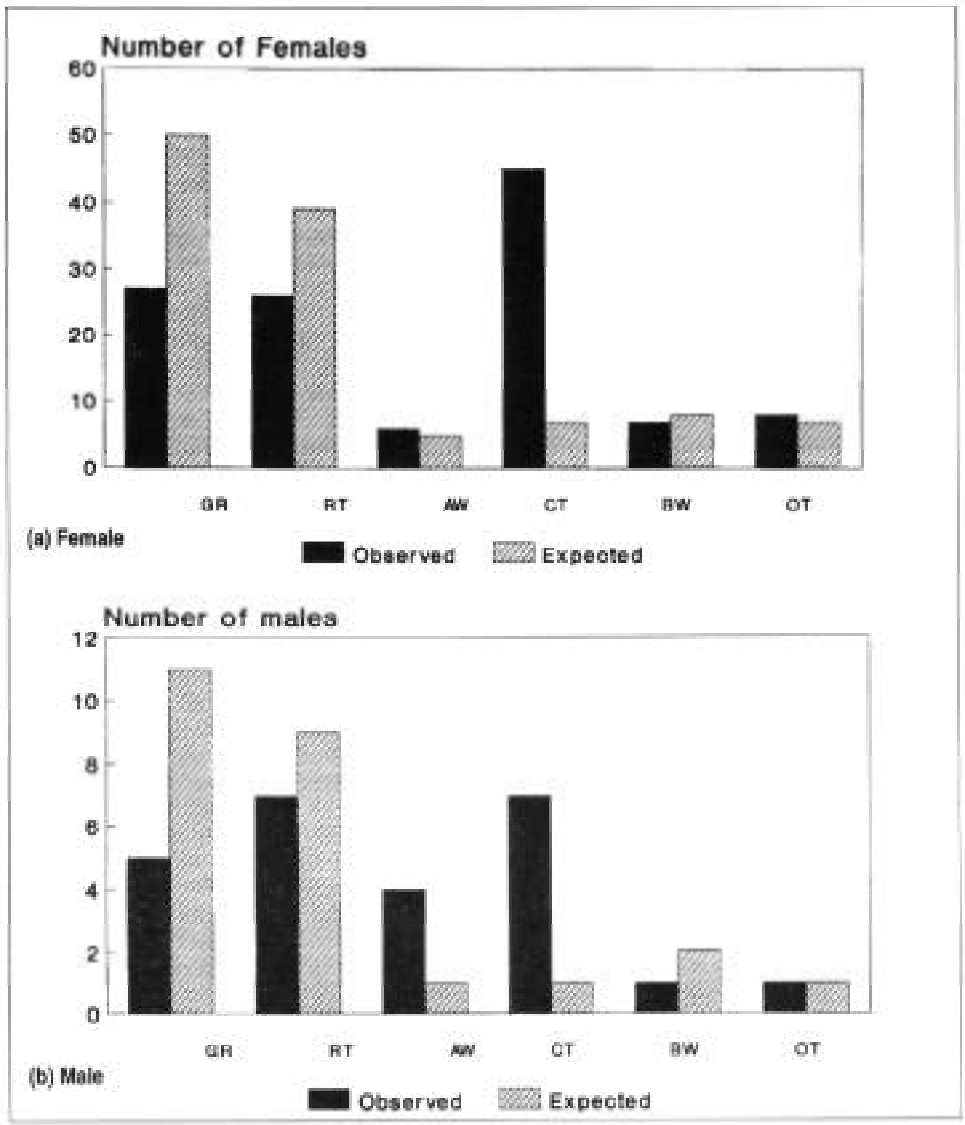


Figure 3. Dry season habitat preferences of (a,) female and (b) male elephants in the Mara. The expected valves were calculated from a breakdown of the monthly circuit by habitat type. The observed numbers were derived from censuses driven on this circuit each month.

Table 2 Mean herd size by. season and year-round for all-bull herds, mixed-sex herds and cc w-calf herds. The number in parentheses is the number of each herd type observed by season during the monthly census circuits.

Type of herd	Wet	Dry	Year-round
Mixed-sex	16.1 (85)	12.9 (28)	14.8
Cow-calf	7.4 (132)	7.7 (146)	7.5
All-bull	1.9 (113)	2.0 (78)	1.9

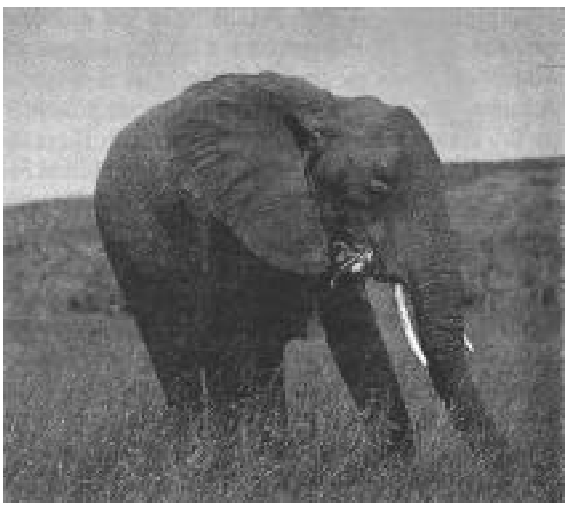
Mean size for each herd type did vary between seasons and between habitats (Table 3). In general all herd types tended to be larger in the wet season than during the dry season across the major habitat types. However, this seasonal difference was only significant for cow-calf groups accompanied by males $\underline{H}_{2,222} = 8.32$, P<.0l). Mean herd sizes between habitats within a season did not differ significantly regardless of herd composition (all H-values were not significant).

Table 3. Mean herd sizes by habitat type for mixed-sex herds, all-bull herds and co w-calf herds by season (w= wet; d= dry). The number in parentheses is the number of herds observed in each habitat type during the monthly census circuits summed over the entire season.

		Grassland Thicket		Relict Woodland		*Acacia* Thicket		*Croton*		Swampy		(n)
Mixed-Sex	w	18.8	(14)	19.0	(31)	12.2	(10)	14.8	(20)	10.7	(10)	85
	d	12.9	(7)	8.6	(5)	10.4	(6)	14.5	(10)	-	-	28
Cow-Calf	w	8.3	(20)	8.2	(65)	10.7	(13)	6.2	(21)	9.2	(13)	132
	d	8.0	(39)	7.9	(41)	6.0	(25)	7.9	(33)	7.6	(8)	146
All-bull	w	1.6	(21)	2.0	(55)	4.0	(5)	2.2	(18)	3.6	(14)	113
	D	1.7	(21)	1.7	(19)	1.8	(21)	1.8	(12)	2.6	(5)	78

Aerial count data also showed no significant correlation between average herd size and numbers per habitat type for either the wet (rs = 0.43, n = 8, n.s.) or dry season (r_s = 0.54, n = 8, n.s.). The largest groups were seen in relict thickets and grasslands in the wet season.

Photo credit: Holy Dublin



A female elephant browsing in the Mara

DISCUSSION

Habitat selection

The study revealed that during the rains, when forage of all types was abundant, Mara elephants were primarily grazers, like those in other populations (Field, 1971; Field & Ross, 1976; Guy, 1976; Barnes, 1982; Western & Lindsay, 1984). This is consistent with the idea that forage quality is the determining factor in habitat choice because the new grasses and sprouting seedlings growing in these areas are highly nutritious. Although new browse leaves may have higher absolute crude protein levels than new grasses (Dougall, 1963; Dougall & Glover, 1964; Dougall *et al.,* 1964; Field & Ross, 1976; McNaughton *et al.*, 1985), they may also contain high levels of secondary compounds such as tannins which may interfere with feeding (Coley, 1983; Sukumar, 1985; Jogia *et al.,* 1989). For the most part, the habitats selected during the wet season were dominated by grasses.

Unlike Amboseli elephants (Lindsay, 1982), Mara elephants followed a dry season foraging pattern more like that reported for elephants in other seasonal areas such as Queen Elizabeth and Kidepo Valley National Parks, Uganda (Field, 1971; Field & Ross, 1976),

Sengwa Wildlife Research Area, Zimbabwe (Guy, 1976), and Ruaha National Park, Tanzania (Barnes, 1982). They switched to a predominantly browse diet in the dry season (Dublin, 1986). Even among those elephants remaining in grassland during the dry season, there was an observed shift to more "shrubby" grassland, where they foraged on small seedlings among the grasses. Dougall et al. (1964), Field (1971) and Barnes (1982) pointed out that woody species maintained higher crude protein levels relative to grasses during water-limited times. The nutritional quality of grasses declines rapidly as they begin to age in the dry season. Habitat choices in the dry season may reflect these forage preferences.

Facing an already reduced availability of browse forage and shade trees (Dublin, 1991), elephants concentrate their time within the *Croton* thickets. With the significant loss of other woodland habitats in the

Mara over the past three decades, these thickets now provide one of the last wooded refuges available to elephants. Here they are able to find shade, and also to forage on woody species, and herbs which thrive in the moist, shady conditions under the canopy of these thickets.

This constant use of *Croton* thickets for food and shade has caused severe damage to their internal structure and opened large pathways through the vegetation (Dublin, 1991). In subsequent rainy seasons, these light gaps grow thick swards of grass. Most grazers avoid the risk of hidden predators in thickets so the grass is frequently left to dry. When fires occur it burns very hotly, so that the nearby trees and bushes are also destroyed. As the years progress the thickets become increasingly fragmented.

The general tendency for elephants to under-utilise grasslands in the dry season may be a direct consequence of competition with the migratory wildebeest which are present in the Mara throughout that time. The sheer numbers of wildebeest present in the dry season displace elephants from both *Themeda triandra* grasslands and the more highly preferred but more limited *Cynodon dactylon* patches (Dublin, 1995).

Leuthold and Sale (1973) suggested that elephant habitat selection in Tsavo National Park was limited mostly by the quantity of food available and may be constrained further by the distribution of permanent water sources which are critical to their survival, particularly during the dry season (Corfield, 1973). The findings of Western and Lindsay (1985) in Amboseli partially supported this idea. In the dry season, Amboseli elephants utilised the swamps most heavily. These swamps were the lowest in crude protein (quality) but the highest in forage biomass (quantity). However, elephants used the bush-grassland habitat to a similar extent in the dry season. This bush-grassland habitat was lowest in available forage biomass but significantly higher than swamps in available crude protein. From this evidence and from the findings in the Mara, it seems likely that elephants may select primarily on the basis of forage quality but may be limited in their choice by the amount of food available within their range. The relative importance of quality versus quantity may be mediated by local elephant densities. In areas of high density, elephants may be more restricted by the absolute quantity of available food, regardless of the nutritional value of the type of forage eaten or habitat in which it is found. At the time of this study, when elephant densities were not considered to be very high in the Mara. their choice of habitats may have been influenced to a greater extent by forage quality than quantity as they appear to be in Amboseli, where local densities are much greater.

Group size

It is possible that elephants form aggregations as a direct consequence of the numbers in a habitat. However, the data do not support this hypothesis. In fact, there was no correlation between elephant numbers in specific habitats and average group size in these same habitats. Group size appeared to be determined by factors other than random aggregations based on habitat preference. In general, average herd size was correlated with season, with larger herds forming in the wet season when availability of preferred forage is greater. This was particularly true for cow-calf groups accompanied by bulls.

Such seasonal variation in herd size may be attributed to the seasonality of mating and birth peaks. In a number of populations, mating occurs during or slightly after the peak of the long rains (Hanks, 1969; Dublin, 1983; Moss, 1983; Western & Lindsay, 1984). At this time males temporarily join cow-calf herds to gain access to oestrous females. Births then occur just before or during the rains (Dublin, 1983; Hanks, 1969). Variations in the size of Mara elephant herds are consistent with this hypothesis. The average size of herds containing adult males was considerably larger than exclusively cow-calf groups and this was particularly significant during the wet season when breeding was observed.

Douglas-Hamilton (1972), Moss and Poole (1983) and Western and Lindsay (1984) have all suggested that additional social benefits provide a strong impetus for herd formation. For example, elephants may aggregate on a periodic basis as a means of maintaining and strengthening bonds or establishing dominance hierarchies within kin groups. These relationships may last throughout their long lives.

Findings by Poole *et al.* (1988) demonstrate that the low frequency sounds associated with certain behavioural patterns among elephants may actually be exchanges of information on levels previously unrecognised. Periodic aggregations would provide an opportunity for such exchanges between individuals and herds. Laws *et al.* (1975) cited predation on elephants as a basis for aggregation. Western and Lindsay (1984) discussed the possible foraging ben-

efits which larger groups may accrue through the exchange of information or through facilitation but emphasised that there is currently no hard evidence to support these ideas.

Untangling the relative contributions of various factors to group formation and tenure is a difficult task. For a variety of possible reasons larger herds seem to be desirable but are possible only when local food supplies are not limited. For an animal as large as an elephant, this condition could restrict formation of very large groups to the rainy season only.

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Photo credit: Holly Dublin

THE LOSS OF A POPULATION OF ELEPHANTS IN THE MIDDLE SHIRE VALLEY, SOUTHERN MALAWI

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ABSTRACT

This paper presents the results of two surveys of elephants in the Middle Shire Valley, southern Malawi, carried out in 1983-1987 and 1994, corresponding to the periods before and after the population's destruction. The 1983-1987 survey estimated that the Middle Shire Valley supported 200-300 elephants, ranging over about 1,000km^2, much of it within Majete Wildlife Reserve. In 1986 and 1987 there was a massive influx of Mozambican refugees, and a refugee camp was established in the northern part of the elephants' range. With the refugees came AK 47 automatic military rifles and elephant hunting escalated to unprecedented levels, The Malawi Government's response was inadequate to contain the poaching, and by 1992 reports from the field suggested that the entire elephant herd had been eliminated. Ground and aerial surveys carried out in 1994 confirmed that no elephants remained in the region and suggested that it was unlikely that any had escaped into Mozambique, but that they had all been killed in and around Majete Wildlife Reserve. The implications of the extinction of perhaps 10% or more of Malawi's national elephant herd are discussed. Recommendations are made for ensuring the maintenance of Majete Wildlife Reserve, and for the development of strategies which will prevent Malawi's remaining elephant populations from suffering a similar fate.

INTRODUCTION

In the 19th century, elephants *(Loxodonta africana)* ranged widely throughout Malawi (Faulkner, 1868; Johnston, 1897). During the colonial period, however, elephant "control" was a significant part of agricultural development, and by the 1950s the elephants' range had became considerably fragmented and restricted (Muldoon, 1957). During the mid 1980s, Malawi's elephants numbered about 2,500 (Jachmann & Bell, 1984; McShane, 1986; Douglas-Hamilton, 1988; Cumming *et al.,* 1990). Until recently there were nine discrete populations, both in and around a number of national parks, wildlife reserves and forest reserves. By the early 1990s, however, one of these populations, centred around Majete Wildlife Reserve (MWR) in the Middle Shire Valley (MSV), southern Malawi, was extinct.

Long-standing conflict has occurred between elephants and man in both Mwanza and Chikwawa districts of the MSV, particularly with regard to crop-raiding (Morgan-Davies, 1983). There was, however, a healthy mutual respect between elephants and man in the region, and they tended to avoid each other. As late as early 1986 there was no apparent large-scale elephant poaching.

Since 1983, and probably earlier, much of MWR was as heavily hunted as the surrounding unprotected areas, which accounted for the generally low densities of large mammal populations (Clarke, 1983). There were no Department of National Parks and Wildlife (DNPW) staff stationed outside MWR, and in general wild animals were left to fend for themselves, with minimal protection. Under such conditions Sherry (1987) warned that commercial poachers could very quickly reduce elephant numbers.

Following increased hostilities in neighbouring Mozambique, hundreds of thousands of refugees flooded into southern Malawi during 1986 and 1987. With the establishment of numerous refugee camps in the region, there was a general breakdown of law and order. Elephant hunting with AK 47 automatic rifles proliferated, apparently lead by a small number of Mozambicans who became well-known to local communities (Sefu, 1993). In 1989 a joint Malawi Government/FAO national survey of large mammals gave an estimate of 125 elephants for the Majete area (Simon *et al.,* 1990) and noted an increase in elephant poaching.

In response to field reports of the apparent disappearance of the MSV elephant population, the DNPW Re-

search Unit carried out a ground survey of part of MWR to assess their status in 1992 (Bhima, 1992). This was followed up in 1993 by an DPWN aerial survey. The remains of only five elephants were located in MWR and there was no sign of living elephants.

However, doubts remained among senior DNPW staff: first, that there had ever been a large (more than 100), permanent MSV elephant population, and second that the population had been exterminated rather than that it had emigrated into Mozambique. Here, the size and range of the MSV elephant population is detailed between 1983 and 1987. Then, through analysis of DNPW scout reports and interviews with the DNPW staff and local villagers, the circumstances surrounding the very heavy hunting pressure sustained by the population between 1986 and 1992 are documented. Finally, through ground and aerial searches carried out in 1994, the population's extermination through commercial hunting is confirmed.

METHODS

Study area

The MSV lies in the Great Rift Valley in the southern region of Malawi, The study area covered 1,200km^2 of the MSV (Figure 1), over half of which comprises the 689km^2 MWR. The main vegetation type occurring in the MSV is miombo woodland. There are three seasons: the hot, wet season (November to March); the cool, dry season (April to August) and the hot, dry season (September to November).

1983-1987

Range and seasonal distribution were estimated by direct observation, local knowledge and by the presence of vegetation damage, spoor and droppings (Jachmann & Bell, 1979, 1984). Direct observation of the elephants was difficult because of their low density, their secretive, aggressive nature, and the broken country and dense vegetation in which they occurred. They had considerable impact as crop-raiders, and therefore in settled parts of the study area local people were interviewed informally, concerning the number, seasonality and behaviour of elephants visiting their areas.

In MWR, staff of DNPW were requested to report any of their own observations or hearsay information gleaned during their patrols or visits to neighbouring villages.

Elephant density was estimated using the formula derived from studies in Kasungu National Park and Nkhotakota Game Reserve, Malawi, by Jachmann (1984a,b) and Jachmann & Bell (1979,1984) which incorporates defecation rate (ranging from 23.6 droppings per elephant per day in the wet season to 15.7 in the late, dry season, September-October) and rate of dung decay (averaging 16.5 per day in the early and mid-dry season and end of rains in August). This method involves recording numbers of droppings along roads of known width and length.

Population size was also estimated by direct sightings along roads, following Caughley's (1980) formula for strip counts. Population size was calculated assuming a dry season range estimated from the distribution of elephant signs during this season.

As far as possible, each group of elephants seen was sexed and aged following Hanks's (1979) criteria for field identification: old adult (30-60 years); younger adult (15-30 years); sub-adult (10-15 years); juvenile (3-10 years); calf (1-3 years); young-of-the-year (<1 year).

Scout report analysis and interviews

Control of wildlife comes under the jurisdiction of the DNPW (Nsanjama, 1985). In MWR there were four scout posts, each staffed by two or three law-enforcement scouts and their assistants. Each scout camp produced monthly reports including details of their patrol routes and patrol effort, law-enforcement activities, sightings or signs of large mammals and any problems encountered. All available monthly scout reports were read, from all four camps, for the period 1986-1992. From these, data were collated on poaching incidents, sightings of elephants or carcasses, and patrol effort. However, out of an expected 288 original, hand-written scout reports, only 112 were on file.

In 1994 the DNPW field staff in MWR along with members of rural communities adjacent to the Reserve were interviewed informally. In addition, a meeting was held with the DNPW Parks and Wildlife Assistant who had been in charge of MWR during much of the period when the elephants had been killed. Eight days were spent interviewing villagers within the elephants' former local range. A total of 16 villages were visited, including four in the Mwanza River Valley to the south and south-west of MWR. Local people were informed of the purpose of the study through the local government

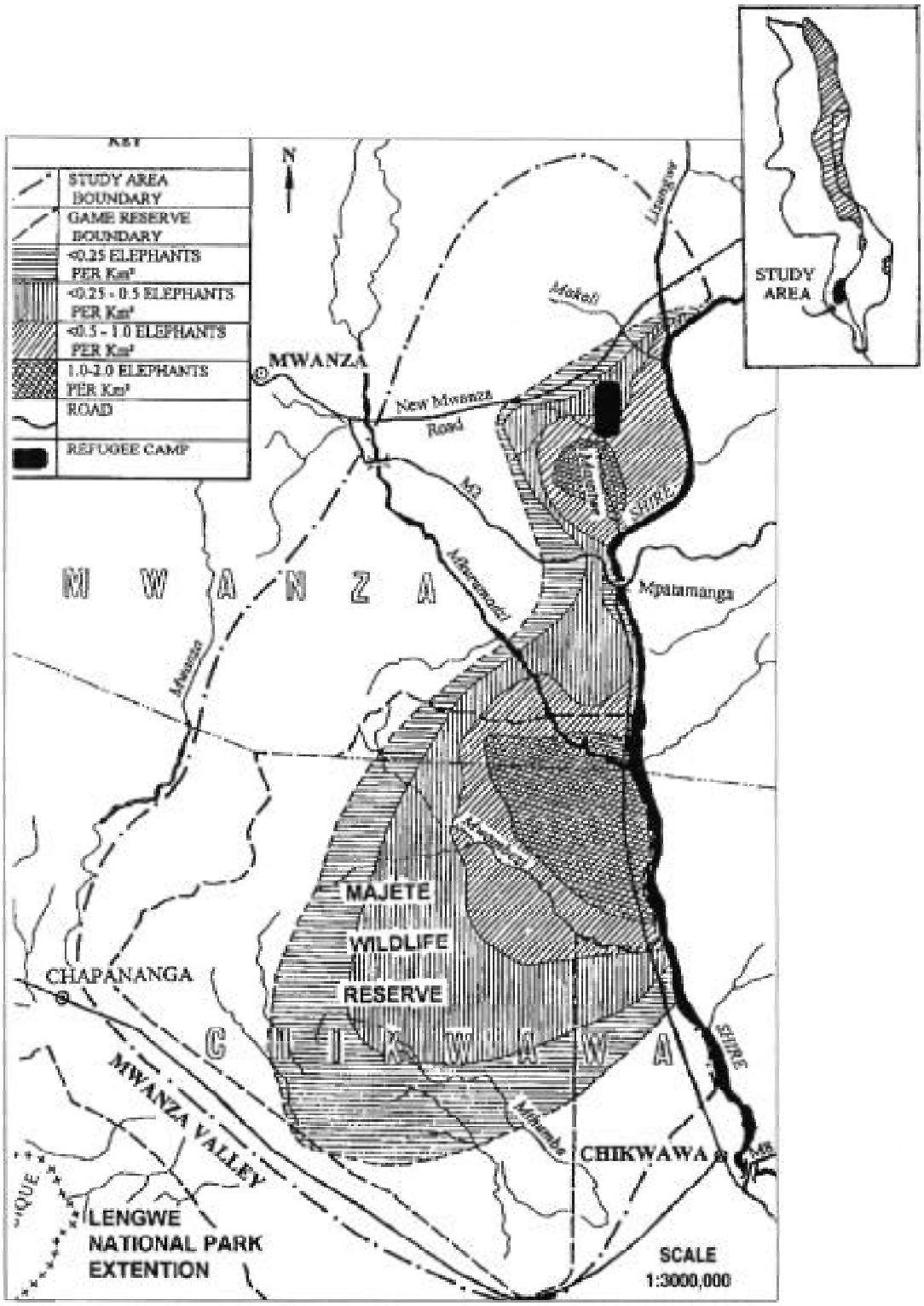

Figure I. The Middle Shire Valley, showing the location of the study area; the boundaries of MWR, ma/or roads and rivers, the refugee camp arid elephant dry season occupance and wet and dry season ranges.

party chairman, or informally on a one-to-one basis. They were asked when elephants had last visited these areas and of the location of elephant carcasses (a cash incentive was offered for this).

1994 aerial surveys

In order to locate further elephant remains, two sample flights were flown in 1994, over parts of the former dry season elephant range. The first covered southern and central areas of MWR, and the second covered northern areas, and included land lying to the north of the Reserve. In total, 200 linear kilometres were surveyed at an altitude of approximately 100m above ground level. Carcasses were recorded in a l00m strip along one side of the flight path, following Taylor & Cumming's (1988) method for surveying live elephants.

RESULTS

Elephant status in the MSV, 1983-1987

The total area of elephant range in the MSV covered approximately 1,000km^2 (Figure 1), which was also effectively the elephants' wet season range. From the start of the dry season in April, concentrations of elephants increased around permanent water supplies in two main areas: along the banks of the Shire river in the north of MWR; and outside MWR to the north, along the Mawatwe and Makili river valleys adjacent to the Shire river (Figure 1). During the early part of the study, the dry season range was estimated to cover 550km^2, but later, during the mid 1980s this shrank to 400km^2 as a result of hunting pressure.

Using dropping counts along vehicle tracks over three years (1984-1986) overall mean ± SE density of elephants was estimated at 0.54 ± 0.8/km^2 (1984: 0.52 ± 0.08; 1985 ;1986: 0.51 ± 0.08), and from the combined density samples an overall mean ± SE population of 294 ± 42 was estimated. These estimates assumed a dry season range of 550km^2, which may have been excessive. At a density of 0.54 ± 0.08/km^2. an adjusted dry season range of 400km^2 gave a population estimate of 214. Direct sightings gave an estimate of 279 elephants.

Of the 34 groups of elephants seen, fifteen were bachelor groups, comprising a total of 26 animals (mean ± SE group size = 1.7 ± 1.2; range = 1-5). The remaining 19 groups were breeding groups, totalling 185 animals (mean group size = 9.7 ± 5.6; range = 5-23 elephants). Of 142 individuals in 27 groups fully sexed and aged, 40 were adult or sub-adult males, 47 adult or sub-adult females, 23 juveniles, 20 calves and 12 were classed as young-of-the-year. Thus, approximately one in four females had a young-of-the-year calf, indicating an inter-calf interval of about four years.

Between 1984-1987 there was little field evidence of mortality, and the remains of only five elephants were discovered, three having been killed between 1982 and 1986.

Analysis of scout reports and interviews

Interviews and analysis of reports by MWR field staff for the period 1986 to 1992 provided considerable insight into the circumstances surrounding the elimination of the MSV elephants. Commercial poaching appears to have begun during late 1986 and continued unabated in the ensuing years up to 199 l. After March 1991 there were no elephant sightings. Local villagers living to the west of the MWR did not recall elephants passing through their area into Mozambique.

In late 1986, a refugee camp was established near the elephants' northern dry season high-occupance zone (Figure 1). The camp eventually hosted in excess of 60,000 refugees, and previously undisturbed woodland supplied their building and fuel-wood requirements. Disruption of elephant behaviour and increased

Photo credit: Paul Beattie

The remains of an elephant carcass in MWR.

conflict between elephants and man was an inevitable consequence of the camp's location at this site. During the period 1988-1991, there are records of at least 40 elephants killed by poachers. Nine refugees were arrested and 13 AK 47s and 14.5kg of ivory were confiscated outside MWR.

In spite of numerous reports of elephant poaching and harassment of scouts by armed poachers, there was little effective response by the Government, Although some poachers were arrested, and some AK 47s were recovered by the Police Mobile Force, following an early incident in which DNPW scouts encountered armed poachers, there is little evidence for further substantial support.

The DNPW scouts were armed with .303 rifles, usually with no more than three rounds of ammunition each -no real match against groups of poachers armed with automatic weapons and apparently plenty of ammunition. Although some increases were made in law-enforcement staff numbers, the only other response was to exhort the scouts, in writing, to increase their efforts. Morale amongst MWR staff became severely eroded.

Analysis of patrol effort showed that coverage of the MWR became minimal, with scouts patrolling for as little as nine days per man per month, half of their required 18 days.

Carcass surveys during 1994

Forty-six elephant remains (including the five found by the DNPW surveys in 1992 - 1993) were located by ground searches both within and outside MWR, and aerial surveys located a further six carcasses not previously reported, in addition to two which had been located before (Figure 2).

Although in total only 52 elephant remains were located, extrapolation of the results of the aerial survey samples support the hypothesis that all the elephants (200 or more) were killed in and around MWR. Eight carcasses were seen during the flights, which covered an area of 20km^2. Using a dry season range of 400km^2 this gives an overall estimate of 160 elephant carcasses. However, assuming that approximately 30% of the population was less than ten years old, and therefore not large enough to have easily identifiable carcasses in an aerial survey, the total number of animals killed can be estimated at 229 animals. There was no evidence that any elephants had fled into Mozambique.

DISCUSSION

In spite of a stated commitment to wildlife conservation, during the mid-1980s the Malawi Government was unable to provide the law enforcement input necessary to curb illegal hunting in and around MWR. The consequence of this failure has been the extinction of one of Malawi's few remaining elephant populations, possibly amounting to as much as 10% of the national herd.

The loss of the MSV population has wider implications for Malawi's eight discrete remaining elephant populations. These currently have a discontinuous range, being isolated by agricultural development and high-density human settlement, Many elephants normally resident in protected areas extend their range seasonally (usually during the wet season) when they follow normal dispersal patterns and are attracted to agricultural crops (Morgan-Davies, 1983). In some parts of the country there is movement across international boundaries, between Malawi and Zambia in the west and between Malawi and Mozambique in the east (Jachmann & Bell, 1979; Morgan-Davies, 1983). Such movements make comprehensive elephant protection extremely difficult.

Whilst the greatest threats to Malawi's elephants are probably the ever increasing demands for agricultural land and fuel-wood which are destroying the elephants' habitat, illegal hunting, not only for ivory but for meat and community protection as well, may also pose a threat. Prior to the extirpation of the MSV elephants, other protected areas had suffered the depredations of illegal elephant hunting, both from within Malawi and from Zambia (Bell & Jachmann, 1984; McShane, 1986). Conflict between elephants and man in the peripheral areas of the elephants' range is likely to remain an ongoing problem (Bell *et al.*, 1982; Bell, 1985). If Malawi's elephants are to survive this combination of threats there must be the utmost commitment and co-operation among all concerned agencies, not only in government and local non-government organisations, but also in the external donor community and in neighbouring countries.

RECOMMENDATIONS

A national strategy is needed to ensure the survival of Malawi's remaining elephants. Such a strategy should learn from mistakes made in the MSV and could be adapted to other large wildlife. The following actions are recommended:

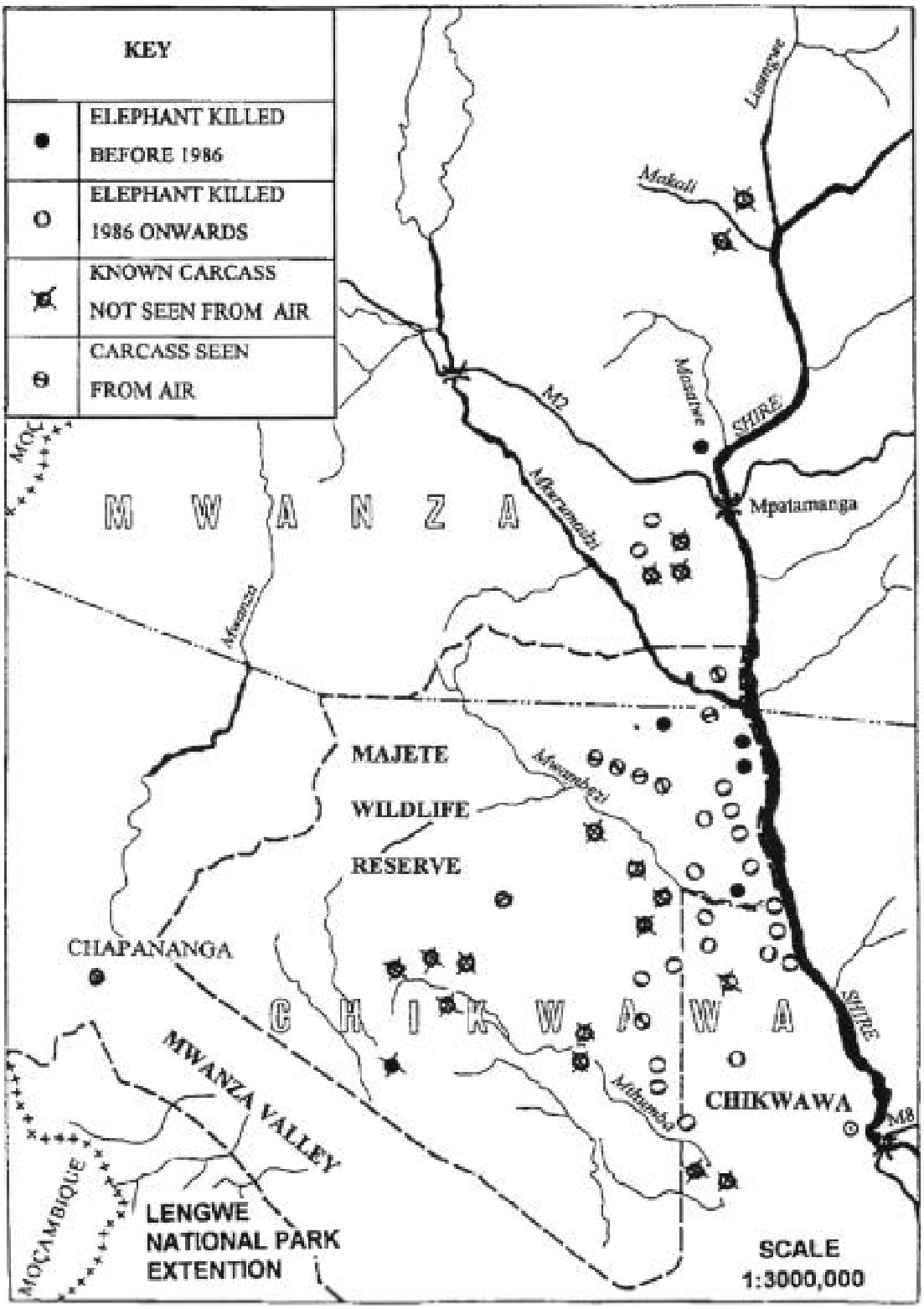

Figure 2. The distribution of elephant remains in the study area.

- Improvement of ground coverage and communication between field staff and senior DNPW personnel, to ensure that changes in the status quo are rapidly detected and brought to the authorities' attention.

- Establishment of a national crisis response law-enforcement unit within the DNPW, with police support, to ensure that field staff are given the necessary moral and material support.

- A review of the southern African regional commitments of senior DNPW personnel, which might be compromising the attainment of Malawi's internal wildlife conservation goals by placing unfair demands on resources.

- Attainment of substantial donor assistance to provide Malawi's DNPW with adequate resources to achieve basic conservation goals for MWR and other areas. The successful future of Majete as a wildlife reserve seems likely to hinge upon external funding.

- Improved co-operation and exchange of information between Malawi and the neighbouring elephant range countries of Mozambique and Zambia.

- The re-introduction of elephants to MWR is not recommended until such time as illegal activities within the Reserve, such as tree-cutting and poaching, are under control.

ACKNOWLEDGEMENTS

The support and encouragement given over the years spanned by these studies, by the Chief Parks and Wildlife Officer and his staff at Malawi's DNPW are greatly appreciated. Thanks are due also to the Biology Department of Chancellor College, University of Malawi. The Wildlife Society of Malawi promoted the 1994 Majete elephant study, and grateful acknowledgement is extended to Fauna & Flora International, which helped to fund this study with a grant from its *Oryx* 100% fund.

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AFRICAN ELEPHANT SPECIALIST GROUP MEETING, KRUGER NATIONAL PARK, SOUTH AFRICA, 4 TO 10 FEBRUARY 1996

Photo credit: Holy Dublin0

SESSION TITLE: TOPICAL PRESENTATIONS

Chairs: lain Douglas-Hamilton, Moses Kofi Sam, Marion Garai, Daboulaye Ban-Ymary
Rapporteurs: Debbie Gibson, Joseph Matlhare

MANAGEMENT OPTIONS FOR SHIMBA HILLS ELEPHANTS AFTER FENCING OF THE RESERVE

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ABSTRACT

The Shimba Hills National Reserve is a remnant coastal rainforest in Kenya. The forest has an estimated population of 300 elephants. By the end of 1997, the Reserve and an adjacent forest, a total area of about 250km^2, will be fully surrounded by an electric fence. Concern has been raised that the confinement of the elephant population within the Reserve will lead to radical habitat change. The fence is being installed to alleviate the severe and widespread human-elephant conflict around the Reserve. This paper investigates the options available for the management of the Shimba Hills elephants.

SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

The Shimba Hills National Reserve is 35km south of Mombasa, Kenya and covers an area of 220km^2. North of the Reserve is a corridor which is accessible to elephants and links the Reserve with the adjacent Maluganji forest, increasing the area available to elephants to about 250km^2. The vegetation of the whole area comprises a mosaic of high-canopy forest, grass, deciduous forest and thicket. The Reserve is surrounded by human settlements where subsistence agriculture is practised. There is considerable conflict between humans and wild animals, with elephants, baboons and bushpigs being the main offenders.

There are between 300 to 600 elephants in the area, according to estimates derived from an aerial total count, dung sample counts, and from direct observations during which 34 family groups comprising a total of 354 elephants were identified. It is not known how the elephants utilise the area seasonally.

The Kenya Wildlife Service is installing an electric fence around the Reserve and the adjoining Maluganji forest to prevent elephants from leaving the area; it will be completed in 1997. The elephants will still be able to move between the Reserve and the forest using the corridor. Fencing is considered the ultimate solution to keeping all problem animals out of cultivated areas. However, while the fence will solve conflict problems, it may cause additional management problems.

There is concern about the impact which elephants have on the vegetation, particularly in the Maluganji forest and in the north-west of the Reserve where there appear to be more fallen than standing trees. It has been observed that in the northern area the elephants debark and knock down trees, mainly in dominance displays, rather than eating them. The area seems to be a "meeting place" for elephants. Elephants are preventing regeneration and there is concern that the rate of habitat loss will be accelerated due to the fence.

The following management options can be considered:

- A "wait and see" approach, i.e. let nature take its course.
- Translocation: the elephants could be moved, perhaps to Tsavo National Park, but the terrain and vegetation in Shimba present formidable challenges to elephant capture.

Culling: Kenya has resisted culling, even when overabundance is apparent, mainly for ethical and humane

reasons. Kenya might "mentally tiptoe" towards the idea of culling - but in this case it is not known how many elephants should be culled. Questions also arise as to what would be done with the carcasses, what equipment would be needed, etc.

In conclusion, there is no easy solution: anagement options depend on what is wanted. The (simple) choices are either to save the elephants, to save the trees or to save a bit of both.

DISCUSSION

Question: Why can't humans be translocated?

Answer: People cannot be translocated. There are political considerations.

TUSKLESSNESS AMONGST THE QUEEN ELIZABETH NATIONAL PARK ELEPHANTS, UGANDA

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ABSTRACT

Among Asian elephants *(Elephas maximus),* sexual dimorphism in tusk development is pronounced: females are tuskless or have undeveloped "tushes". Most males have some tusk development and the proportion of elephants possessing tusks varies enormously among different Asian elephant populations. With regard to the African elephant *(Loxodonta africana),* both males and females have tusks, although tusklessness occurs in approximately 10% of females and very rarely in males. From elephants shot in Uganda in the 1920s, tuskless elephants accounted for 1.6% in 1929 and 1.0% of those shot in 1930.

Selective hunting of elephants for ivory has been going on since the Pleistocene period. Intensive hunting for ivory co-existed with the slave trade, and still continues today. Single tusks weighing 1001b ((≈45.5kg) each were common and even those of up to 1751b (≈79.5kg) were not rare. In Uganda, between 1959 and 1967, the average weight of tusks was 6.4kg. Over the years there has been a reported decline in the weight of ivory coming into the markets. Recently, observers in regions where heavy poaching has occurred have commented on the high proportions of tuskless elephants. Douglas-Hamilton *et al.* (1980) noted that in the Queen Elizabeth National Park (QENP) most of the surviving matriarchs were tuskless, which is probably the reason they survived.

The level of tusklessness amongst the QENP elephants was examined in order to find out if there had been selective offtake of tusked individuals and to determine if there had been a significant increase in the level of tusklessness. It was hoped that the study would provide more information about the genetic manifestations of tusklessness but, due to the longevity of the elephant and its slow reproduction, the trends related to inheritance of tusklessness can not be determined. There has been no systematic study of tusklessness, and this report may stimulate interest in the subject.

SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

The present study was initiated in 1988 due to a decline in elephant numbers in the QENP from 3,500 to 150 in 1980. The objectives of the study were numerous, with the study of tusklessness being just one of them.

Tusklessness was previously very rare in the QENP. In 1920 only one out of 2,000 elephants which were shot was tuskless and the specimen was sent to the British Museum to establish if it was diseased.

In the present study, elephant family units were identified and individuals were classed as tusked, tuskless or single-tusked. The following observations have been made:

- 10% of the females are tuskless, 9.5% of the females are single-tusked and 9.5% of the males are tuskless. Two-thirds of all the elephants over 40 years are tuskless. No young males less than 10 years old are tuskless.

- Tusked mothers produce no tuskless males but can give birth to either tusked or tuskless females. Tuskless females do not have tusked female calves, but can produce tusked males. No single-tusked female has a tuskless calf. There appears to be a strong genetic basis for tusklessness. Of the 21 families identified in the study, 42.8% are tusked, 28.6% are tuskless and 23% are mixed tusked/ tuskless.

- Old tuskless males do not appear to mate successfully but are instead chased away by younger, though large, tusked bulls.

The presence or absence of tusks may be important to survival. There is an abundant supply of water and salt in the QENP, but in less favourable or arid areas, elephants probably need their tusks to compete successfully for resources.

Future work may include biopsy analysis to find the genetic basis for tusklessness. Tusklessness may be a very localised phenomenon. It is not seen in other elephant populations in Uganda although there are many single-tusked elephants. In general there has been a trend from growing big tusks to having none at all.

DISCUSSION

Question: Why has tusklessness arisen? Is it the impact of civil unrest?

Answer: It would seem to be due to the selected offtake of elephants with big tusks. It is genetic.

Comment: In Amboseli (Kenya), tuskless elephants comprise less than 1% of the population. Tuskless females have both tusked and tuskless male and female calves. Tuskless males over 40 years are the only males left in some populations in three parts of Kenya. All have been seen in musth and are clearly the breeding males in these populations. It is suspected that the tuskless trait is passed on by the males, not by the females.

Comment: The increasing frequency of tusklessness is due to unnatural selection. The trait must be passed through both males and females unless it is carried on the mitochondrial DNA.

Question: How will biopsies help?

Answer: Biopsies from mating males and from offspring will establish which animals are reproducing.

THE ECOLOGY AND DETERRENCE OF CROP-RAIDING ELEPHANTS; RESEARCH PROGRESS

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ABSTRACT

A study is being conducted in the Sengwa Wildlife Research Area of Zimbabwe on the ecology of crop-raiding elephants. This project is examining the feeding ecology and movement patterns of bull elephants which raid crops and explores a variety of other factors which influences this behaviour. Chemical deterrents are being tested in an effort to identify compounds that may reduce elephant crop damage.

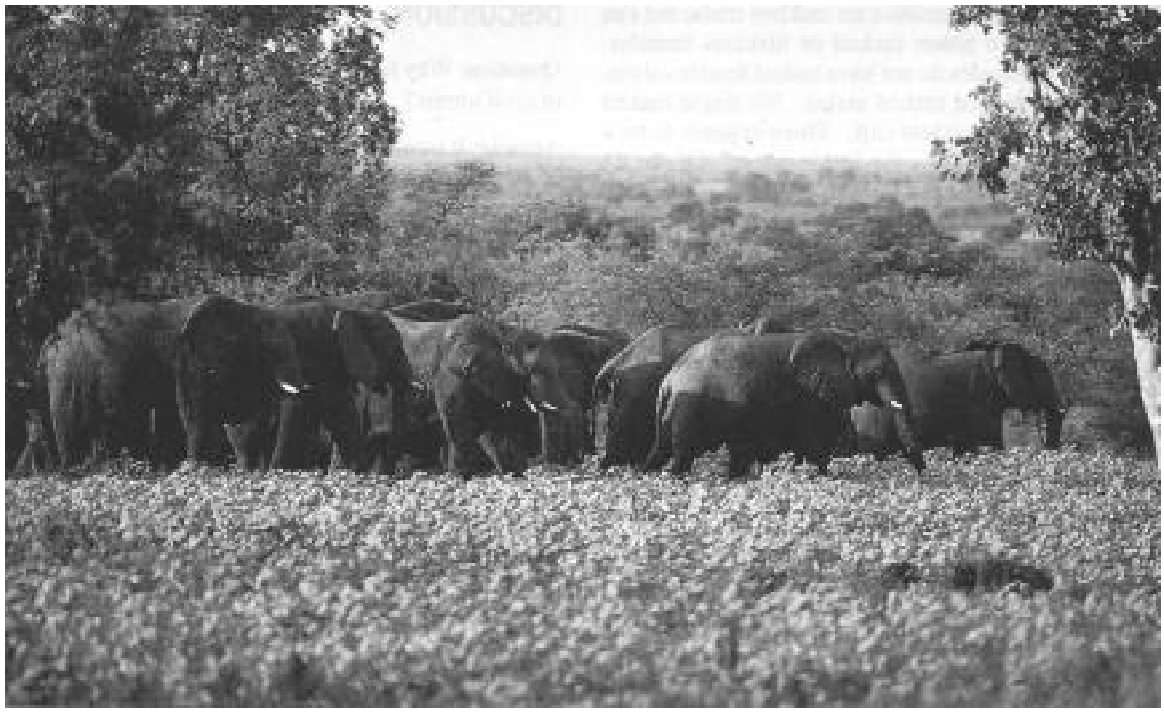
SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

Initially this was intended to be a study only of elephant deterrents but it became clear that the ecology of elephants needed further investigation. The study concentrated on why elephants raid crops and whether their movements are due only to their attraction to crops, or to other factors. This objective required a comparison of vegetation within and outside the Reserve and a study of the movements, social behaviour and feeding behaviour of elephant bulls.

The study is being carried out in the Sengwa Wildlife Research Area (SWRA), which comprises 373km^2 and supports between 600 to 800 elephants (1.5-2 elephants per km^2). It is surrounded by communal lands to which there has been high human immigration. The human population density is now about 25 per km2, concentrated mainly in riverine areas.

The southern boundary of the SWRA was fenced in the 1960s, and in the past 30 to 40 elephants were shot per year on problem animal control outside the protected area. In the early 1970s, changes in vegetation due to

Photo credit: Chris Thouless



A herd of crop-raiding elephants in northern Cameroon

elephant damage and fire caused concern and culls were carried out in the 1980s to reduce their numbers. For 25 years the area outside the SWRA was not browsed by wild herbivores and there are still some areas which have not been cleared for cultivation.

The study focuses on the elephant bulls which do most of the crop-raiding. Preliminary results indicate that the movements of elephants out of the SWRA are associated with the onset of rain or the appearance of grass. Food availability seems to be a major motivating factor for the movement out of the SWRA. The predominant diet is grass in the humid, hot season January/February, and browse between June and December, the dry season. Crop-raiding decreases around June, when the elephants switch to feeding on browse. Elephants continue to break out of the SWRA even after the crops have been harvested. This is attributed to the abundance of tree species in the communal area. The preliminary conclusion, therefore, is that elephants leave the SWRA to feed on browse as well as to raid crops.

Feeding behaviour

The study includes feeding rates, plant selection, dung analysis to determine the percentage of grass and browse, and seasonal changes in food selection. Grass is abundant between May and August and limited from September to October. From December to February the dung is composed mainly of grass, but switches to browse from June to November/December. Most crop-raiding occurs in the transition period between the availability of grass and browse. The key question is whether crop-raiding is triggered by this transition or by nutritional stress. There may be another factor which motivates crop-raiding, not just desire to eat crops.

The differences in digestive rates of browse and grass are also being investigated.

Vegetation

It is necessary to compare the vegetation in the SWRA with that outside. Outside the SWRA the riverine area still has tree species which no longer occur within the Reserve. The average number of species is higher on the communal lands than within the SWRA although the total number of trees is higher in the SWRA. There are mainly *Acacia* and *Combretum* species inside the SWRA. Elephants spend two-thirds of their time browsing (at night) in the communal lands.

Control

Unless large numbers of animals are killed, shooting of the crop-raiding elephants has no (deterrent) ef

fect. Shooting in turn causes a problem in that the surrounding communities start to depend on the meat

supply, which is not sustainable. There need to be options for local people to use to combat elephant damage, rather than having to rely entirely on help from the wildlife officials.

DISCUSSION

Question: Do local people report to a central office or do you go to them to investigate incidents of crop-raiding?

Answer: People who live in the area are employed to track the elephants and to investigate whether there has been crop-raiding.

Question: What is the abundance and availability of crops i.e. does crop-raiding peak during the growing season?

Answer: The elephants seem to begin crop-raiding late in the growing season. Crops may be grown in December/January; e.g. this year (1996), because of the good rains, there were "mealies" available but there was no crop-raiding. The elephants seem to have what they need without crop-raiding at this time of the year. As the grass moisture decreases they return to the fields.

Question: Why are there more tree species outside the SWRA?

Answer: Soil types are being studied because they could be an influencing factor. Inside the SWRA there is thick bush and spiny trees. Outside the SWRA there are large canopy trees which have not been browsed by large herbivores.

Question: Do elephants prefer some crops to others?

Answer: They do not like okra.

Question: Is it possible that any of the areas being raided are historical migratory routes?

Answer: Not in this study area.

PROBLEMATIQUE DE GESTION DE L'ELEPHANT D'AFRIQUE DANS LA RESERVE DE FAUNE DE CONKOUATI, AU KOUILOU (CONGO).

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INTRODUCTION

La présente communication se propose d'identifier les contraintes pesant sur la gestion de 1'éléphant d'Afrique dans la réserve de faune de Conkouati.

Elle se fonde sur une série d'observations effectuées sur place entre 1988 et 1995, et tente d'analyser les limites, les particularités physiques, humaines, biologiques et technico-économiques de ce milieu ainsi que les pressions de toutes sortes qui sont à l'origine de conflits entre les hommes et les é1éphants.

LA RESERVE DE FAUNE DE CONKOUATI ET SES ENVIRONS

La réserve de faune de Conkouati a été créée le 20 mai l980. En 1984, la protection absolue de toutes les entités écologiques est déclarée pour une période indéterminée (arrêté 7.262 du 12 juillet 1984). Administrativement, elle se situe dans la Région du Kouilou (Districts de Madingou-Kayes et de Nzambi), au nord de la capitale économique, Pointe-Noire, en bordure de 1'océan Atlantique et de la frontière gabonaise. Il y a trois points d'accès possibles: Tchizalamou-Nkola et Cotovindu à partir des pistes venant de Pointe-Noire et une voie venant de Dolisie (troisième ville du Congo) qui rejoint Nkola, à 32km de Cotovindu.

Constat *in situ*

Les limites initiales de la réserve de Conkouati ne sont plus que virtuelles. La réserve est menacée tant à l'intérieur qu'à l'extérieur par :

- des mesures réglementaires successives qui en réduisent la supefficie et
- l'octroi de nombreux permis d'exploitation à l'intérieur de la réserve et dans ses abords immédiats, notamment :

• Les exploitations et entreprises forestières (ECIK:89,450ha - COFIBOIS: 63,000ha - COMETRAB: 84,000ha), presque toutes à l'intérieur, soit 236,420ha sur les 300,000ha théoriquement en réserve, auxquels il faut ajouter les entreprises en bordure (FORALAC - SIDETRA)

• Les sociétés de recherches pétrolières (dans leurs parties sud et sud-ouest), qui entraînent l'intervention de sociétés d'études géophysiques et sismiques (Western-CGG) et éventuellement une exploitation pétrolière *on shore*

• Les sociétés minières (SOCOREM) pour la recherche de wolfran et de calcithérites dans la réserve (zone de Ngongo et Poumbou) et les Potasses du Congo en bordure (Lac Youbi)

• La recherche artisanale de l'or (Ngongo)

Données biologiques

Végétation

Un des intérêts de la réserve de Conkouati réside dans 1'extrême variété de ses écosystèmes. De la côte vers l'intérieur on peut distinguer :

• la frange de végétation littorale halophile correspondant à une formation de type *bush*

• la mangrove, en particulier dans la lagune de Conkouati et à l'embouchure de la Noumbi *(Rhizophora racemosa* et *Phoenix reclinata)*

• les papyraies (peuplements de papyrus et bambouseraies)

• le mélange sublittoral (savanes et pseudo-steppes de substitution avec de rares lambeaux fortement anthropisés de forêts semicaducifoliées)

• la forêt de type ombrophile guinéo-congolais qui couvre Ia moitié nord de la réserve

Carte montrant la situation de la réserve de faune de Conkouati au Congo.

Un gradient Nord-Sud parallèle à la balance hydrique influence la composition forestière.

La flore forestière reste très intéressante grâce à la présence de familles caractéristiques de 1'endémisme régional guinéo-congolais, telles que les Huacaceae, les Scytopetalaceae, etc.

Faune

La diversité des écosystèmes a permis la présence d'une faune riche et variée (dont on ne possède pas de recensement exhaustif). Parmi les mammifères les plus menacés, on doit citer 1'éléphant d'Afrique dont les villageois de la zone de Conkouati reconnaissent deux types, le plus grand qui serait 1'éléphant de forêt *(Loxodonta africana cyclotis)* et le plus petit qui serait ce que certains appellent 1'éléphant pygmée *(Loxodonta a. pumilio* ou *Loxodonta pumilio* selon les auteurs). Ce demier serait plus agressif.

D'après Doumenge (1992), la densité moyenne des éléphants en secteur sublittoral s' avérerait près de deux fois inférieure à la moyenne de la partie nord

de la réserve où les é1éphants. nombreux, pénètrent jusqu'aux abords du village et dans le camp de Moufoumbi.

Peuplement humain

La population du District de Madingou-Kayes avoisine les 8,000 habitants pour une superficie de 6,260km^2. Madingou-Kayes compte environ 2,000 habitants, et le reste de la population se répartit dans des villages plus ou moins importants dont Youmbi, Nkola, Youngou et Ntié-Tié sont les pluus gros. Le reste de la population est très dispersée et fluctuante (Lucas et Ancrenaz, 1990).

Les habitants du PCA de Nzambi (actuellement district) sont répartis dans environ une quinzaine de villages d'importance très variable qui sont tous situés en périphérie de la réserve, à part Ntié-Tié, Nzambi et Ngongo qui sont installés à 1' intérieur.

PROBLEMATIQUE DE GESTION DE L'ELEPHANT ET MANIFESTATION DES CONFLITS

Impact de l'exploitation forestière

La réserve de faune de Conkouati est située dans l'Unité Forestière d'Aménagement (UFA) sud 2 Kayes (selon la planification définie par le code forestier de 1974).

Selon les quelques cartes et les ouvrages que nous avons Pu consulter (Vennetier, 1968; Gibert et Sénéchal, 1989), l'exploitation forestière dure depuis longtemps, mais en l974, sa suspension avait été décidée officiellement jusqu'au 01/12/1985 (arêté n˚3086 de juin 1974).

Malheureusement, le Ministère de l'Economie forestière, sous différentes pressions, a attribué des dérogations dans cette UFA malgré le rapport sur l'aménagement de l'UFA sud 2 (Setzer, 1988).

Selon les conclusions de ce rapport, aucune activité d'exploitation forestière ne devait être acceptée dans la zone de Conkouati pendant la durée de la rotation qui est de 25 ans. Ces recommandations se basaient sur des inventaires qui permettent de penser que "dans aucun des blocs de l'UFA sud 2, le coefficient de régénération naturelle ne donne la certitude d'un avenir équilibré poùr la forêt naturelle".

Malgré des textes de lois remarquablement complets, la gestion des forêts du Congo connaît de nombreuses incohérences. Ainsi, deux arrêtés signés tous deux le 22/02/1988 précisent, le premier, qu'aucune attribution de nouveaux permis ne pourra avoir lieu jusqu'à nouvel ordre dans l'Unité sud 2 Kayes (arrêté n˚958/MEF DGEF/DSAF), et le second, que l'exploitation forestière est désormais ouverte dans cette même UFA (arête n˚959/MEF/DGEF/DSAF). L'arrêté n˚176 du 10/03/ 1989 reprenant les conditions d'exploitation de l'UFA sud 2 Kayes indique que cette Unité est exploitée par coupes successives avec une rotation de 25 ans et qu'elle est ouverte à l'exploitation de toutes les essences.

Cette relance de l'activité forestière dans le secteur de la réserve de Conkouati et dans ses zones limitrophes a favorisé l'exploitation de 28 essences.

Tous ces revirements, l'impact répété de l'exploitation forestière et la non application des plans de gestion ont contribué et contribuent à:

> une exploitation anarchique et une raréfaction des gros arbres d'essences commercialisables. De plus, et c'est particulièrement notable au nord du permis Kayes "A" entre Ngongo et Kotovindou, l'exploitation forestière a largement contribué au remplacement des forêts denses par de vastes zones de forêts clairsemées secondarisées à sous-bois de Maranthaceae, et Barnes *et al.* (1991) confirment ce changement. Les Maranthaceae perturbent àleur tour les processus de régénération naturelle des arbres. Ceci s' observe dans le secteur sublittoral.

On croit que les éléphants profitent de l'exploitation forestière parce qu'elle favorise la croissance des espèces secondaires qui ont la préférence des é1éphants. Mais dans le secteur compris entre le village Sialivakou et Ngongo, on a plutôt l'impression que certaines espèces végétales connues comme nourriture des éléphants ont disparu et que c'est la surexploitation des forêts qui a entraîné ces disparitions:

> la destruction intensive et extensive des écosystèmes principalement forestiers tout en diminuant durablement la biodiversité naturelle l'ouverture de voies d'accès qui facilitent les transactions commerciales liées au braconnage. Par exemple, l'ancienne piste d'exploitation forestière Nzambi-Ngongo a été rouverte par la SOCOREM le 06/04/1989. C'est sur celle-ci que nous avons pu voir la majorité des animaux observés le 01/ 06/ 1989 et que nous avons appris Ia saisie à Mandingou-Kayes de sacs de viande d'éléphant

boucanée en provenance de Ngongo dont le transport était assuré par un véhicule militaire

- Ia création de campements ou de villages de chasseurs le long des pistes, comme celui de Loukagni

- l'éloignement, la perturbation et la désorganisation des mouvements de la faune sauvage, principalement des éléphants qui ont migré vers les zones sublittorale et nord de la réserve (la Ngongo) où ils divaguent et causent des dégâts aux cultures

LE BRACONNAGE

La chasse se pratique partout où du gibier subsiste, et toute l' année malgré une fermeture officielle de six mois par an (arrêté 3.772 du 12 août 1972).

La cause première relève des habitudes alimentaires. La viande de chasse est très prisée par les Congolais. De plus, la demande en provenance des villes (Pointe-Noire par exemple) s'accroît sans cesse du fait de l'exode rural. L'arrivée d'ethnies forestières en territoire vili, l'habitude des vili eux-mêmes de pratiquer un travail rémunéré et de disposer d' argent frais, la prolifération d' armes à feu, notamment de guerre comme le Kalashnikov, l'existence d'une manufacture de cartouches inondant toute l'Afrique centrale, la facilité des rapports ville-campagne et le marché de Pointe-Noire entre autres ont augmenté les capacités d' abattage de gibier tandis que Ia demande locale et régionale se faisait plus pressante. Un commerce fructueux s'est ainsi créé entre la ville et les campagnes.

Actuellement, ce commerce est bien organisé et souvent commandité par des commerçants ou des résidents des centres urbains qui n'hésitent pas à recruter des chasseurs à leur compte en leur fournissant armes, munitions, piles, cigarettes, etc. Tous les chasseurs ne possèdent pas d'armes à feu, et le système de prêt (avec rétribution par une partie du produit de la chasse) ou de location de l'arme (le "locataire" paie au propriétaire une somme convenue et dispose de la totalité de son tableau de chasse) est largement répandu dans les villages.

Toutes catégories de chasseurs confondues, la quantité de gibier abattu chaque année semble très importante. En 1989, une étude menée dans la zone de Conkouati (réserve et alentours) estimait à au moins l50,000, le nombre d'animaux braconnés par an pour la région de Kouilou, principalement dans la réserve de faune de Conkouati. Par contre, Doumenge (1992) estime qu'annuellement, de 80 à 100 tonnes de gibier sont prélevées dans Ia réserve de Conkouati et affirme que ces chiffres sont probablement en deçà de la réalité.

L'essentiel de cette production est vendu aux commerçants venus en taxi-brousse de Pointe-Noire, Dolisie; la viande est boucanée car la pratique des campements est de plus en plus répandue et rend le boucanage de la viande indispensable. La coexistence de la chasse de subsistance et de la chasse commerciale du fait des besoins en protéines animales et en argent frais, entretient à longueur d'année un état de conflit larvé avec les autorités des Eaux et Forêts chargées de la gestion de Ia faune. Les periodes d'ouverture et de fermeture de la chasse ne sont pas respectées, et on peut seulement noter dans ce dernier cas un peu plus de précautions (voyages aux heures tardives de la nuit).

L'éléphant n'est pas épargné, et l'on note une recrudescence du braconnage d'éléphants depuis 1992. Le but en est toujours la collecte d'ivoire, malgré la mesure de la CITES (l 989) interdisant le commerce de l'ivoire et celles de la Conférence Nationale (l99l) dont l'acte l14 a été confirmé par arrêté gouvernemental. Le marché de l'ivoire est devenu officiellement inexistant depuis l' interdiction, mais l'intérêt pour l'abattage des pachydermes grandit sans cesse. Des campements, voire même des villages s'installent dans la zone sublittorale, et Loukagni dont l'installation a **été** favorisée par l'ouverture d'une route forestière a pris le surnom de "village des chasseurs".

C'est le point central de toute l'activité de chasse à l'éIéphant. Les commanditaires peuvent être classés en trois catégories:

- Certains exploitants forestiers organisent euxmêmes des abattages illicites d'éléphants. Cet ivoire-là prend des destinations inconnues et la porte de sortie est probablement le port de Pointe-Noire

- Certaines personnalités de la sphère politique profitent de leur influence et arment des chasseurs. L'ivoire est versé dans le circuit commercial entretenu généralement par des expatriés ouest-africains. En décembre l995, 4 éléphants ont été abattus aux environs du chef-lieu de la sous-préfecture et l'ivoire est encore détenu à la sous-préfecture de Mandingou-Kayes

- Certaines autorités militaires (zone l) confient des armes (Kalashnikov) et ds munitions de guerre à des chasseurs recrutés et installés à Loukagni "vil-

lage des chasseurs", construit entre la base-vie d'ECIK et Sialivakou. C'est la zone de braconnage à l'éléphant par excellence. La viande et l'ivoire illégaux sont transportés par camions militaires ou par des véhicules loués à des particuliers. Convoyés de jour comme de nuit, ils échappent au contrôle des agents des Eaux et Forêts

En août 1995, on a saisi dans le village de Loukagni 4 pointes d'ivoire et de la viande provenant de deux éléphants fraîchement abattus. Il arrive que de nombreux éléphants blessés par balle errent à proximité des villages de Sialivakou, Mpella, Vandji, Goumbi, Yanika où Ngongo et menacent leurs habitants. Suite à de nombreuses plaintes formulées par ces derniers et aux exactions relevées par les autorités chargées de la gestion de la faune, on a organisé à Pointe-Noire une réunion de concertation constatée par procès verbal (11/11/95). Elle a réuni le Haut Commandement de la zone militaire n˚l, la Direction Régionale des Eaux et Forêts du Kouilou et une ONG (Nzambi Solidarité). Ses conclusions ont reconnu la nécessité d'améliorer les relations interprofessionnelles, le contrôle des véhicules militaires en provenance de la réserve de Conkouati, l'arrêt des abattages illicites d'éléphants et la destruction du village de Loukagni dont les habitants devraient intégrer les villages de Sialivakou, Mpella, Ngoumbi où rejoindre leur localité d'origine.

Tableau 1. Evolution de quelques saisies d'ivoire opérées par l'Administration forestière du Kouilou depuis l'interdiction (exprimées en kg).

Annee	Ivoire sculpté	Ivoire brut	Provenance
1989	24,050	16,400	Conkouat
1990	18,150	08,050	
1991	-	-	
1992	07,200	30,250	"
1993	01,500	17,200	"
1994	41,240	64,700	"
1995	-	69,600*	"
TOTAL	92,140	206,200	

Il faut noter que la quantité d'ivoire de 1995 ne prend pas en compte l'ivoire provenant des quatre éléphants abattus au mois de décembre dans l'île de Banga et au village de Ngoma-Tchilounga (Mandrngou-Kayes).

Il faut relever l'inefficacité des services de répression des infractions. En effet, il n'existe qu'un seul poste de contrôle basé à Mandingou-Kayes que l'on peut éviter par des pistes de contrebande. Les contrôles sont trop rares et donc les résultats présentés au tableau l ne reflètent pas du tout la réalité.

Circuit do commercialisation do la viande

Une première partie de Ia viande de chasse, légale ou non, est consommée localement car c'est la seule source de protéines animales (à l'exception du poisson sur Ia côte).

Le reste est acheminé vers les différentes villes, Pointe-Noire, Dolisie et même Brazzaville. Plusieurs fois par semaine, des grossistes passent dans les village pour vendre divers biens de consommation courante et charger toute la viande qu'ils peuvent trouver. Certains sont équipés de glacières où congélateurs qui leur permettent de ramener de Ia viande fraîche sur les marchés. Certaines personnes de la ville sont assez riches pour entretenir des véhicules et peuvent avoir des accords avec des chasseurs qui sont alors leurs salariés.

Les acheteurs réguliers n'ont pas de véhicule mais emploient les transports en commun et paient environ l'équivalent d'un dollar US par animal transporté. Le chasseur écoule rarement lui-même son gibier en ville, il préfère le vendre au village.

Les acheteurs occasionnels sont des gens qui travaillent en brousse et qui rapportent de la viande à leur famille ou à des connaissances quand ils rentrent en ville. Ce sont des pétroliers, miniers où forestiers, qui cachent la viande pour échapper aux contrôles.

La faune de Conkouati subit évidemment la pression de la chasse. L'espoir se tourne vers le projet UICN qui vient de commencer ses activités.

CONFLITS HOMME/ELEPHANT : DEGATS AUX CULTURES

L' agriculture est une des activités debase des villageois mais c'est une agriculture vivrière de subsistance. Les plantations se pratiquent en forêt, et les surfaces moyennes vont de 5,000 à 8,000m^2.

Les plantations additionnelles de savane varient de 1,000 à 2,000m^2. C'est surtout du manioc, destiné à la consommation personnelle. Le principal inconvénient de ces cultures, en plus d'un sol souvent moins riche, est qu'elles sont régulièrement dévastées par des animaux, particulièrement des é1éphants.

Barnes *et al.* (1991) révèlent l'importance du phénomène dans les villages de Sialivakou (en bordure de la réserve de Conkouati) et de Ngongo

(dans la réserve). Il peut entraîner une pénurie de manioc, et les revenus dérisoires des paysans leur permettent peu d'en acheter ailleurs.

D'après les paysans, les problèmes avec les éléphants ont vraiment commencé en 1988 (zone littorale et Ngongo), année de l'ouverture de l'exploitation forestière et de Ia prospection pétrolière (ouverture de layons sismiques au bulldozer). La situation est devenue tellement grave que certains paysans, notamment ceux de Sialivakou et de Mpella, ont commencé à quitter leur village pour s'installer dans des endroits plus tranquilles et supposés inaccessibles aux éléphants comme par exemple la zone semi-inondée autour de la lagune de Conkouati. A Ngongo, il existe une véritable compétition entre les hommes et les é1éphants. Ceux-ci sont si nombreux qu'ils approchent des maisons et que les risques sont réels (au moins une personne tuée par an depuis 1988). Les plantations de manioc et de bananiers sont les cibles principales.

Dans d'autres villages, aucune mesure particulière n'est prise pour protéger les cultures. Par ailleurs, d'autres défrichements ne respectent pas les zones de pacage et les couloirs de migration des éléphants; ceux-ci sont pourtant placés loin des villages, jusqu'à souvent 5km.

Hecksweiller et Mokoko Ikonga (1991) rapportent que les dévastations par les éléphants ne sont pas récentes mais que depuis les années 80, elles sont devenues plus importantes. Dans le Mayombe, le long de l'axe menant à Kotovindu, les éléphants dévastent les plantations en toute saison mais de façon nettement moins grave que dans les zones sud-ouest et nord-ouest de la réserve.

En marge des commissions d'enquête et de sensibilisation des populations au sujet des dégâts aux cultures et de l'acceptation du Projet d'aménagement et de gestion de la réserve de Conkouati, réalisées en 1994, une autre mission a **été** effectuée de juin à juillet 1995 dans la réserve afin d'établir un bilan complet de la situation des dégâts aux cultures par les animaux sauvages, principalement les éléphants, dans les villages de Ntié-Tié, Nzambi, Tandou-Ngoma, Ngoumbi, Vandji, Sialivakou et Mpella.

La collecte de données de terrain, effectuée pendant cette période relativement courte a fait appel à des réunions, des entretiens avec les villageois, repris dans des procès verbaux, des visites des parcelles dévastées par les éléphants et les autres animaux, des évaluations qualitatives et quantitatives des dégâts, des observations directes des causes des dégâts, des exposés sur l'importance d'une réserve et sur la nécessité des activités de substitution. On a pu remarquer la participation très active des villageois aux réunions organisées dans chaque village. Ils ont pu présenter leurs doléances comme en l 994, lors de la mission de l'équipe du projet UICN Conkouati pour la récolte de données pour l'acceptation ou non dudit projet. Ils ont confirmé que le danger posé par les éléphants remonte à 1988, qui a vu le démarrage de l'exploitation forestière mais aussi l'intensification du braconnage que cette dernière facilite. Les pertes causées aux cultures ont pu atteindre par endroit 63,7% mais il faut remarquer que les zones connues de pacage et les couloirs de migration des éléphants sont souvent obstrués par des cultures installées anarchiquement.

Les dédommagements sollicités (équivalant à 1,200 à 2,000 dollars US) sont relativement légitimes et poussent les autorités à mener à bien les études pour une gestion durable de la réserve.

Causes des dégâts aux cultures

Les dégâts causés aux cultures par les éléphants sont de plus en plus graves; il y a à cela plusieurs raisons.

L 'exploitation forestière

Les compagnies forestières ont largement exploité et même surexploité la zone de Conkouati (Setzer, 1988). De quelques essences, le nombre d'espèces exploitées est passé à une trentaine (dans le cas d'ECIK). De plus, à cause d'intervalles trop brefs entre chaque extraction, certaines espèces se raréfient et les forêts denses tendent à disparaître au proft de formations forestières à sous-bois envahis de grandes maranthaceae. Celles-ci perturbent ou empêchent la régénération des arbres. Il en résulte un appauvrissement des ressources forestières car l'exploitation est plus rapide que Ia régénération. De plus, le bruit incessant causé par les exploitations pousse les éléphants vers le sud de la Noumbi et près des villages.

Le braconnage

La pression du braconnage avait baissé après la mesure de la CITES (1989) interdisant le commerce international de l'ivoire. Elle a toutefois repris, avec des moyens de plus en plus sophistiqués. Traqués, les éléphants errent à proximité des terres agricoles où ils entrent en compétition avec les hommes.

Les causes alimentaires

En période de moindre fructification forestière, les cultures, à commencer par le manioc, peuvent attirer

les é1éphants. Par ailleurs, les sols psammitriques du bassin sédimentaire ne leur offrent peut-être pas suffisamment les sels minéraux qui leur sont indispensables, et Hecksweiller et Mokoko Ikonga (1991) rapporte l'existence d'un profond fossé près du village de Mbéna où seraient déjà morts plusieurs é1éphants. De plus, l'extension des zones secondarisées autour des villages peut attirer les animaux en saison sèche, quand le manque de fruits les pousse à fréquenter les zones plus abondamment fournies en éléments foliacés comestibles.

CONCLUSIONS

Les questions posées par la protection des écosystèmes, la conservation des éléphants et l'exploitation rationnelle de la forêt dans la zone de Conkouati et ses environs ne peuvent se résoudre par le seul aménagement d'une réserve.

Toutefois, les conflits entre l'homme et l'éléphant, entre l'exploitation et la conservation du milieu, ont créé une situation qu'il devient urgent d'aborder, et la réserve en est sans doute un élément important.

Il est urgent de défnir les priorités et de mettre en place une coordination institutionnelle dotée de pouvoirs réels. La réussite de l'opération repose indissociablement sur l'aménagement, le développement et la conservation du Kouilou. Il faut viser:

- d'urgence, un renforcement drastique de la surveillance et du contrôle de la réserve
- la recherche de solutions pour protéger la vie des hommes tout en sauvegardant celle des éléphants
- à court terme, l'aménagement de la réserve (projet de gestion et de conservation, UICN, Conkouati)
- à moyen terme, la conciliation entre développement et environnement et la création d'un schéma d'aménagement régional du District de Mandingou-Kayes
- un programme qui englobe chaque objectif et respecte les délais nécessaires à leur bonne réalisation

REMERCIEMENTS

Nous exprimons nos remerciements sincères au Groupe des Spécialistes de l'Eléphant d'Afrique qui sans cesse nous donne l'occasion de et nous encourage à mener des investigations sur l'éléphant d'Afrique. Ces remerciements sont également adressés au Directeur Général des Eaux et Forêts, au Directeur de la Faune et de la Flore, au Directeur Régional des Eaux et Forêts du Kouilou, à Monsieur Célestin Mbemba, pour leur soutien inconditionnel, aux populations du District de Nzambi et à tous ceux qui, de près ou de loin, ont contribué à la réalisation de cette étude.

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DISCUSSION COMPILED FROM RAPPORTEUR NOTES

Question: Do you have data on population trends in the area, especially in relation to poaching?

Answer: We have limited data available. In 1991 Barnes and Agnagna carried out a dung survey. In 1992 a socio-economic study was conducted. There are more elephants in the north, but it is difficult to make an accurate count.

Question: What is the government attitude to poaching in general?

Answer: There has been a Structural Adjustment Programme in place since 1985. There have been no new officers or game wardens deployed to the area.

We tried to initiate talks between the military commander, an NGO and the forestry department about the poaching problem. We asked the army to ensure that vehicles were searched when they passed through the gates. We asked them not to give arms to the population or to give them ammunition for their guns. We also asked them to destroy a village set up for hunting as it contained people from other countries who had come to hunt in the area. However, poaching is a political problem and hard to solve.

Question: The number of ivory seizures went down after the ban but is increasing now. Is this increase due to decreased enforcement or because there is more ivory? Is ivory used locally, within Congo or internationally?

Answer: Since CITES 1989 we found there was a reduction in poaching but normally things change just before the CITES meeting. The people involved try to build up stocks of ivory in case elephants are downlisted to Appendix II.

Poaching has increased. There are public administrators, e.g. the military and the politicians, who cannot be controlled by wildlife authorities. Ivory is sold on the local market. Sculptures are made locally. Before CITES, traders had large stocks which they were unable to export. Now people think stocks are legal and they continue poaching.

DEVELOPMENT OF NATIONAL POLICY FOR ELEPHANT CONSERVATION IN TANZANIA

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ABSTRACT

The main decision-making framework for conservation action rests at the range-state level. Therefore, the development and implementation of coherent and strong national policy are necessary for effective conservation of the African elephant. The approval of the Policy for Management of the African Elephant in Tanzania in November 1994 provides the basis for Tanzania to move ahead with a programme for managing its population of African elephants. The policy contains statements on the following: Legislation, Management in Protected Areas, Population Recovery, Community Involvement in Elephant Management, Utilisation, Law Enforcement and the Ivory Stock, International Obligations and, Monitoring and Research. The thinking behind the plan and its structure could serve as a model for other countries.

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SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

The responsibility for elephant conservation lies with the range states. The development of coherent, strong and politically-approved national policy is necessary to identify targets for effective action. Implementation of policy can then be assessed against these targets. All range states have action plans (developed through the African Elephant Conservation Coordinating Group) but few range states have approved elephant conservation policies.

The National Policy for Elephant Conservation in Tanzania was developed by the Department of Wildlife through the Protected Areas Wildlife Management (PAWM) programme in 1993-1994 and received approval from the Minister in November l994.

A broad policy statement recognises that major requirements for elephant conservation are:

In protected areas

- To increase elephant numbers and to restore their sex and age structures
- To promote their economic value for tourist game-viewing or to produce a sustainable harvest for tourist hunting

Outside protected areas

- To control numbers where necessary and appropriate
- To manage elephants where appropriate for the benefit of local communities

International obligations

- To abide by the terms of CITES and to maintain an Appendix I listing for the foreseeable future
- To remain open to initiatives of other range states, providing they are undertaken within the premises of CITES and unlikely to cause increased illegal use in Tanzania

ELEPHANT NUMBERS IN BOUMBA-BEK, CAMEROON

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SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

Cameroon is currently developing a long-term strategy for the management and conservation of its biological diversity and renewable natural resources. The forests in south-east Cameroon, which are under increasing pressure from commercial logging and safari-hunting, have been targeted as biologically important areas and the status of "essential protection zone" has been conferred on three forest areas, leading to the creation of three new reserves: l. Boumba-Bek, in which there is an abundance of forest elephants. It is minimally disturbed and there is no logging; 2. Lobeke and 3. Nki, which both have some logging.

In 1993 a grant of US$80,000 was received to survey the Boumba-Bek Reserve and to make a zoological inventory. The project has the following overall objectives:

- To conduct pilot studies to investigate options for utilisation, including game management, timber harvesting, collection of non-timber forest products and tourism
- To carry out basic biological and sociological studies of the Reserve and surrounding areas
- To formulate a management plan to divide the area for different uses

The Reserve has an area of 2,400km^2 and is bounded to the east, north and south by rivers. The climate is equatorial with two rainy and two dry seasons. Rainfall averages 1,005mm per annum and the minimum temperature is 25˚C Vegetation is mapped as being a transition between evergreen and semi-deciduous forest. A number of different tribes live in the area.

The elephant population has been estimated from two dung count surveys. The study area was divided into 5x5km cells and a 2.5km transect was randomly situated within each cell. The first survey gave an estimate of 7,000 ± 3,000 elephants, while a second survey gave an estimate of only 250 ± 100 elephants. Where do the elephants go? They probably go south to the Nki area, but further investigations are needed. There are plans to ft radio-collars on some elephants and to conduct more transect surveys in an effort to identify their seasonal range and movements and any "corridors" they might use.

DISCUSSION

Question: How do you find the starting point of each transect?

Answer: A GPS is used.

Question: It appears that the elephants do not stay in the Reserve throughout the year and probably have seasonal movements. Is there going to be any survey work outside the reserves?

Answer: Research may show that some areas outside the reserves are more important (for elephants) than was previously thought and therefore the government may consider increasing the size of the protected areas.

Question: How large are the human populations and are there human-elephant interactions?

Answer: In this area, there are less than two people per km^2 so there are no problems caused by man. Elephants cause less than l % of crop destruction in the area. An increase in the area of the Reserve may change this percentage. In other parts of Cameroon there is greater human-elephant conflict.

STUDYING FOREST ELEPHANTS BY DIRECT OBSERVATION IN THE DZANGA CLEARING: AN UPDATE

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The Dzanga clearing, located in the forests of south-western Central African Republic, continues to attract large numbers of forest elephants, *Loxodonta africana cyclotis*, which are the subjects of the first long-term study, by direct observation, of this subspecies.

To date, more than 2,100 individual elephants have been identifed, 85% of which have been re-identified a second time or more. After five years of observation, data are still being collected on population structure and growth, social organisation, birth rate, behaviour and biometrics.

This presentation updates the results presented at the AfESG meeting in 1994 and later published in an article by Turkalo and Fay (1995), in which a full description of the study site and methods used is provided.

RESULTS

From l January 1991 to 31 December 1995, a total of 932 days and 2796 hours were logged in the clearing.

The following table summarises the population structure and increase in individuals observed between March 1994 and December 1995.

Table l. Population structure in Dzanga clearing, March 1994 and December 1995

Age class	31 March 1994	31 December 1995
Adult females with offspring	509 (31.7%)	539 (25.3%)
Solitary females	50 (3.1%)	104 (5%)
Adult males	448 (27.9%)	519 (24.3%)
Subadult males	103 (6.5%)	83 (3.8%)
Offspring	495 (30.8%)	887 (41.6%)
TOTAL	1605	2132

The number of elephants identified per day, expressed as a percentage of the maximum 30 minute count, continues to increase. At the end of December 1995 it was calculated at 82% for the period of l October 1995 to 31 December 1995 .

New identifications now average one individual per week.

Groups

Females

Of a total of 655 adult females recorded, 539 were mothers accompanied by at least one offspring. The following table illustrates the frequencies of group sizes occurring in the Dzanga population.

Table 2 Frequency distribution of female -calf groups, including solitary females (adults and subadults).

Number of elephants in group	Frequency of group size
l (Subadults & adults)	104
2	239
3	200
4	41
5	16
6	5
7	2
8	l
9	l
11	2
14	l

The mean group size, including solitary individuals, is 2.5 (1994: 2.3) and 2.8 (1994:2.7) **if** the solitary females are excluded. The mean number of offspring per female is 1.6 (1994:1.3).

Reproduction and birth rate

During the entire study period, from January 1991 to December 1995, a total of 154 newborn were recorded, from known females. Of these females, three are known to have given birth a second time.

In trying to determine a birthdate when the observation point is fixed, one can only know between which two dates an infant was born i.e. between the date when a particular adult female was seen without a newborn and the date when she was observed first with a newborn. For the three adult females who have given birth a second time during the study period, a birth interval of between approximately three and a half and four years has been determined. This is similar to the birth interval in savanna elephants.

Males

Behaviour

Adult males are never observed forming groups and are always solitary. Younger males may associate with adult males but these associations are never observed to exist for more than a few hours. They centre around social activities, such as play, ingestion of minerals and feeding on the edges of the saline.

Musth

Musth is a common phenomenon observed in the saline where large numbers of elephants congregate. During the period from January l99 l to January l996 a total of 45 bulls were seen in musth. Nineteen of the 45 were observed in musth at least a second time. The following table represents the number of bulls and their frequency of musth.

Table 3. Frequency of musth in males in the Dzanga population.

Number of males	Frequency of musth
26	I
13	2
4	3
2	4

Musth in the Dzanga male population appears to be synchronised, occurring approximately at the same time each year for each male seen in musth. Sixteen of the 19 males observed in musth more than once were in musth during one of the two dry seasons: 11 in the long, dry season, which spans from November to February and five in the short, dry season, which occurs in July and August. Among bulls observed only once in musth (n=26), 14 were seen in musth during the long, dry season, six in the short, dry season and the remaining six at other times of the year (i.e. rainy season).

The table below shows the frequency of musth by month in the Dzanga bull population.

Table 4. Frequency of musth by month in the Dzanga bull population.

Month	Frequency of musth
January	12
February	3
March	3
April	2
May	2
June	1
July	7
August	5
September	2
October	1
November	1
December	6

From this data, musth can be described as a dry season phenomenon. In the Amboseli study (Poole, 1987) it was found that musth mainly occurred during or following the rainy season. In the case of the Dzanga population, musth occurs most frequently after the rainy season in the two annual dry seasons. This high frequency of musth during the two dry seasons may be correlated with the fruiting period and food availability, but dietary data have yet to be analysed.

In the Dzanga study the duration of musth has been impossible to determine because of the fixed point observation method. Bulls in musth spend little time in the saline and are generally not seen more than once during their musth period.

Guarding of cows by musth males has been observed on three occasions and one copulation has been seen between two known individuals.

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TRANSLOCATION OF ELEPHANTS: THE KENYAN EXPERIENCE

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ABSTRACT

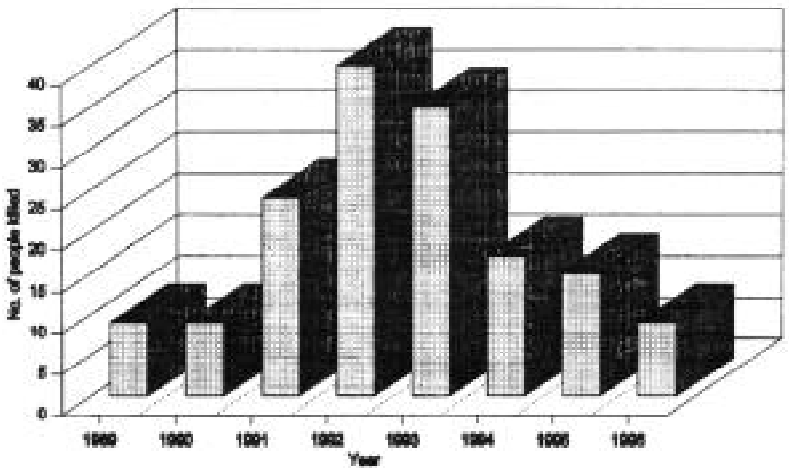
Human-elephant conflict problems in Kenya have attained severe proportions, and with them, new ideas and techniques for conflict mitigation are emerging. Towards the goal of mitigation, the Kenya Wildlife Service (KWS), through the Elephant Programme (EP), initiated a series of trials on elephant translocations during the last quarter of 1995. The plan was to transport 26 elephants from Mwea National Reserve in central Kenya, which is completely surrounded by farms and human settlements, to Tsavo East National Park in south-eastern Kenya, some 500km away. Sixteen elephants were successfully translocated in five operations between September 1995 and June 1996. Another five elephants died, three of them in a recumbent state after darting and the remaining two a few days later, due to changes in physiological conditions during the third operation. Hence a total of 21 elephants were removed from the Mwea population. Details of the operational techniques, the successes, challenges and problems, as well as some general conclusions and recommendations about the Kenyan experience, are discussed in this paper.

INTRODUCTION

Human-elephant conflict

Human-elephant conflict in Kenya has attained severe proportions and requires urgent solutions. Since the formation of KWS in 1989, poaching, which reduced Kenya's elephant population by 85% in the past two decades, has been effectively curbed. However, strong protection of elephant populations has increased their numbers and reduced their fear of people. Relative to the pre- l989 era, elephant deaths have fallen to an all-time low while human deaths and destruction to crops by elephants have steeply increased, as illustrated in the figure below. With the implementation of management intervention measures, including fencing and shooting of rogue elephants, these incidents have, on a national level, declined. However, in certain local areas, the problem has continued to escalate.

In and around the Mwea National Reserve, one person was killed in 1994 and two more in the next year. The Reserve is small (42km^2) and completely sur-



Number of human deaths caused by elephants between 1989 and 1995

rounded by farms and human settlements which prevent elephants from migrating naturally. Before the translocation exercise there were 48 elephants, which, in addition to being a threat to nearby farmers and their crops, were damaging the environment. On the other hand, Tsavo National Park (East and West), located in southeastern Kenya, is large, covering an area of 21,000 km^2. Currently Tsavo has an elephant population of approximately 8,000 individuals, five times less than it supported in the early l970s before rampant poaching depleted its population. In September 1995, the EP embarked on its first elephant translocation operation, from Mwea to Tsavo, a distance of 500km. The objective of the operation was to reduce the density of elephants in the Mwea National Reserve from one elephant/km^2 to 0.5 elephants/km^2 by translocating 26 individuals to Tsavo East National Park. The following is a summary of the experience.

METHODS

Pre-translocation

Surveys to establish social structure

Elephants live in a complex social world comprised of a network of relationships, radiating out from the family unit to bond groups and clans (Moss & Poole, 1983; Moss, 1988). This implies that the first requirement for successful translocation should be minimum disruption of this complex social structure and, ideally, the basic unit for translocation should be the family.

Five aerial surveys were conducted of the Mwea National Reserve prior to the translocation exercise. The objectives of the survey were (i) to establish the distribution and the population estimate of the Mwea elephants (ii) to determine the population structure and (iii) to identify and recommend, based on the survey data, the elephant groups to be translocated (Njumbi *et al.*, 1995; Sakwa & Waithaka, 1995).

Based on the results of these surveys, a family herd of 22 elephants (led by "Big tears"), and another of four elephants (led by "Left fangs") were identified for translocation.

Studies of the vegetation, soils, topography and roads

The above parameters were studied because they are important for the successful planning of logistics and pre-operation procedures. In particular, it was important to determine the state of the existing road network, the access points to the Reserve and their suitability for the translocation trucks.

These studies revealed that 90% of the Reserve was covered by thick bushland or woodland, dominated by *Commiphora* species. It was recommended that certain bridges, culverts, drifts, luggas" (depressions) and narrow bends that were to be used in and around Mwea be repaired or modified prior to the transloction exercise (Mungai & Mwathe, 1995).

Survey of Tsavo East National Park

A survey was carried out in Tsavo East National Park to determine the best release site (Hamisi & Waithaka, 1995). Accessibility to the site, food and water availability and security from poachers were the main criteria for selection of the release site. The Thambangunji area, situated at the northern half of Tsavo East, beyond the Galana river, was eventually selected.

Translocation

Capture and handling of target animals

The procedure for capturing and subsequent handling of the elephants involved three steps:

Immobilising

Because of the thick vegetation at Mwea, the elephants were darted from a helicopter. The darts contained three drugs, etorphine (immobiliser; 7-15mg depending on body size), hylase (tranquiliser; 1500-3000 i.u.), and azaperon (sedative; 60-100mg). It took between 7-15 minutes for the drugs to take effect.

Maintaining recumbency

Once an elephant was immobilised, veterinary doctors continuously monitored the depth of anaesthesia, mainly by measuring the animals' temperature, respiration and pulse rate. If an animal was becoming "light" (showing signs of waking up), a small dose of etorphine (usually 2mg) was administered, while if it became "deep" (showing signs of becoming comatosed), then nalorphine, a weak reversal, was proscribed. During this stage, water was poured over the elephant's body to cool it down as animals are generally unable to thermo-regulate when under the influence of the drugs.

Reviving

After being rolled into a specially built crate (see next section), an immobilised elephant was given a com-

Photo credit: Steve Njumbi

A recumbent elephant

plete reversal (diprenorphine (revivon)) during the last stage of lifting the crate. However, it was found necessary to keep those elephants that were to be transported in the container slightly sedated, otherwise they would become extremely aggressive.

Loading, transportation and release of elephants

Loading of adults

The loading, transporting and transfer of adult elephants was facilitated by a custom-made translocation truck, "Hannibal". The truck, a Volvo NLl0 6x6 rigid truck, built with a special container box with power winches, was designed to lift and load immobilised adult elephants of up to seven tons on to other lorries or on to itself. The truck was built at a cost of US$140,000.

For the purpose of post-translocation monitoring, each adult elephant was fitted with a radio-collar (Telonics model).

Loading of calves and juveniles

Calves and juveniles were rolled, using ropes, onto a conveyor belt and then dragged into a container. The container was then winched on to transportation trucks.

Description of the capture operations

Five capture operations were carried out at the Mwea National Reserve between September l 995 and June l 996. Twenty-five elephants were darted during the operations; 16 were translocated to Tsavo, five died and the remaining four were revived and released at the capture sites in Mwea. The table below lists the elephants which were translocated.

During the first operation, a target family of four elephants was spotted in a herd of ten inside thick *Commiphora* thickets. Efforts to drive the elephants to more open ground using the helicopter proved futile as the animals would reach the edges of the thickets, run along the thicket boundaries and double back into the thickets. Difficulties were also encountered during attempts to isolate the four target elephants from the rest of the herd because the individuals scattered in different directions, contrary to the belief that they would split into their respective family units when disturbed by the helicopter. However, after much work, the four elephants were darted. The recumbent matriarch could not be reached by the loading truck "Hannibal" because she fell on to a steep incline. The truck cannot operate on steep slopes - it would tip over while loading the elephant. The matriarch was therefore revived and released. The two calves and a juvenile which had been darted were also revived as their chances of survival at a new site without their mother was considered slim.

Alone, bull elephant was thereafter identified, darted, loaded and transported to Tsavo. The loading, being the first trial, witnessed a considerable lack of coordinated activities, and the exercise dragged on for over 10 hours and the subsequent journey for 17 hours. The entire crew was thoroughly exhausted at the end of the operation. A moment of danger was experienced at the release site in Tsavo when the bull, upon being released from the crate, charged at a column of media personnel which had lined up behind the crate to capture this moment of history.

Photo credit: Steve Njumbi

The translocation truck, "Hannibal".

The translocated elephants.

Operation	No. of elephants	Old adults (>15 yrs)	Young adults, juveniles & calves (< 15 yrs)	Number of radio-collars fitted
1	1	1 (>35 years)	mone	1
2	5	1 (>35 years)	4	1
4	5	2 (>30, 25-30 years)	3	2
5	5	2 (>30, 20-25 years)	3	1

Photo credit: Steve Njumbi

Loading an elephant on to the truck.

During the second operation, co-ordination among the capture crew was improved, and a family of five elephants was successfully captured, loaded, transported and released at Tsavo. A tractor with a sledge that was used to clear a path towards the recumbent elephants developed two punctures during the operation. The tyres could not be repaired at the site and instead had to be ferried by helicopter to the nearby town of Embu, 60km away, to be mended. This considerably slowed down the operation time to 12 hours of loading. Hence fatigue and exhaustion were evident among the capture personnel. The tractor was replaced by a bulldozer during the next operation.

The third translocation was abandoned after three of the six darted elephants died. It was later established that the elephants died of acidosis - a physiological condition that is brought about by abnormally high levels of potassium in the body, leading to heart failure. The condition is precipitated by a change in diet which occurs after animals engorge on fresh, green forage that sprouts with the arrival of rainfall after a long dry spell. It so happened that this operation was carried out after the onset of rains in Mwea. In such circumstances, the animals are especially vulnerable to any physiological stress that may affect their acid-base balances - such as being darted with immobilising drugs. After the death of the first three recumbent elephants, a decision was taken to revive the remaining three. However, two of them died a few days later.

The last two operations, carried out in June 1996, were the most successful in terms of time, handling and improvements to capture techniques. Prior to the actual operations, a "mock" translocation was done, enabling last-minute adjustments to technique and equipment to be incorporated. The fourth operation saw five elephants tranquilised, loaded and ready for transit to Tsavo in under five hours! The only bottleneck in the operation was the slow transfer of animals from "Hannibal" to the transportation containers/trucks and the long journeying time of 19 hours. However, even better organisation during the fifth operation saw the next five elephants darted and loaded within four hours and transportation time reduced to 15 hours.

CONCLUSIONS AND RECOMMENDATIONS

The primary objective of the translocation project was to reduce Mwea's elephant population by half. A total of 2 l elephants were removed from the population, 16 by translocation and 5 by dying during and after the third operation, representing a 44% reduction in population size.

The terrain of Mwea, comprising thick *Commiphora* bush and relatively steep slopes, presented major difficulties for darting and/or isolating the animals as well as for the manoeuverability of the heavy trucks. Although the operations improved with experience, "Hannibal" and the transportation trucks are obviously suited for open savanna-type vegetation and not for thick bushland/forested areas. It is recommended that translocation be confined to the latter regions and that alternative management interventions be sought for bushlands and forests.

Unpredictable behaviour of the family herds when confronted by the helicopter posed a number of challenges. Scattering of individual family members, failure to drive them to more open ground, or inaccessibility of an individual (such as the matriarch) often tempted organisers to dart any elephant or transport only those that were accessible. It has been shown that elephant calves under two years and those between two and five have a zero to 30% chance of survival without their mother (Lee, 1987). Hence at the very least, translocated juveniles and calves must be accompanied by an adult female. Death of elephants at the release site, within a two-year period, would defeat the purpose of a translocation.

Finally, it was demonstrated that team co-ordination, efficiency and morale are the basis of a successful translocation operation. If the capture crew is using new equipment or equipment which has not been in operation for some time, a "mock" test should be a standard undertaking as part of project preparations.

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ECHO OF THE ELEPHANTS: THE NEXT GENERATION*

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* This was a film presentation.

POTENTIAL IMPACT OF THE US ENDANGERED SPECIES ACT ON ELEPHANT MANAGEMENT AND CONSERVATION

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ABSTRACT

The African elephant is only one of 277 foreign mammalian species listed in the United States (US) Endangered Species Act (ESA) of 1973: The ESA is the principal legal conservation instrument in the US, but it is of special significance to all elephant range states in which sport-hunting of elephants supports community conservation and development programmes. It is through the ESA mechanism that the US allows or disallows the import of sport-hunted elephant trophies and thus controls the most lucrative foreign market for elephant hunting in the world: Several range states have been concerned for years about: the lack of transparency surrounding the implementation of the ESA, overlaps and contradictions with the Convention on International Trade in Endangered Species of Wild Fauna and flora, as well as the moral justification for the inclusion of foreign species in the domestic legislation of the US.

The US Congress began the process of re-authorisingthe ESA in 1994: This process creates opportunities for amendments or for the adoption of entirely new bills: The subsequent debate surrounding the ESA has led to major controversies and divisions within the US, reflecting philosophical and socio-economic differences between the western states dependent on natural resources and the urbanised and industrialised eastern states: The parallel with the usual "developed versus developing country" split on a global scale is obvious: The debate should be of considerable interest to other parts of the world, particularly where the example of the US approach to conservation is followed. There is an astounding depth of dissatisfaction within the US about the consequences of the ESA in terms of the erosion of property rights, the role of federal government, and the growing dissatisfaction with the financial, economic and social cost of species protection: The question of the impact of the ESA on foreign conservation programmes has been asked by southern African countries, where there is concern about the continuous threat posed by the ESA to the long-term future of community conservation programmes and to the principle of sustainable development:

OPTIONS FOR THE MANAGEMENT OF ELEPHANTS IN NORTHERN BOTSWANA

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INTRODUCTION

The northern region of Botswana (see map) contains one of the largest populations of elephants remaining in Africa. This population was estimated to be about l2,000 in the late l970s (Sommerlatte, l976) although this figure was believed to be an under-count (Work & Owen-Smith, 1986; Campbell, 1990). By 1994, the population had increased to over 70,000 (Said *et al.*, 1995) and was apparently expanding at a rate of 5% (Spinage, 1990; Calef, 1991a). An elephant hunting ban has been in place since 1983 (Campbell, 1990). Culling, poaching and human-elephant conflict have not been management factors and the demand for shooting elephants has been rare (Chadwick, 1991).

The elephant population is contained in a range of 80,000km^2 which includes about 18,247km^2 of the protected areas of Chobe National Park, Nxai Pan National Park and Moremi Game Reserve: The remaining areas fall within forest reserves and proposed Wildlife Management Areas. Elephant distribution during the dry season is restricted by the availability of surface water. During the hot, dry season, up to *75%* of the population may be confined within an area of 10,000 to 12,000km^2, mostly within 30km of the permanent water sources of the Kwando/ Linyanti and Chobe rivers (Craig, 1990; Calef, 1991a,b).

The impact which elephants have exerted, and continue to exert, in dry season concentration areas, has been a source of much concern (Child, 1968; Simpson, 1978; Sommerlatte, 1976; Moroka, 1984). The future of elephants in northern Botswana was debated (Hancock, 1990) but no management policies were adopted: Defining management policies to deal with the elephant over-abundance in Chobe is problematic because of the lack of scientific facts. Potential management options for the elephant population in northern Botswana, to reduce or contain severe impact on woodlands, may include one, or a combination of, (a) reduction culling, (b) culling directed at elephants in the age classes which cause the most damage, (c) stabilisation culling by removing the annual increment, (d) capture and translocation, (e) localised culling in areas associated with habitat degradation, (f) creation of elephant cropping zones adjacent to parks, (g) redistribution of elephants away from localities of concern, by disturbance culling, (h) alternative water provision, (i) creation of dispersal sinks and (j) non-interference.

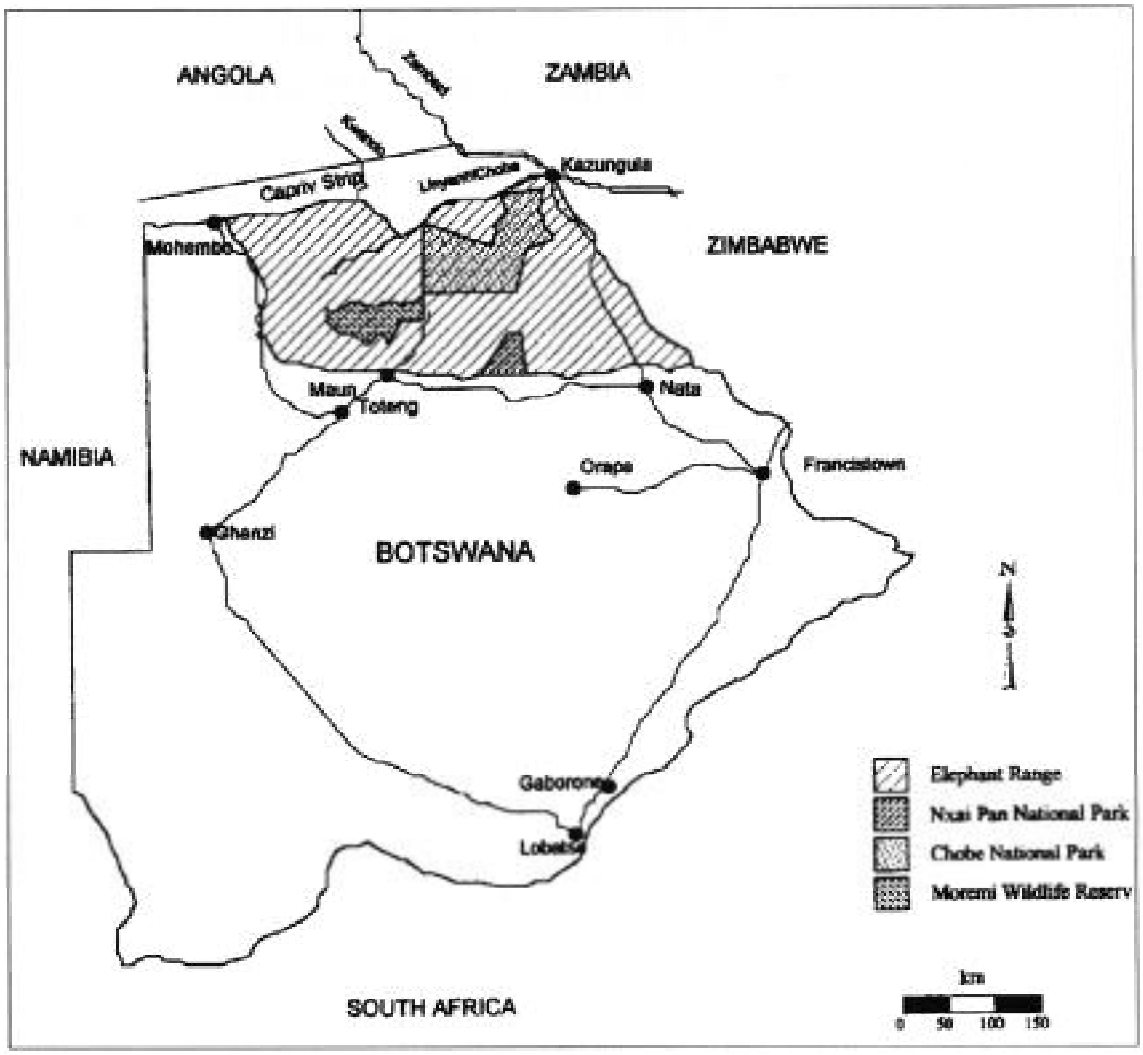
These management strategies were discussed in relation to the problem of elephant over-abundance in Ruaha National Park, Tanzania (Barnes, 1983), in Chobe National Park, Botswana (Work & Owen-Smith, 1986), in Zimbabwe (Martin & Conybeare, 1991), and more generally, by Owen-Smith (1988). We reconsider these alternatives for northern Botswana in the light of a recent three-year study on factors governing selective impacts of elephants on woody vegetation (Chafota, in prep.). There is still a lack of information to address some of the management strategies, but lessons learned from other conservation areas will be used as a guideline. It is emphasised that the effects of each management option adopted must be monitored and evaluated to check whether multiple objectives are met.

MANAGEMENT OPTIONS

Non-interference

The non-interference option entails allowing elephant populations to regulate themselves by natural density-dependent means. In northern Botswana, elephant numbers were reduced to low numbers by ivory hunting from the early 19th century to the late 1930s (Campbell, 1990). Thereafter, elephant numbers increased (Child, 1968; Campbell, 1990), facilitated by the creation of Chobe National Park in 1961 (Sommerlatte, 1976).

Legal hunting in northern Botswana ceased in 1983(Campbell, 1990) due to the low economic value



Map of Botswana showing elephant range and protected areas the northern region (based on Craig, 1990: Spinage, 1990: Calef, 1991a,b; Said et al., 1995).

of tusks, which were found to be small and fragile (Work & Owen-Smith, 1986; Seeletso, 1990). Since Botswana is sparsely populated by people, there has been neither much human-elephant conflict nor demand for shooting elephants by communal farmers (Work & Owen-Smith, 1986; Chadwick, 1991).

The impact of elephants on woody vegetation in northern Botswana was first reported by Child (1968) and later by Sommerlatte (1976), Simpson (1978), Moroka (1984), Coulson (1992) and Wackernagel (1993). Despite the concern shown by these researchers, no management action was taken. Although not explicitly stated, the chosen management option in Botswana has therefore been effectively one of non-interference. Fears associated with this approach are the possibility of irreversible habitat change and loss of biodiversity (Martin & Conybeare, 1992; Jones, 1993; Lindsay, 1993). Owen-Smith (l988) listed the concerns arising from vegetation changes induced by expanding mega-herbivore populations. These were: (a) radical modification of certain habitat types leading to perhaps the loss of species which depend upon them; (b) elimination of certain sensitive plant species; (c) reduced vegetation cover leading to accelerated erosion and decline in the overall productivity of the ecosystem; (d) depression of the resource base for mega-herbivore populations themselves and (e) loss of aesthetic features of landscape, such as mature trees.

Elephant-habitat interaction and regulatory mechanisms

Despite many years of elephant management, research and debate, the interaction between elephants and trees is still relatively poorly understood in ecological terms (Lindsay, 1990): Elephant populations have continued to increase despite vegetation changes which are perceived as adverse: Ultimately, food supply may limit populations, but not until the vegetation has been considerably altered. Time lags commonly arise when herbivore populations respond to changing resource supply, which may lead to oscillations rather than stability (Caughley, 1976). The response of elephants to nutritional deficiencies could be a progressive reduction in calf recruitment, as documented in Uganda (Laws, l 968) or catastrophic mortality as observed in Tsavo, Kenya (Corfield, 1973; Parker, 1983).

Lindsay (l990) suggested that an elephant population crash or irreversible vegetation change was unlikely in Botswana, although the conversion of woodlands to an open, patchy mosaic, might occur. For Hwange National Park, Zimbabwe, Conybeare (1991) concluded that vegetation change could be reversed if elephant numbers were reduced, otherwise there would be a progressive decline of tree density throughout the dry season range. In Chobe National Park, Botswana, elephants subsist largely on the shrubs *Baphia massaiensis, Bauhinia petersiana* and *Diplorrynchus condylocarpon* (Chafota, in prep:): Shrubs may show profuse regrowth following elephant use, as documented elsewhere by Jachmann and Bell (1985) and McShane (1989).

The range of the Botswana elephant population extends into Zimbabwe and Namibia, and possibly into Zambia and Angola (Lindsay, 1990; Said *et al.*, l995), although movement into the latter two countries still needs to be documented. Re-distribution is apparently occurring in response to changing food and water availability and protection from poaching, thus reducing the likelihood of localised population crashes:

Elephants have had a severe impact on canopy trees in localised zones near permanent water, for example, along parts of the Chobe river front (Child, 1968; Sommerlatte, 1976; Simpson, 1978; Moroka, 1984): Observations suggest that tree-felling may occur episodically in association with events such as droughts, frosts and fire (Chafota, in prep.). Accordingly, no local equilibrium between elephants and woodlands may be attained in these areas. Nevertheless, both elephants and trees may persist on a regional scale, provided that elephants are free to move. If movements are suppressed, a stage may be reached whereby one or a combination of factors may prevent recovery of woodlands (Dublin *et al.*, 1990).

Effects of vegetation impacts on wildlife species

The vegetation changes induced by high elephant densities may result in loss of habitat for other wildlife species. Of course, some species may benefit from the opening of woodlands. Species likely to be affected adversely are those dependent on closed woodlands or thickets, especially along river fronts. Simpson (1978) suggested that the destruction of riparian woodlands by elephants along the Chobe river would be detrimental for bushbuck *(Tragelaphus scriptus ornatus).* Addy (1993) confirmed that the bushbuck population had declined in the region most severely impacted by elephants. Nevertheless, indications were that bushbuck were not in danger of extinction because adequate cover remained in the form of woody species not favoured by elephants:

Reduction or stablisation culling

Culling has been justified as a cautious option by managers faced with uncertainty about the ecological consequences of the vegetation changes induced by elephants. However, this uncertainty cannot be resolved if elephant densities are held at low levels indefinitely. In Kruger National Park, vegetation changes perceived as detrimental have not been prevented despite placing a low ceiling on the elephant population (Viljoen, 1988).

The elephant management policy for Botswana which was recommended in 1990 was to maintain the population at its 1990 level by removing the annual increment (Seeletso, 1990; Lindsay, 1993). For several reasons, this policy was never implemented. Concerns were that (a) the 1990 population level was arbitrary and already high (over 60,000), (b) further vegetation change would still occur, and (c) the optimum number of elephants had not been established.

In northern Botswana, the following considerations must be taken into account before culling is implemented:

- Severe woodland destruction has already occurred along much of the Chobe river front, and would not be reversed unless local elephant densities were reduced drastically. Such action would adversely affect the attraction of Chobe National Park for tourists.

- The elephant population range extends across international boundaries. Elephants culled in Botswana may be replaced by elephants dispersing from Zimbabwe and Caprivi, or even further afield.

- The impacts of uncontrolled fires, frost, and droughts on the dynamics of woodlands may be as great as that of elephants, and more extensive. The regeneration stages of all woody species, including those which are utilised little by elephants (e.g. *Baikiaea plurijuga, Guibourtia coleosperma* and *Burkea africana),* are adversely affected by annual, recurring fires which spread over vast areas of northern Botswana.

- Sensitive woody species (notably *Berchemia discolor, Acacia erioloba, Acacia tortilis, Acacia nigrescens* and *Acacia luederitzii)* are restricted primarily to the riparian woodlands along the Chobe and Linyanti rivers. Justification for a large-scale cull, just to induce recovery of these tree species, is questionable.

- Localised culling could simply cause elephants to move elsewhere and exacerbate vegetation impacts in other regions.

- The economic and logistical issues associated with culling at the scale needed are huge. If poorly conducted, culling could have adverse consequences for Botswana's image and for tourism.

- Mature elephant bulls have a greater impact than cows on canopy trees (Chafota, in prep). However, destroying just adult bulls may result in adverse effects on breeding, age, sex distribution and social organisation of the population (Martin & Conybeare, 1992).

Elephant cropping adjacent to parks

Rather than being culled within national park boundaries, elephants could be harvested economically in the adjoining Wildlife Management Areas or on communally occupied land (Seeletso, 1990). Killing could be done by citizen hunting, safari hunting, or by organised rural communities living adjacent to these areas.

However, the disturbance associated with hunting or cropping may cause elephants to seek sanctuary within national park boundaries, thereby increasing pressure on the vegetation in the park. The number of elephants removed from the population through this means is likely to be much less than the annual increase.

Augmenting water supplies

Populations of water-dependent herbivores, like elephants, are limited by the amount of food accessible near water during the dry season. In the long term, the augmentation of water supplies would raise the ceiling which the elephant population could reach. Elephants staying away from river fronts because of the availability of dry season water elsewhere would eventually be replaced at the river front by increasing elephant sub-populations remaining dependent on the rivers for their dry season range.

Child (l968) recommended supplying water points on a rotational basis to reduce elephant concentrations in sensitive areas during the dry season. Sommerlatte (1976) suggested that water points needed to be placed in habitats resistent to elephant impact, such as *Baikiaea plurijuga* woodlands. Work and Owen-Smith (1986) pointed out that vegetation growing in such regions may have limited potential to recover, if severely damaged, because of low nutrient status of the soil. Water underlying nutrient-poor sand may be less attractive to elephants, because of its low mineral content (Weir, l972). By rotating the water points, vegetation damage merely spreads over a wider area.

Dispersal sinks

The dispersal sink (or vacuum zone) option was proposed by Owen-Smith (1974, 1981) initially for the management of the white rhino population in the Hluhluwe-Umfolozi Park in South Africa. It was later generalised for mega-herbivores, including elephants (Owen-Smith 1983, 1988). The concept is based on the observation of Laws (l968), that dispersal is the only mechanism which can adjust the population densities of long-lived animals to short-term fluctuations in resources. Accordingly, these species can reach density levels which exceed those supported by resources, if dispersal is prevented by fences, settlements, hunting or other boundary restrictions. This option avoids arbitrary assignment of permissible population levels within conservation areas. The expectation is that animals will disperse when resources in the core area become inadequate.

Dispersal sinks are created by removing all or most of the animals of the target species from designated zones, either within or adjoining the protected area. Ideally, these zones should encompass the extent of one to two

home ranges, i.e. perhaps 500 to 1,000km^2 for elephants. Animals settling within these "vacuum zones are culled periodically, by whatever means. Periods between culls within any one sink should be long enough so as not to condition animals to avoid these zones, i.e. perhaps five to ten year intervals for elephants.

Unless suitably placed, vacuum zones may not attract animals from the population core. Their effectiveness is questionable for mobile populations where animals do not occupy fixed home ranges, as may be the case for the Botswana elephants. The rate at which animals settle within vacuum zones may be inadequate to halt population growth, unless densities in the core area are sufficient to cause food-stress. Nevertheless, an important function of the sink areas would be to serve as a safety valve by providing an area which elephants can occupy during crisis periods, such as severe drought. Moreover, these areas also retain habitats unaffected by high elephant densities, thereby protecting animals and plant species sensitive to habitat changes induced by elephants.

CONCLUSIONS

It is evident that all management options are problematic. A policy of non-intervention is difficult to justify when the population range extends well beyond park boundaries, bringing elephants into conflict with people who occupy adjoining areas. With inhibitions on dispersal as a result of these settlements, elephants could attain densities high enough for severe vegetation degradation to spread over extensive areas. The persistence of other species may become threatened as a result.

We believe that the management authority should employ a combination of actions. Utilisation of surplus elephants outside park boundaries by local people, by acceptable means, should be encouraged. Disturbance culling may be required to alleviate pressure on sensitive habitats where rare plants or animals are threatened. Areas adjoining parks where elephants are exploited commercially could serve as dispersal sinks. The frequency of cropping and the methods used would need to be controlled, so as not to drive elephants back into the park area. Within park boundaries, and perhaps in parts of the adjoining range, the elephant population should be left unculled, so that tourists continue to experience impressive concentrations of relaxed elephants. Additional water points could be used to increase the area attractive to tourists during the dry season, provided these are placed sensitively. Water could also be used to draw elephants into dispersal sinks or other areas outside parks where animals are exploited economically. An effective fire management policy should be part of the strategy to control elephant distributions.

The overall objectives for management of the elephant population must be clearly stated, and a system of monitoring and evaluation put in place to check whether the objectives are being met. Severe vegetation impacts must be accepted as inevitable in some part of the elephant range. The distribution and extent of habitat transformation may need to be controlled to ensure that biological diversity is not sacrificed.

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SESSION TITLE: DISCUSSION ON REPORT BY DUBLIN, MILLIKEN AND BARNES *Four Years After the CITES Ban: Illegal Killing of Elephants, Ivory Trade and Stockpiles*

Chair: Brian Huntley
Rapporteurs: Ruth Chunge, Lamine Sebogo

Of the members who answered a questionnaire at the close of the meeting, the majority requested that the minutes of this session should not be published.

SESSION TITLE: NATIONAL, REGIONAL, CONTINENTAL AND INTERNATIONAL NEWS AND VIEWS

Chairs: Holly Dublin, Bihini Won wa Musiti
Rapporteurs: Lamine Sebogo, Andrea Turkalo

During this session, updates were given on the status of the African Elephant Database and the African ElephantBibliography, as well as country reports from each region.

SESSION TITLE: THE NEW IUCN LISTING CRITERIA

Chairs: Simon Stuart, Nigel Leader-Williams
Rapporteurs: Ian Whyte, Kadzo Kangwana

INTRODUCTION

The IUCN Red Listing system has changed completely since the last list was compiled in 1994. The African elephant was listed as "Vulnerable" under the old system, but had to be re-evaluated with the new listing system (IUCN Species Survival Commission, 1994). Eight categories are listed in the new system. They are" "Extinct" (EX), "Extinct in the Wild" (EW), "Critically Endangered" (CE), "Endangered" (EN), "Vulnerable" (VU), "Lower Risk" (LR), "Data Deficient" (DD) and "Not Evaluated" (NE).

The new IUCN Red List categorisation of the African elephant was discussed on Tuesday 6 February 1996 at a plenary session. The session was chaired by Simon Stuart. Consensus of all the issues was not achieved during the session and a working group chaired by Niger Leader-Williams was tasked with finalising the categorisation that evening. Other persons in this working group were Colin Craig, lain Douglas-Hamilton, Marion Garai, Amar Inamdar, Kadzo Kangwana, Malan Lindeque, Cynthia Moss, Steve Njumbi and Ian Whyte.

CRITERIA FOR CATEGORISATION

Under the new listing system, the categorisation of any species can be conducted on any one of the following three criteria:

1. Indices of abundance
2. Reduction in the area of occupancy
3. Levels of exploitation

As indices of abundance existed for most of the range states (Burrill & Douglas-Hamilton, 1987, Cumming *et al.,*1990, Douglas-Hamilton, 1977-1979, Douglas-Hamilton *et al.,* 1992, Said *et al.,* 1995), these were used for the basis of the categorisation.

The categories EX, EW, DD and NE are clearly not applicable to the African elephant and it thus falls in to one of the other four categories. The categorisation is dependant upon the percentage reduction of the population over the last ten years or three generations (see below), whichever is longer. While it is accepted that some regional populations would qualify as "Lower Risk", IUCN is still in the process of developing guidelines for use of national Red List categories (IUCN Species Survival Commission, 1994 page 8); the listing requires global consideration, and as this trend has been downward the discussion was to decide whether this species falls in CE, EN, VU or LR.

For a species or taxon to be categorised as CE, there should have been an observed, estimated, inferred or suspected reduction of at least 80% of the population over the past ten years or three generations, whichever is longer.

For a species or taxon to be categorised as EN, there should have been an observed, estimated, inferred reduction of at least 50% of the population over the past ten years or three generations, whichever is longer.

For a species or taxon to be categorised as VU, there should have been an observed, estimated, inferred or suspected reduction of at least 20% of the population over the past ten years or three generations, whichever is the longer.

A species or taxon is LR when it has been evaluated and does not satisfy the criteria for any of the above categories.

GENERATION TIME

In terms of the definition provided by the IUCN Species Survival Commission, (1994), a generation is considered to be "the average age of parents in the population". This is greater than the age at first breeding. As no data were immediately available, a generation for elephants was subjectively estimated by Group members to be about 20 years, or 60 years for three generations (a later calculation on all the adult female elephants (n=385) randomly culled in the Kruger National Park during 1989, 1990, l 991, and 1992 yielded a generation time of 26.3 years (I.J. Whyte, own data).

POPULATION TRENDS AND THE "MOVING WINDOW"

An apparently unique problem with the categorisation of elephants is that during the past three generations, the population was known to increase initially but then to decrease dramatically due to the illegal killing of these animals for their ivory. This creates difficulty in interpreting the trend over the past three generations. A special option was thus agreed to by the IUCN for elephants - any period equivalent to three generations (60 years) could be used. The choice can be either:

l. The trend over the past 60 years
2. The expected trend over the next 60 years
3. Any period of 60 consecutive years between the above two extremes

There was general agreement that the continental population had increased to a "consensus" high point of 1.1 million in 1981 (Cumming & Jackson, 1984) and that the present level was 0.52 l million. This included all total counts, sample counts, dung counts and "informed guesses" in the 1995 African Elephant Database (Said *et al.*, 1995), but excluded "speculations". It was further agreed (with cautious hope) that with the current Appendix l CITES listing, the population was not expected to decline much below this point until 2040 (the remainder of the 60 year-period after 1981). The calculated percentage decline is therefore:

$$\frac{\text{1981 total - l995 total}}{\text{1981 total}} \times \frac{100}{\text{l}} = \frac{\text{1.100.000-521.000}}{\text{1,100,000}} \times \frac{100}{\text{1}} = -52.6\%$$

The estimated decline of the continental population falls between 50% and 80% and thus the African elephant must be considered "Endangered" due to an estimated reduction of the population of at least 50% over the past three generations, based on indices of abundance appropriate to the taxon.

The working group therefore proposed to the AfESG membership that the African Elephant's IUCN Red List Categorisation should be: ***(EN) A.I. (b).***

This categorisation was accepted by the AfESG during a plenary session of their meeting on 7 February 1996.

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SESSION TITLE: NATIONAL, REGIONAL AND CONTINENTAL ISSUES OF CONCERN

Chairs: Russell Taylor, Dominique NSosso
Rapporteur: Loki Osborn

CAPITAL CITY ARTISAN MARKETS IN AFRICA AND THEIR IMPACT ON ELEPHANTS: A CASE STUDY FROM THE REPUBLIC OF CONGO

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ABSTRACT

A study was conducted in the Marché de Plateau in Brazzaville, Congo, which is the largest artisans' retail market-place for wood, stone, metal and ivory in the Congo. Three data sets were collected during the study.

1) Four retailers were monitored over a one-year period from September 1994 - September 1995, with totals of over 300 observation days per retailer. Data were collected on every client that passed the stand of the retailers, and included the purchases, the prices paid, the buyer's nationality and occupation. 2) A taxonomy was developed for all ivory items sold in the market. A large sample size of weights was obtained for each taxonomic type. 3) A complete inventory of the ivory sold and its quantity was made monthly throughout the market. Results showed that citizens of at least 60 nations purchased ivory during the study period and tons of ivory are sold at this market annually. Nationals of France, Senegal, Congo and the ex. Soviet States (mostly Russia) were particularly frequent clients. Based on the quantity per client, and through interviews, it is evident that most French purchase ivory either as gifts or for personal use. The three other major purchasers are wholesalers who hand-carry items to Europe and West Africa for sale, or ship their merchandise through the diplomatic pouch. There is evidence that the level of ivory sold in the Plateau market has increased significantly in the past three years. There has been an accompanying increase in the level of poaching of elephants in Congo.

SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

The idea for this study arose from conversations with Tom Milliken about the carving of ivory in central and west African markets and the impact of this trade market on elephant populations.

A very open tourist trade exists in all the central and west African capital cities. However, this trade has never been quantified and is largely uncontrolled. After the (CITES) ban there was a drop in sales of ivory but there has been a dramatic increase in the last two years.

In order to find out how much ivory was being sold, two assistants, posing as students, monitored the trade of four ivory sellers (they each monitored two) in the main Brazzaville market. They worked with the sellers for one year (365 data days) to monitor the amount of ivory being moved and to whom it was being sold. They documented every piece of ivory which they saw being sold.

A total of 1,178 people bought 683kg of ivory. The majority of buyers were from the neighbouring African states, for re-sale, followed by tourists from Europe, Asia and the Middle East. North Africans (especially Algerians) bought the largest average weight of ivory per client, while the French constituted the biggest number of clients, buying a total of 322 pieces.

The origin of the ivory was not discovered but the volume is significant when all markets in the region are considered. The author asks "what happened to the ivory ban?".

MONITORING THE IVORY TRADE AND IVORY STOCKS IN THE POST-CITES BAN PERIOD

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SUMMARY OF PRESENTATION

Ivory trade developments in the post-CITES ban era are being assessed by TRAFFIC. The two major objectives are: 1) to identify and monitor the accumulation of ivory stocks, and 2) to develop a database of all ivory seizures, the so-called Bad Ivory Database System (BIDS).

Concerted efforts have been made by TRAFFIC to register and mark legally-held ivory stocks in compliance with CITES regulations. So far, TRAFFIC has worked in Sudan, Ethiopia, Tanzania, Uganda, Zambia and Malawi, and documented ivory in many other countries. Data collected so far from 16 countries show a total of 380 tonnes, but there are no data for 16 range states. Altogether, it is estimated that there are about 500 tonnes of ivory in Africa. Kenya and Zambia have burnt stocks. The largest stocks are in Burundi (86 tonnes), South Africa (69 tonnes), Tanzania (52 tonnes) and Sudan (46 tonnes). Sudan's stocks are largely held in the private sector and they have lost 15% of their weight since they were first registered in l988, due to the arid climate. West and central African countries have poorly recorded, poorly controlled stocks. Most ivory accruing to governments in these regions seems to be sold in local markets, which is ironic given the West and central African support for the CITES trade ban.

TRAFFIC believes that the existence of growing stocks is a measure of accountability, good management and law enforcement practices. In general, countries which are successful on this score have growing ivory stocks. Southern Africa has the best managed and fastest growing ivory stocks. Most countries still view ivory stocks as assets and protect them, though thefts have occurred in a number of countries.

Before the ban, information about the ivory trade came from official trade statistics. Now, because the trade has gone underground, these data are no longer useful so TRAFFIC has developed BIDS in an attempt to use law enforcement records to monitor the illegal trade in ivory. More than 2,700 seizures since 1989 have been documented in BIDS. Because newspaper reports are often inaccurate, TRAFFIC strives to obtain data from primary sources such as customs, police or wildlife department investigation units.

BIDS data indicate that trade volumes are down, but the critical issue to assess is that of trends. Other developments suggested by the BIDS data are an increase in Asian-run, Africa-based processing operations to produce blank name seals for export to Asia. Prior to the ban, only two such operations were identified; now they seem to exist in 12 countries. It is much more difficult to track the trade in small, worked ivory pieces leaving the continent now, rather than raw tusks as before. The decline in ivory prices may be contributing to an increase in African processing as high-wastage operations are still profitable. This trade development needs to be watch closely.

SURVEYING CROSS-BORDER ELEPHANT POPULATIONS IN SOUTHERN AFRICA

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SUMMARY OF PRESENTATION

Proposals to downlist and manage southern African elephants have prompted criticism of the population estimates, particularly on the grounds that populations which cross international borders have not been surveyed as a unit.

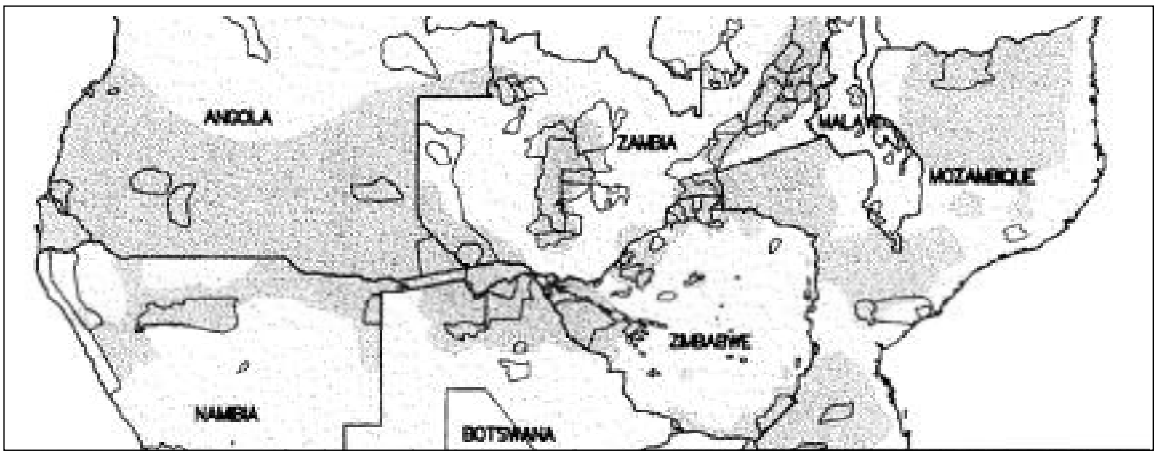
Census methods assume that everything is counted simultaneously so that animals within the sample will not be missed and none will be counted twice. Some violation of this assumption is inevitable but it becomes a serious problem if parts of the same population are estimated by surveys separated by weeks or months, as could happen with populations divided by international boundaries.

Mindful of this potential source of error in their elephant estimates, southern African wildlife management authorities conceived the ELESMAP project to improve the level of co-ordination among southern African states. Under this initiative Namibia, Botswana, Zimbabwe and Malawi receive European Union funding. South Africa is not funded but is associated with the project.

The key cross-border population in the region, numbering over l00,000 elephants, is found in the area comprising north-west Zimbabwe, northern Botswana and parts of the Caprivi strip in Namibia (see map below). It is the largest single contiguous population in Africa and proper co-ordination of surveys of its national components is critical.

Co-ordinated surveys of this population carried out in the dry seasons of 1994 and 1995 demonstrated the usefulness and necessity of international co-operation. The population was surveyed by systematic reconnaissance flights over Botswana and Namibia's Caprivi strip at the same time as the adjacent part of Zimbabwe. The agencies involved standardised methods to permit the combination of results, and improved them where necessary to conform to the standards of information required by the African Elephant Database. The planning and analysis has been automated and a database of results has been set up under the ELESMAP project.

It was clear from the results that the main cross-border survey problem is along the Namibia/Botswana international border which cuts straight through the main population concentrations. Simultaneous surveys in this area are therefore vital. It is envisaged that this co-operation will continue indefinitely even after termination of the ELESMAP project.



REVIEW OF AFRICAN ELEPHANT CONSERVATION PRIORITIES*

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* An introduction to this session was given by Simon Stuart, Head, Species Survival Programme, Gland, Switzerland

SUMMARY OF PRESENTATION COMPILED FROM RAPPORTEUR NOTES

A series of action plans - about 30 - have been published by IUCN's Species Survival Commission in the last ten years, for use by governments, non-governmental organisations, etc. In 1993, the United Nations Development Programme established the elephant and rhinoceros conservation facility to find funds for conserving of these animals. In 1995 the Asian Rhino, Asian Elephant, African Rhino and African Elephant Specialist Groups were pledged funding by the facility for specific tasks, including the production of updated action plans where necessary. The AfESG's task is to create a document reviewing African elephant conservation priorities, rather than producing another action plan. This document, now in draft format, is being presented to the AfESG members at the meeting for comment and correction.

The draft document differs considerably from previous documents overviewing African elephant conservation (e.g. African Elephant Action Plan [Douglas-Hamilton, 1979]; Africa's Elephants and Rhinos: Status Survey and Conservation Action Plan [Cumming *et al.,* 1990]; African Elephant Conservation Coordinating Group [AECCG] country action plans [early 1990s], etc.). The report is divided into five sections, which deal with: poaching, law enforcement and the ivory trade; habitat loss and human encroachment; local overpopulation (little data exist on the impact of large elephant populations); human-elephant conflict; and status (how much information do we need to manage elephants?). It is noteworthy that in recent years, attention has been focused more on human-elephant conflict (rather than poaching) and forest elephant populations (rather than savanna populations).

Some of the questions posed to the AfESG members to assist them in consideration of the document during working group discussions were as follows:

Is it worthwhile naming "key" populations? Previously, much emphasis has been given to "key", "baseline" or "priority" populations. But what is a "key" population? All previous action plans had different definitions. How do we determine the biological importance of different populations - by population size, area of range, ecological uniqueness, the "keystone" effect on important ecosystems - or what? Does population size determine stability? What is the intrinsic importance (scientific/cultural/ economic) of a population? What is important for conservation action? Which populations are under threat? What is the chance of effective action?

One day of the meeting was devoted to reviewing the draft chapters in five working groups in a session entitled: African Elephant Conservation Priorities. This document is still in the process of being completed.

REVIEW OF THE AFRICAN WILDLIFE AND PROTECTED AREA PROJECTS DATABASE

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SUMMARY OF PRESENTATION COMPILED FROM RAPPORTEUR NOTES

In 1991, 33 conservation action plans were drawn up, presenting a total of 400 projects requiring $300 million to carry out. The action plans were used for dialogue between range states and potential donors. A great deal of interest in the plans was shown by donors after the (ClTES) ivory trade ban but very little of the money promised to several range states was actually delivered, leading to general disillusionment.

This current project is an assessment of donor funding since January 1992. The specific objectives of the project are to:

1 .Assess the current level of support being given by donors

2. Set up a database for projects

3. Give feedback to range states on what donors have funded

4. Look at the state of proposed funding versus actual funding

SESSION TITLE: REVIEW OF SOUTH AFRICA'S ELEPHANT MANAGEMENT POLICY, WITH SPECIAL REFERENCE TO KRUGER NATIONAL PARK

Chair: Holly Dublin

Rapporteurs: **Krnger** National Park personnel

The proceedings of this session are being prepared for publication elsewhere by the National Parks Board, South Africa.

SESSION TITLE: MANAGING ELEPHANTS INSIDE AND OUTSIDE PROTECTED AREAS

Chair: Eric Edroma
Rapporteurs: Steve Njumbi, Richard Hoare

LAW ENFORCEMENT WITHIN PROTECTED AREAS

Bruce Bryden
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SUMMARY OF PRESENTATION COMPILED FROM RAPPORTEUR NOTES

In southern Africa, elephants and rhinos occupy the same habitat. Therefore, joint security operations of the two species have been implemented under the auspices of the Rhino and Elephant Management Security committee. The committee's membership comprises representatives and owners, law enforcement officials and investigation officers, whose overall mission statement is to promote the security of rhinos and elephants in southern Africa.

The committee is at an advanced stage of seeking formal government approval for its operations, which follow a well elaborated "eight point counter-poaching model" detailing what has to be done when there is a problem. The committee is also involved in seeking funds from non-governmental organisations for its activities and to train staff. The latter need is of major concern, with motivation of personnel being seen as crucial for achieving the security goals.

With regard to elephant poaching in southern Africa, the incidence of poaching has been low and sporadic except during the years 1981-1985 when a sharp increase was experienced. This period coincided with the demobilisation of over 70,000 troops in Mozambique and subsequent reports of marauding, armed "gangs" along the eastern border of Kruger National Park. Major training and anti-poaching operations were thus mounted and the situation had been contained by 1986. In contrast, whereas rhino-poaching mortalities were minimal in the l 980s, they have increased in the (post-ClTES ban) period since 1989.

ELEPHANT TRANSLOCATIONS

Clem Coetsee
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SUMMARY OF PRESENTATION COMPILED FROM RAPPORTEUR NOTES*

*This presentation was accompanied by a video-taped film

The presentation focused on the techniques used for the mass capture of elephants, which were first developed and tested in Zimbabwe in l993. Additional trials have since taken place in South Africa and Kenya.

During l 993, 670 elephants in family units were moved from Gonarezhou National Park in Zimbabwe. 470 of the elephants were translocated to large conservation areas within Zimbabwe and the remaining

200 were transported to the Madikwe Reserve in South Africa.

During the 1993 operation, a Hughes 300 helicopter was used to facilitate a search of the area in order to identify suitably-sized herds which could be moved with the available transport. Once selected, the elephants were ushered slowly, using the helicopter, towards an access road where the capture team was on standby with all the equipment. Darting commenced when the animals had moved to within a short distance of the ground team.

The matriarch, whenever possible, was the first in a herd to be darted, followed by any remaining adults. During the darting operation, the herd was guided continuously towards the road. The matriarch (being the first to be darted) was usually the first to "drop" and it was observed that the rest of the group stayed near her.

Of the 670 animals captured, 12 (1.8%) died. The main cause of mortality was suffocation by restriction of the trunk, either by an elephant falling on its own trunk or by another elephant lying on top of it.

Haloperidol (40 to l 20mg depending on body size) was used as a tranquiliser during transport. In addition, Azaperone (50-200mg) was often administered to avoid aggression. Trilifon (100-300mg) was administered to keep the animals calm after their release into bomas.

The Zimbabwe exercise proved that elephant herds can be successfully captured and translocated over long distances. This technology gives wildlife managers an additional option for elephant management, although it may not replace culling entirely.

ELEPHANT POPULATION CONTROL IN AFRICAN NATIONAL PARKS

Roy G. Bengis
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INTRODUCTION

The African elephant is an extremely intelligent and adaptable species which, along with its resistance to drought and most diseases, as well as its lack of natural enemies (except man), has become a highly successful and competitive inhabitant of African savannas, woodlands, tropical forests and even deserts. From time to time, usually as a result of conflict with man's interests in the shrinking, available habitat, the need to reduce certain elephant populations is perceived as a short-term or temporary solution to a long-term problem. Caughley (1977) defines population control as "the treatment of a population that is too dense, or which has an unacceptably high rate of increase, to stabilise or reduce its density". Hanks (1979) commented on the reluctance of biologists to use the word "kill". Words such as "cropping" and "culling" have therefore come to be synonymous with killing of wildlife for management purposes. "Cropping" however has a "sustained yield" connotation, which is not what most wildlife biologists have in mind in national parks. "Culling" on the other hand, implies selective killing to remove some undesirable or inferior trait in a given population. This does not reflect on non-selective, random killing of animals as is practised in most protected areas where population reduction without any change in population structure is desired. This paper will deal with techniques (both past and current) used by conservation agencies in Africa to kill and process elephants as part of a population control strategy in areas where they have become a problem to man, or to the available habitat.

BACKGROUND

Elephants in Africa have been hunted by man for millennia, and certain tribes even specialised in this activity (e.g. the Liangulu), but human population densities were low and the available elephant habitat was enormous, which resulted in minimal conflict between these two species. During the early colonial era, human population densities increased and elephant habitat decreased resulting in conflict situations which were usually solved by destruction of the offending animals by civil servants of the administration or by hunters contracted for the job. Many accounts from this era have been written describing crop-raiding and "rogue" elephants. During the first 50 years of the twentieth century, conflict between man and elephants increased as human populations expanded further, and once again it was the task of game department personnel or contracted hunters to shoot the problem animals. In some areas of East Africa, conflict reached such proportions that "elephant control officers" were appointed by certain conservation departments to shoot problem elephants as well as to reduce elephant populations in general in an identified area. These were, in fact, the first true elephant "culling" operations. In post-colonial Africa, human populations increased at an unprecedented rate, and with the accompanying expansion of human activities, elephant distribution became restricted to national parks and game reserves, as well as sub-economic agricultural areas and tsetse fly belts. Thus the range available to elephants has decreased dramatically, and within the smaller, often fenced, areas, elephant population densities have reached levels which are perceived to have a negative impact on vegetation and biodiversity in general. This has given rise to elephant population control programmes in certain protected areas in southern and eastern Africa during the past few decades.

ELEPHANT CONTROL

Elephant control operations can be divided into four distinct steps (De Vos *et al.*, 1983), namely:

1 . Research, including habitat monitoring and aerial censuses to establish control quotas.

2. The field killing phase.

3. The field clearing-up operation.

4. Processing and disposal of products.

FORMULATION OF CONTROL METHODS

Ecological considerations

The objective of a control programme is to stabilise populations of elephants at densities which can be sustained without retrogressive changes in habitat and biodiversity through the full spectrum of climatic extremes. Habitat and population monitoring are an integral part of decision making and certain limits to acceptable change must be set. Also, in the event that a "culling" option is decided upon, it is important to create the necessary infrastructure to remove the carcasses from the field to prevent abnormal and unnatural population build-up of predators, scavengers and blow-flies.

Ethical considerations

The decision to kill elephants is not an easy one, being highly emotive and sensitive. Once the decision has been made, the most important consideration is that the most humane killing method possible should be used, so as to ensure the minimal amount of stress and suffering to the animals. At the same time, risk assessment of possible injury to officials and the public must be brought into the equation. The total annihilation of a targeted family group or unit is considered more humane than the piecemeal selection of individuals out of different family groups. Finally, it would be unethical to let carcasses rot in the field, whilst protein deficiency remains a grave issue amongst Africa's fast-expanding human populations.

Veterinary and public health considerations

The veterinary and public health considerations revolve around risk assessment with regards to the possible presence of endemic infectious animal disease producing agents or potential zoonoses in contaminated elephant products. The only two diseases that have been identified to date which occur naturally in free-ranging elephants and which may have animal health implications for domestic stock and other wild animals, as well as having zoonotic potential, are Anthrax and viral encephalitis/myocarditis. Tuberculosis has been described in captive zoo elephants, and also in several free-ranging ungulates, and intensive meat inspection for this disease should always be undertaken. Another consideration, where chemical agents are used to immobilise the elephants prior to them being killed, is that the residues or metabolites from such agents are safe for human consumption.

Economic considerations

It is also important that any population reduction exercise should, if possible, be economically viable and not a financial drain on the resources of the conservation agency involved. To this end, the animal products generated by the population control exercise should be processed in such a way that they can be sold commercially to offset the considerable investment in equipment and manpower.

ELEPHANT KILLING TECHNIQUES

The Zimbabwe technique

This technique involves stalking a group of elephants on foot by a group of four to six marksmen. Most of the marksmen are armed with semi-automatic assault rifles of 7,62mm calibre, which have large magazine capacities, and only "hard ball" full metal jacketed ammunition is used. One or two of the marksmen are armed with heavy calibre rifles using steel jacketed or monolithic solid bullets, and they function as an emergency stopper group. The elephants are approached from downwind and when the marksmen are correctly positioned in close proximity to the elephants (l0-30m), they open fire with the semi-automatic rifles, aiming for the animals' brains, and frequently killing the matriarch first. The stopper group is there to shoot any adult bulls or very large cows that may be present in the group, as well as any other elephants that attempt to escape from the killing ground. Occasionally alight, fixed-wing aircraft may be used to locate the elephants or even drive them in the direction of the ambushing marksmen. With experienced marksmen, this technique is highly efficient and frequently 10 to 20 animals may be killed in less that two minutes.

The carcasses are then processed in situ or in the nearby vicinity. The meat is cut into thin strips and smoked or salted on locally constructed drying racks. The skin panels are salted and dried and the ivory extracted, cleaned and dried. This whole processing activity is highly labour intensive, requiring little mechanical infrastructure and making use of locally available resources.

The East African technique

This technique was used mainly in Uganda. and was essentially the same as the Zimbabwe technique ex

cept a helicopter was usually used to herd the elephants to the killing ground where the marksmen were waiting in ambush. The helicopter was also used as a backup to follow and kill any escaping or wounded elephants, which was rarely necessary.

The South African technique

This technique was developed in the Kruger National Park, and was subsequently also used in Namibia (Etosha). By this method, elephants are located during a helicopter reconnaissance flight, and the ground team, together with carcass retrieval vehicles, are vectored to the proximity of the identified potential killing ground. Three different techniques have been used to date for the actual killing phase:-

a) The elephants are herded to the chosen killing ground, and are then darted with paralysing doses of the muscle relaxant, Succinyl dicholine chloride (Scoline). This drug is used because it is composed of biochemical constituents normally found in mammalian metabolic pathways, namely succinic acid and choline, which renders the carcass fit for human consumption and has been approved by the Chief Veterinary Public Health Officer in Pretoria. During the darting phase, the helicopter continuously circles and herds the elephants, keeping them within the confines of the identified killing zone until they are immobilised. As soon as the last elephant has gone down, the ground crew move in and a marksman quickly dispatches each elephant with a well-aimed brain shot. The elephants' throats are then cut, to facilitate exanguination, and thereafter each carcass is eviscerated and inspected, then loaded onto a vehicle for transport to the centralised abattoir for further processing. Physiological research has demonstrated that this technique is highly stressful and therefore inhumane.

b) The second technique is basically a modification of the first technique described, but in order to attempt to reduce the stress experienced by the animals, they are brain shot out of the helicopter as soon as the Scoline has immobilised them. Although an improvement, this technique still has shortcomings, and delays are experienced before the delivering of the coup de grace, especially when the culling operation is combined with a capture operation.
c) The third technique, which is the technique currently used, is to do away with Scoline completely, and to brain shoot the elephants out of the helicopter while they are being herded in the killing ground. By shooting the matriarch first, the rest of family group become anchored and confused, facilitating the rapid and humane killing of the entire group. There has also been a move away from combining a capture operation involving young members of the group with the culling of adult animals.

At the abattoir, the elephants are skinned in panels, the head and feet are removed, and the meat is deboned and hung in cool rooms. Forty-eight hours later some of the meat is cut into strips and immersed in a pickling brine for a further 24 hours. Thereafter the meat strips are hung in forced convection drying rooms, and made into biltong. Those cuts of meat not suitable for biltong production are cut into blocks, cooked and canned as a form of "braised steak" in gravy. There is also a small demand for raw elephant mince.

The elephant skin panels, after being cured in salt and sodium fluorosilicate solution, are stacked and dried and then are ready to be sold.

The ivory is cleaned, immersed in 10% formalin for 48 hours and then dried and stockpiled in a large strongroom.

ALTERNATIVES TO KILLING

In 1982, when research carried out in the Kruger National Park demonstrated definitely that elephants are not susceptible to foot and mouth disease, and that it was highly unlikely that they played any role in the epidemiology of this dreaded disease, the Directorate of Veterinary Services gave the "green light" for elephants to be translocated out of Kruger. In the following 13 years, more than l,000 juvenile elephants have been successfully translocated out of the park into provincial game reserves and onto private land. In the past two years, techniques have also been developed to capture and translocate entire breeding herds. Unfortunately, areas of suitable habitat with adequate size are dwindling and the local market for live elephants is almost saturated. These translocated meta-populations of elephants will, in years to come, confront us with the same dilemma when they breed and outgrow the available habitat.

A second future option which still needs thorough research is the possibility of elephant contraception. This option should only be considered if a safe, reversible method is developed, and after adequate behavioural studies have been undertaken in a pilot project.

In conclusion, the culling of elephants is a very emotive issue because these magnificent creatures are

highly intelligent, have a high profile internationally and are being progressively decimated in many parts of Africa where financial constraints, conflict with man, corruption of officials, and civil unrest all mitigate against their protection. Nevertheless, in several southern African countries, conservation efforts have been so successful that elephant populations in certain confined areas are damaging habitats, causing biodiversity loss. This problem must be addressed no matter how unpalatable, and the methods employed must be humane, non-wasteful, and ecologically sound.

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DISCUSSION COMPILED FROM RAPPORTEUR NOTES

Comment: TRAFFIC will publish a document on the elephant hide trade (of South Africa and Zimbabwe l 986- l 989) in l 996. Sales from hides by the National Parks Board, South Africa, amounted to US$ l,700,000 during this period. There is no evidence of any current poaching for hides (probably because they are very heavy and perishable).

Question: What is the cost of culling to Kruger National Park?

Answer: With the meat sales, we barely break even.

Question: Is the ivory stockpiled?

Answer: Yes. Since the ban on culling operations, South Africa has experienced a deficit of US$200-300,000. Hide sales would easily cover this deficit.

DEVELOPMENTS WITH HORMONAL CONTRACEPTIVES FOR ELEPHANTS

Rudi van Aarde

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SUMMARY OF PRESENTATION COMPILED FROM RAPPORTEUR NOTES

The research for a hormonal contraceptive started in response to the objections raised against culling of elephants.

It is evident that the elephant has a unique endocrine reproductive system. There are many factors which maintain pregnancy in an elephant - not just progesterone production. In fact, the level of progesterone is very low in elephants and perhaps it is less essential during pregnancy than initially expected. The female elephant produces chemical substances throughout her pregnancy which are only produced in a horse in the final three weeks of pregnancy. The whole reproductive process needs to be better understood.

The research programme includes the study of: biochemical correlates, interactions between steroids and receptors in the elephant; and techniques to interfere with the receptor mechanism. A receptor for progesterone in the elephant has been identified, and norethindrone and levornorgestral show some potential as anti-progesterones. The human drug RU486 is of no use in elephants.

During the programme 29 out of 34,000 possible blockers of receptors have now been screened.

DEVELOPMENTS WITH IMMUNOCONTRACEPTIVES FOR ELEPHANTS

Cobus Raath
Kruger National Park, Private Bag X402, Skukuza 1350, South Africa
on behalf of Dr. H. Bertschinger, Department of Theriogenology, Faculty of Veterinary Medicine, Pretoria University, Private Bag X04, Onderstepoorte 0100, South Africa

SUMMARY OF PRESENTATION AND DISCUSSION COMPILED FROM RAPPORTEUR NOTES

The ideal immunocontraceptive control agent combines an antigen with an adjuvant in a vaccine which produces antibodies that render sperm incapable of penetrating eggs. This is not a new concept, and the technique has been used in over 90 mammal species so far. The antigen is derived from pig ovaries (zona pellucida proteins, isolated and purified). An adjuvant is added to increase the antigenicity. Delivery of the vaccine is accomplished by darts or "biobullets". The administration of three vaccinations in a horse provides protection for three years. Only fertilisation is inhibited and there is no behavioural change.

Four phases have been planned in the research programme to develop an immunocontraceptive for elephants, with the following objectives:

Phase 1: To prove the effectiveness of the vaccine in the elephant. Research to date shows that there is homology between pig and elephant zona pellucida, which is promising.

Phase 2: To test the vaccine in zoo elephants and establish the dose and other requirements. Trials are now ongoing.

Phase 3: To try the vaccine in 20 to 30 elephant cows in Kruger National Park for about five years. The animals will be fitted with radiocollars to track their movements.

Phase 4: To implement the vaccine on a wider scale, once a clear plan for the desired population (in Kruger) is established.

DISCUSSION

Question: Why not sterilise females over 40 or delay puberty in young females?

Answer: This would pose logistical problems in large populations but may have potential in small, relocated populations. It is possible that behavioural changes could occur as a result of repeating cycles and no pregnancy.

Comment: There is recent evidence that total destruction of all ovarian tissues occurs as a side effect (to immunocontraception), and other species may develop mammary cancer.

PROBLEMATIQUE DE GESTION DE L'ELEPHANT ET PERSPECTIVES DES FORETS D'AFRIQUE CENTRALE

Bihini Won wa Musiti
IUCN, BP 244, Brazzaville, Congo

INTRODUCTION

Les éléphants représentent une importante ressource à la fois à l'échelle régionale et continentale. Ils se repartissent dans les forêts de tous les pays d'Afrique Centrale et leur habitat forestier couvre environ un tiers du domaine continental des éléphants, bien qu'aucun inventaire régional n'ait **été** entrepris jusqu'à présent.

Les premières tentatives d'inventaires réalisés par Dr R.Barnes en 1989 et les plans d'actions de l'éléphant réalisés par les pays de l'aire de répartition de ce pachyderme n'ont malheureusement plus **été** soutenus par les bailleurs de fonds.

Au travers de cet exposé, nous n'allons pas prétendre faire un état des lieux exhaustif de la situation de l'éléphant dans les forêts d'Afrique Centrale. Cependant, nous nous efforcerons d'une part de faire un constat sur la conservation et l'utilisation des forêts d'Afrique Centrale, et, d'autre part de réfléchir sur les menaces et problèmes actuels par rapport à la conservation de la faune en général et de l'éléphant en particulier. Nous rechercherons les voies de sortie de cette impasse et proposerons les lignes directrices de la stratégie de gestion de ce pachyderme versus perspectives de la forêt.

CONSTAT

Les forêts denses d'Afrique Centrale sont le refuge d'une diversité biologique très remarquable caractérisée par un endémisme important de la planète. Elles représentent 77% des forêts denses du continent dont la superficie est de 2,800,000km^2. On distingue trois grands ensembles écologiques: Les forêts denses humides de basse altitudes, les forêts denses humides de montagnes et les forêts ou savanes plus ou moins arborées.

- Les forêts denses humides de basse altitude se trouvent dans les pays du bassin du Congo (Cameroun, Congo, Gabon, Guinée Equatoriale, RCA et le Zaïre)
- Les forêts denses humides de montagne caractérisent l'ouest du Cameroun et l'Est du Zaïre
- Les forêts claires ou savanes plus ou moins arborées sont au centre et au nord de la RCA, au nord du Cameroun, au centre du Congo et au sud-Est du Zaïre

En Afrique Centrale, on constate que l'engouement des pays à l'exploitation forestière s'accroît de plus en plus pendant que le conflit homme-éléphant gagne du terrain. Les pays sont comme lancés dans une course effrénée de la coupe des forêts pendant que l'habitat de l'éléphant s'amenuise de plus en plus.

L'éléphant est un maillon important de cette forêt et joue le rôle de régénérateur des essences forestières. Il constitue avec son habitat, un ensemble aux éléments interdépendants dont la gestion distincte constituerait une menace évidente pour sa survie.

MENACES ET PROBLEMES DE NOTRE TEMPS

Les problèmes majeurs de notre temps auxquels est confronté la gestion de l'éléphant c'est la perte des habitats et le braconnage.

Dans les Aires Protégées il se pose des nombreux problèmes notamment la surveillance, le braconnage, le manque d' infrastructures, l' insuffisance du personnel, faiblesse de statut de l'aire protégée etc...

En dehors des Aires Protégées, il y a des pertes d' habitats (fragmentation, dégradation, ou combinaison des facteurs).

Les tendances démographiques

Dans les centres urbains, l'effet de la croissance rapide de la population a fait reculer les forêts. Il existe une relation inversement proportionnelle entre l'accroissement de la population humaine et celle de

Carte d'Afrique Centrale

l'éléphant. Cette situation est très souvent à l'origine du conflit homme-éléphant.

Le Cameroun et le Zaïre sont les deux pays les plus peuplés de l'Afrique Centrale et totalisent environ 52,000,000 d'habitants. Dans le reste des pays de la région, les populations sont faibles. De ce fait, l'Afrique Centrale est comptée parmi les régions les moins peuplée du continent.

Mode d'utilisation de terres

Le mode culturale sur brûlis en usage en Afrique Centrale et dans d'autres parties du continent a toujours contribué à la déforestation et ainsi à la réduction de l'aire de répartition de l'éléphant d'Afrique.

Suite au développement agricole, le taux annuel de déforestation serait de 5,000 à 12,000km^2 par an en Afrique Centrale.

Le besoin en Ressources énergétiques

La forêt demeure la source de l'énergie la plus accessible pour les populations. Le prélèvement de bois pour l'énergie est devenue une des raisons profondes de déboisement des forêts. Si dans le temps le bois était ramassé pour le besoin énergétique, aujourd'hui, il est coupé en plusieurs stères pour satisfaire les besoins des populations urbaines. La coupe de bois étant devenu lucrative elle a **été** mécanisée allant jusqu'à utiliser des tronçonneuses et des outils permettant l'augmentation du volume de bois. D'où la fragmentation rapide des forêts car même dans ce domaine, il faut faire le choix des essences les plus combustibles.

Actuellement, la recherche de bois de combustion se fait dans les forêts déjà exploitées. Cette pratique contribue de façon significative à la réduction de la biodiversité. Dans ces types de forêts très fréquentées, l'éléphant y a disparu et avec lui, les essences forestières dont il est à la base de la régénération.

L'exploitation forestière

Elle se déroule sur des grandes étendues et les économies des pays reposent sur cette activité. Cependant, son déroulement n'est pas suivi dans tout son contexte. Malgré la capacité naturelle de régénération de la forêt, l'exploitation forestière artisanale et industrielle a une influence sur les écosystèmes forestièrs et sur la gestion de la faune en

général et de l'éléphant en particulier. Elle permet l'ouverture des clairières très appréciées par l'éléphant.

Ces clairières apparemment riches en biodiversité sont parfois des sites de prolifération de certaines plantes envahissantes telle que le *Chromonella odorata* dont les spores ont une grande capacité d'envol. Les maranthacées colonisent également ces clairières.

Le passage de la structure de forêt dense humide à celle de clairière devrait faire l'objet des études approfondies sur les changements qui interviennent au niveau de la faune tellurique. Car, cette dernière est la plaidoirie actuelle qui pourrait offrir beaucoup de données sur la biodiversité en Afrique.

Dans les forêts d'exploitation industrielle de bois, suite aux bruits des engins, il apparaît difficile d'observer les troupeaux d'éléphants ou d'autres espèces de faune.

La sélectivité dans la coupe de bois est un autre problème. Sur environ 500 essences forestières exploitables et possibles à commercialiser, plus ou moins dix seulement peuvent faire la totalité des transactions commerciales internationales.

On reconnaît à l'éléphant et à certains oiseaux le rôle de disséminateurs des essences forestières. Ils influencent également à ce titre la structure de la forêt et de son sous-bois. Dans une aire à éléphant le sous-bois est ouvert et permet ainsi la régénération des essences forestières.

Si l'exploitation forestière à elle seule a un impact relativement réduit, la chasse incontrôlée est une grande menace pour la faune, l'éléphant y compris. Il va sans dire qu'une grande pression de chasse dans une concession forestière peut aboutir à la disparition des essences forestières dont la régénération dépend de la faune ou de l'avifaune. Il y a donc lieu de promouvoir la conservation de la diversité biologique par une classification de la végétation à partir des communautés fauniques, l'éléphant étant considéré comme une espèce déterminante dans ce cas.

L'exploitation forestière en Afrique Centrale entraîne avec elle le désenclavement des forêts par l'ouverture des pistes et routes forestières d'évacuation des grumes. Ces pistes à la longue servent de routes appropriées pour les braconniers qui exercent une forte pression sur Ia faune par la chasse commerciale. Dans les concessions forestières, les techniques de chasse vont du collet au fusil de guerre en passant par une multitude d'autres pièges auxquels la faune ne peut échapper. Le boucanage de la viande reste la seule méthode de conservation du gibier.

Les mouvements migratoires traumatiques des éléphants sont causés par les engins, véhicules et Ia présence humaine permanente. Ces changements brusques des domaines vitaux des animaux aboutissent aux itinéraires qui sont très souvent conflictuels avec l'homme. Les aires protégées situées àproximité des concessions forestières connaissent ces genres de problèmes d'hébergement des éléphants provenant d'autres sites.

Sur le plan légal, les textes de contrat d'exploitation artisanale ou industrielle du bois ne font pas objet des clauses spéciales pour garantir la pérennité de la faune et la durabilité écologique.

Sur le plan fiscal, les taxes des permis d'exploitations industrielles ou artisanales ne tiennent pas compte du déséquilibre que l'exploitation forestière cause dans la dynamique de la biodiversité et des produits forestiers non ligneux, ni des perturbations au niveau des biotopes spécifiques des différentes espèces animales dont l'éléphant. En d'autres termes, le coût de Ia taxe de permis devrait varier selon non seulement Ia valeur de l essence mais aussi du potentiel faunique disponible sur le site àexploiter.

COMMENT SORTIR DE L'IMPASSE?

Il est essentiel que tout activité humaine se repose sur les lois écologiques. Il faut donc un code de comportement pour ordonner toute exploitation forestière. Le défis est grand. Les sociétés forestières devraient donc évaluer si leur impact au niveau de leur concessions forestières est durable.

On connaît actuellement très peu de choses sur la régénération de nombreuses espèces commerciales exploitées dans les forêts d'Afrique Centrale. Il est difficile de définir les critères d'une exploitation durable. Les périodes de rotation pour les espèces à faible croissance dépassent la possibilité de rotation. Exemple le Sappelli *(Entadrophragma cylindricum)* abattus dans le nord Congo aurait une période rotatoire allant de 400 à 900 ans pour les spécimens dépassant l m de hauteur, largeur et profondeur.

En général les pays d'Afrique Centrale reposent leurs économies sur l'exploitation et l'exportation desmatières premières brutes, notamment les produits agricoles, forestiers et miniers etc...

La quasitotalité des populations rurales puisent des milieux naturels, sans précaution particulière, l'essentiel des ressources dont elles ont besoin.

L'état des forèts n'est pas bien connu et l'inventaire forestier ne tient pas compte du potentiel faunique c'est à dire de l'éléphant.

Combien de temps faut-il laisser une exploitation forestière pour recouvrir son potentiel faune? Comment les sociétés forestières peuvent-elles réduire leur impact dans les concessions pour ne pas permettre beaucoup de modification du milieu? Voilà des questions auxquelles il faut réfléchir pour assurer Ia promotion d'une exploitation durable des forèts d'Afrique Centrale.

QUELLE SERAIT LA STRATEGIE A METTRE EN OEUVRE POUR LA GESTION DE L'ELEPHANT EN MILIEU FORESTIER?

- La défaillance de la loi et son inaction ne devraient pas limiter les utilisateurs des ressources naturelles renouvelables à réfléchir sur ce qui est possible de faire pour une bonne gestion de l'éléphant en milieu forestier
- Les inventaires forestiers devront tenir compte de la faune avant toute exploitation des concessions forestières
- Les compagnies d'exploitation forestières devront avec l'appui du personnel chargé de la faune être responsabilisées pour la lutte anti-braconnage dans leurs "juridictions"
- Promouvoir l'émergence des modèles de plan d'aménagement de l'éléphant à la satisfaction de l'écologiste, l'aménagiste d'une part et de l'exploitant, l' industriel et l' utilisateur d' autre part
- Inclure l'éléphant dans la réflexion globale de Ia politique forestière nationale et internationale
- Faire obligation aux exploitants forestiers d'assurer la formation de leur personnel avant l'octroi de permis.

PROBLEMS AND SOLUTIONS OUTSIDE PROTECTED AREAS

John M Waithaka
Elephant Programme Kenya Wildlife Service PO Box 40241, Nairobi, Kenya

SUMMARY OF PRESENTATION FROM RAPPORTEUR NOTES

This presentation is based on the experiences drawn from the management and conservation of elephants in Kenya, a country with 56 conservation areas. The Kenya Wildlife Service (KWS) has a total workforce of 4,000 employees. Thirty per cent of its 500 vehicles are based at the KWS headquarters in Nairobi. In comparison, Kruger National Park (KNP) alone employs 3,000 people! As such, there is a clear difference in the amount and distribution of resources and personnel between the two countries.

A dramatic reduction of elephant range in Kenya was the inevitable result of a high increase in human population (and thus a high demand for land), which has more than tripled from 8,000,000 people at **Independence (1 963) to over** 24.000.000 today.

A major problem which has to be dealt with is the negative attitude towards conservation legislation laws and policies in general. This can be traced back to the colonial regime, during which the concept of parks and reserves was introduced, forcing people off their land in an effort to impose the new laws. This was in contrast to the traditional way of life where people interacted freely with animals. At the time of Independence, although people were told that the animals were being conserved for them, the oppressive game laws remained in place. Currently, Kenya is exploring new concepts and approaches to wildlife management which ensure that conservation is by the people and for the people!

Problems which are specific to elephant conservation include: human death and injury; damage to crops and property; degazetting of forest elephant habitats; cross-border conflicts and different cross-border in

terests; logging in elephant forest habitats; poaching in areas where there is banditry eg. north Meru National Park; unpopular policies e.g. no land-use plans and no compensation for property damage, etc.; too much reliance on donor money for conservation activities; high human population increase and therefore encroachment and clearing of land for settlements; very little management- orientated research for elephants; extreme poverty among most of the rural populace; pollution; fragmentation of land; bad infrastructure outside parks; and lack of policy enforcement and implementation.

Some solutions towards the above-mentioned problems which have been tried in Kenya include: provision of food-relief; early harvesting; education programmes and building of classrooms by KWS in conflict areas; placing radio-collars on elephants to track their movements; helping to start tourist resorts outside protected areas; promoting traditional methods of chasing away animals; creating barriers in the form of unpalatable crops e.g. tea zones; taming elephants and/or considering elephant-riding safaris; training scientists to comprehend and resolve problems; problem animal control shooting; improving security and training more rangers; and erecting electric fences and conducting translocation trials.

SESSION TITLE: ADDRESSING KEY MANAGEMENT CHALLENGES

WORKING GROUP SUMMARIES

SAVANNA WORKING GROUP

Chair: David Cumming
Rapporteur: Colin Craig

The group's aim was to start developing an objective system of decision-making to identify appropriate solutions to elephant management problems.

The group identified a number of potential elephant management problems both inside and outside protected areas, as shown in Table l below.

Table l. Elephant management problems.

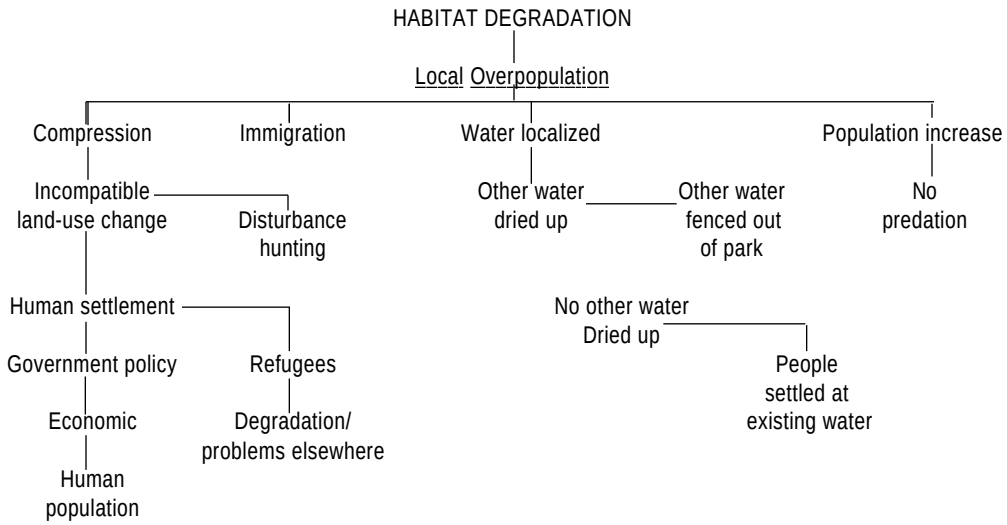
Inside parks	Outside parks
Habitat degradation	Human/elephant conflict
Poaching	Loss of habitat/range
Water provision	Absence leading to habitat change
Movement out	Land-use conflicts (e.g. stock, water)
Overpopulation	Population viability
Disease	Poaching
Small populations in small areas	Disruption of migration routes
Impacts of tourists and tourist/elephant interactions	Management of legal hunting
Lack of information	Lack of information

It was put to the group by Dr.Cumming that problems could be tackled at a number of points, depending on resources, which led to a number of options for action. Options could be determined from a "tree" describing the hierarchy of the ways in which a problem could arise. An example of such a "tree" was constructed, with group participation, for the problem of habitat degradation (see figure).

As time was limited, it was decided to exemplify the determination of options for solutions from the part of the "tree" hierarchy which described the problems leading to water localisation, as seen in Table 2.

Table 2. Possible solutions/interventions.

1 . Provide alternative water, Press/Pulse
1.1. Does an alternative exist?
1.2. Can it be made available?
1.3. What are the consequences of providing this water?
2. Reduce elephant population. How?
2.1. Translocate
2.2. Cull
2.3. Contraception
3. Expand range to include more water
4. Close existing water supply, if natural



Hirarchy of problems leading to habitat degredation.

It was explained by Dr. Taylor and Dr. Cumming that this could eventually lead to the production of a "log frame" description of the actions to be carried out in project implementation, as is constructed, for example, for any European Commission project.

There was clearly insufficient time for the creation of a "log frame" or even the construction of an elementary decision-making system for one component of a problem. The group agreed, however, that a workshop should be set up at the next AfESG meeting to do this for a management problem relevant to the host country of that meeting.

LE GROUPE FORET

Président: Bihini Won wa Musiti
Rapporteur: Dominique NSosso

I . Inventaire elephants

Nécessité de mieux connaître la ressource afin de mieux la gérer.
Recommande: que soit menés des inventaires d'éléphants de forêt avec une formation préalables des équipes de terrain.

2. Expoitation forestière

Le Groupe a fait remarquer les écarts entre la forêt et la faune au niveau des décideurs.
Recommande: que des actions de sensibilisation et de démonstration soient menées au plus haut niveau pour affirmer l'importance économique de la faune.

Le groupe a suggéré que, là où c'est possible, l'exploitation forestière soit reconsidérée en faveur de la faune.

3. Conflit homme/éléphant

Le Groupe recommande faire les methodes de prélèvements des données relatives aux conflits sur le terrain soient harmonisées et que l'usage d'un même modèle mathématique soit encouragé.

4. Lutte antibraconnage

Le Groupe a relevé l'insuffisance des moyens financiers et en personnel. Le Groupe recommandé la sensibilisation des populations et des autorités en charge de la conservation et de l'utilisation durable des ressources.

5. Etudes socio économiques

Le Groupe a reconnu l'importance de ces études en vue d'intégrer toutes les préoccupations des populations utilisatrices des ressources. Les produits forestiers non-ligneux devront faire partie de cette préoccupation.

SESSION TITLE:
A.O.B. AND CLOSE OF MEETING

Chairs: Holly Dublin, Bihini Won wa Musiti **Rapporteur:** Ruth Chunge

The A.O.B. highlights are as follows:

l. Iain Douglas-Hamilton proposed a resolution:

AfESG members note with concern the increases in poaching in Garamba National Park which constitute a grave threat to the remaining rhinos and elephants; AfESG encourages the government of Zaire and international donors to give the necessary support to deal with the situation.

2. Chris Thouless proposed another resolution, that a statement be published in Species:

Members of the AfESG note the controversy surrounding the publication of the report ''Four Years after the Ban..'' and regret the accidental omission of an IUCN disclaimer stating that the views expressed in this publication do not necessarily reflect those of IUCN or the other participating organisations and are not necessarily those of all members of AfESG. Members of the Group feel that the personal nature of the attacks on the authors and the doubts cast on their integrity were unjustified and inappropriate.

3. Colin Craig made a statement which he requested to have minuted:

We have seen the (video) presentation today on the translocation of elephants from Gonarezhou in Zimbabwe to South Africa. Most people seem agreed that this was the right thing to do. However, l would like to make it known to this Group that the decision to translocate those elephants has resulted in the suspension from duty of Dr. Willie Nduku, the Director of National Parks and Wild Life Management of Zimbabwe; and Assistant Director, Mr. R.B. Martin whom some of you know as a former member of this Group. It has also resulted in the withdrawal of all Mr. Coetsee's (translocation) permits.

l do not understand the reasons for the suspensions, but l interpret them as undermining the freedom of thought necessary to the rational decision-making process for management and conservation, and that is why l am sufficiently concerned to want the facts minuted.

I stress that these opinions are my own and l do not expect the Group to support them.

4. Cynthia Moss reported that since the last AfESG meeting in l 994, Tanzania and Kenya have been in an unfortunate position regarding (hunting of) elephant bulls (from the Amboseli population). Tanzania has a legal hunting policy; Kenya does not have a policy. The press "blew up" the (hunting) incident - often being unfair to Tanzania - e.g. "Kenya's elephants being killed". None of us feel those are Kenyan elephants. They belong to a cross-border population. We must decide which is the best way to use elephants for both countries. We did not want to attack Tanzanian policy and we hope that we can resolve the issue.

Emmanuel Severre agreed that the bulls belonged to a cross-border population. There are no political boundaries for elephants. The issues in the press affected tourism in Tanzania. Hunting elephants in Tanzania is a way of conserving elephants in Tanzania. It facilitates better conservation in the wild. Hunting is now banned in Longido until we sit down with our Kenyan colleagues and discuss how to go further.

5. Holly Dublin said that during the meeting she noted the offer for a Taskforce (TF) to be set up on human-elephant conflict, which could be linked to the African Elephant Database (AED) project. She would be pleased for someone to take this forward. Richard Hoare volunteered.

6. Mike Fay pointed out that although issues concerning central Africa and forest elephant surveys have been discussed in the last three meetings, there is a need to consolidate the work from the independent studies going on in the region (WWF, WCS, IUCN) and there may be a need for another Taskforce. There are two major projects in the region, by USAID and the World Bank. Both will provide a good opportunity to raise money. There may be plenty of funds and we should especially think of using some in Zaire.

Holly Dublin agreed that there is strength in a regional approach. She suggested that Mike Fay should let the

secretariat know where it can assist. In terms of a TF, she asked that the people of the region organise themselves and let the secretariat know of any progress. We now have Lamine Sebogo working for the AfESG in Cameroon and she hopes that this will make it easier to communicate within the region.

7. Holly Dublin mentioned that the "hard" copy of the African Elephant Database now exists. She asked for ideas on how to carry out trend analysis and proposed that if trend analysis is to be done, we need to decide on how many populations should be analysed in order to make any comment at the continental level. She suggested that the best way to proceed would be for the "survey" people to present their ideas to the Group, after some initial homework on the subiect.

David Cumming suggested that Iain Douglas-Hamilton could work voluntarily work with the AED manager to agree on areas suitable for trend analysis, then circulate them to the Group. A small group could review the initial analysis and carry out some mathematical modelling.

8. Holly Dublin asked members to provide ideas for the venue of the next AfESG meeting. She suggested having the meeting somewhere in West/Central Africa. (This was the consensus by members who answered a small questionnaire.)

9. After thanks from the Chair and to the Chair, the meeting was closed.

Photo credit: Kes and Fraser Smith

A haul of tusks from 22 freshly-killed elephants in Garamba National Park Zaire, January 1996.

BOOK REVIEW

STUDYING ELEPHANTS

Edited by Kadzo Kangwana

AWE Technical Handbook Series (7), African Wildlife Foundation, Nairobi, Kenya. 1996.

Reviewed by Ruth Chunge

During the past few years there has been a spate of published "elephant" books on both African and Asian species. Many are beautifully illustrated with colour photographs and drawings; several tell a story. Some contain useful and detailed information on the biology of elephants, the history of elephants in relation to man, or the conservation and management of elephants. None, however, describes adequately all the techniques for studying elephants in the field.

Studying Elephants, published in English and French (with a Portuguese version in preparation), does just that. It contains a wealth of information on techniques for studying African elephants (much of which can also be applied to the study of Asian elephants). The information is presented in a systematic, straightforward style, with simple, yet effective, black-and-white illustrations throughout. While it is not a glossy "coffee-table" book, neither is it a heavy-going academic book fit only for the book shelves of professors. As the name of the AWF series suggests, it is a "technical handbook" which is aimed at research students and staff, and protected area staff. It also has the potential for much wider application - to biology students in general, wildlife department staff and a range of conservation workers wanting to refresh their existing knowledge or simply to give themselves a solid background knowledge of elephants and techniques for application to their work in the field or in the office.

The book is well organised by subject. It begins with a general chapter about African elephant biology, which is followed by 17 more chapters, split into six sections, namely: Elephant Management, Counting Elephants, Studying Populations, Developing Research Techniques, Elephants in their Human Context, and Handling Elephants. All the sections are valuable, but the chapters in Counting Elephants and Studying Populations are particularly useful for the collection of accurate, baseline data on elephant populations, while the topics covered in the other sections are more valuable for specialised projects.

Each chapter is written by an expert of the subject being addressed and together, the authors' names present an impressive list. None of the chapters is intended to be an exhaustive guide, but each ends with a reference list of source literature enabling a reader to study the subject in more detail if necessary. Several chapters include "boxes" with additional, more detailed information which complements the main text.

Studying Elephants will prove invaluable to those about to embark on a study of elephants or who want to improve their general knowledge on a wide array of elephant-related techniques. It will be found frequently in the back-packs of research students and field staff and will, no doubt, be often listed as a reference on theses and published research articles. Perhaps one day, even more appropriately, it will be published in hard-back form as a handy "pocket guide", preferably with its striking cover photograph still in place.

Pachyderm

Notice to Contributors

Pachyderm welcomes original manuscripts (not published elsewhere) dealing with the conservation and management of elephants and rhinos. All submissions are reviewed by referees, Manuscripts should preferably not exceed 4,000 words; shorter ones have a greater chance of being published. Contributions may be written in English or French and should be typed on one side of A4 paper, double-spaced with ample margins. Manuscripts may be submitted on IBM-compatible 3.5" diskettes in WP5.I . The full postal address of the first author should be included as well as the address of any other author.

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

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