Pachyderm

JAN-JUL 1998 Number 25

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SURVIVAL
COMMISSION

Pachyderm

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CHAIRMAN'S REPORT: AFRICAN RHINO SPECIALIST GROUP

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1998 AFRSG MEETING

Thanks to generous sponsorship from WWF, Mount Etjo Safari Lodge and Budget Rent-A-Car, the AfRSG was able to hold its fourth meeting in Namibia from 12 to 19 April 1998. Despite the clash of dates with the Easter holidays, the meeting was well attended by 30 members and invited delegates from 11 countries. In addition to the presentation of the usual detailed country reports and technical papers, and the holding of six workshops, delegates were also exposed to aspects of the Namibian rhino conservation programme in the field in three rhino areas.

AFRICAN RHINO NUMBERS REACH 11,000 IN THE WILD

The latest continental statistics compiled at the meeting reveal that African rhino have now increased to 11,000 in the wild. After having been stable since 1992, black rhino numbers have increased from 1,995 to 2,600 by 1997. The increase in white rhino numbers in the wild continues, and by 1997 the species numbered 8,400. About a quarter of Africa's white rhino are now privately owned and managed. Despite these positive trends, the last remaining northern white rhino in the Democratic Republic of Congo and the western black rhino in Cameroon remain in a precarious position.

NORTHERN WHITE RHINO

Two surveys were undertaken in April and June 1998 which indicated that most of the last remaining northern white rhino survived the liberation war in ex-Zaire which overthrew ex-President Mobutu. Both surveys indicated that at least 25 animals remain. However, the security situation in Garamba remains a concern, as poachers have now moved well into the rhino's core area and large numbers of elephant and buffalo have been poached since 1995. The recent civil war in the country further threatens the remaining rhino and conservation efforts in the Park.

WESTERN BLACK RHINO

The threat facing the last known remaining western black rhino *(D.b. longipes)* in Cameroon continues to increase with two black rhinos known to have been poached since February 1996, and a further ten no longer seen or reported from their home range. Current data indicates that there are only ten to a possible 18 animals remaining, scattered in small isolated groups of one to four rhino over an area of 3,200km^2 within a 25,000km^2 range. This situation is undesirable both demographically and genetically. However, any consolidation of remaining animals would be logistically difficult, expensive, and could increase the risk of the animals being poached unless adequate security was put in place. A workshop at the April AfRSG meeting recommended the development of a specific rhino project to develop a Government of Cameroon recovery plan through the President, with WWF/FAC as counterparts who could provide initial funding. Greatly increased government commitment to rhino conservation was seen as essential for success. Short term recommendations include obtaining high level political support, the appointment of a high level steering committee and recruitment of additional anti-poaching staff, the establishment of two protection zones to protect breeding rhino, increased intelligence gathering, and continued monitoring. Much will depend on necessary changes within the government ministry (MINEFF) to allow effective anti-poaching efforts, and on continued support from the existing GEF savannah project.

POACHING DOWN

Based on the country reports at the AfRSG meeting, it appears that levels of poaching are generally down, although undercover wildlife investigators indicate there is still considerable interest in poaching rhino and/or dealing in rhino horn. It is hoped that the increasing imposition of severe sentences in some range States, such as a 20-year jail term in Namibia and ten years in South Africa, may act as a deterrent.

STATUS OF AFRICAN RHINO IN CAPTIVITY

By the end of 1997 there were approximately 900 African rhino in captivity worldwide.

Three quarters of the 240 black rhino in captivity in 1997 were eastern black rhino *(D.b. michaeli)*, with the remaining 25% being southern-central black rhino *(D.b. minor)*. There are no western *(D.b. longipes)* or southwestern *(D.b. bicornis)* black rhino in captivity. Mortality continues to be high in captive black rhino; although over the last two years, the performance of the younger and more recently established AZA SSP southern-central black rhino *(D.b. minor)* metapopulation is encouraging, with births outnumbering deaths by 13 to six. If this progress can be maintained, then for the first time performance of captive-bred black rhino will approximate levels of growth achieved in healthy expanding wild populations.

There are approximately 650 southern white rhino *(C.s. simum)* and nine northern white rhino *(C.s. cottoni)* in captivity worldwide. From 1995 to 1997 the captive population of southern white rhino fell by about 14, while numbers of northern white rhino remaining unchanged. The captive southern white rhino population continues to perform very poorly, and is an ageing population. It is noteworthy that the five institutions in the USA which are currently breeding southern white rhino, for the most part maintain larger groups of rhino in relatively more spacious enclosures. Despite recent matings, the nine remaining northern white rhino have not produced a calf since 1989.

DEVELOPMENT OF INDICATORS OF SUCCESS

I am pleased to report that a CITES Standing Committee meeting approved funding for a proposed workshop to develop standardised indicators for levels of illegal hunting and status of rhino populations, as called for in Resolution Conf. 9.14. It has been decided that TRAFFIC will become the lead organisation in developing the indicators, with the Asian and African Rhino Specialist Groups providing assistance where required. With the scheduling of an upcoming expert workshop to develop these indicators (provisionally scheduled for late in 1998), a working group met at the April AfRSG meeting to clarify the purpose of the indicator process, and to provide technical input on possible indicators (dependent variables) and factors that might cause changes in the indicators in the field in rhino Range States (explanatory variables) with a view to providing this as background information to help inform the deliberations of the expert workshop.

AFRSG INVOLVEMENT IN HORN DEALING AND POACHING CASES

Sentences handed down in another two South African cases where the Scientific Officer was called as an expert witness were also severe, further establishing a precedent for sentencing in South Africa that is commensurate with the seriousness of these crimes. At the request of the Rhino and Elephant Security Group of Southern Africa, the Scientific Officer gave a presentation outlining his experiences in court, and has passed on copies of court statements to assist other wildlife investigators prepare for other court cases.

REVISED DRAFT AFRICAN RHINO ACTION PLAN

A fully revised draft of a new IUCN/SSC AfRSG African Rhino Action Plan has been completed, and it incorporates all the latest information and statistics which emerged from the April AfRSG meeting. This has been submitted to IUCN who have circulated it for editorial comment prior to publication.

NATIONAL AND REGIONAL COORDINATION

AfRSG members continue to be active in national and regional rhino coordinating committees, and members continue to network and share knowledge with each other for the benefit of rhinos. The most recent example of this was when five AfRSG members based in Tanzania, Kenya and South Africa took part in a recent (October 1998) Tanzanian rhino conservation workshop, which reviewed conservation progress and assisted in the process of revising and updating the Tanzanian black rhino conservation plan. A revised draft plan developed by the workshop is currently being written by the Tanzanian rhino coordinator for official approval and ratification.

FOCUSING OF DONOR FUNDING

The AfRSG office continues to regularly assist a number of donor agencies with reviewing and, priority rating project proposal reviews to help ensure limited donor funding is effectively used.

AFRSG SPONSORS

In addition to the generous sponsorship which allowed us the hold the 1998 AfRSG meeting in Namibia, WWF has kindly allocated funds to sponsor an edition of *Pachyderm* as well as enable the undertaking of the horn finger printing project. WWF South Africa also continues to provide support to the Chairman. Thanks also to the UK Department of the Environment for providing bridging funds to support the employment of the Scientific Officer up till the end of June 1998, and to the International Rhino Foundation for their support of the Scientific Officer for three months from October 1998. However, securing long term funding for the Scientific Officer's position continues to be a problem.

RAPPORT DU PRESIDENT: GROUPE DES SPECIALISTES DES RHINOS AFRICAINS

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REUNION DU GSRAF DE 1998

Grâce au gnéréreux support du WWF, de Mount Etjo Safari Lodge et de Budget Rent-A-Car, le GSRAf a pu tenir sa quatrième réunion en Namibie, du 12 au 19 avril 1998. Malgré la correspondance des dates avec les vacances de Pâques, la réunion a vu la participation de 30 membres et des délégués invités de 11 pays. En plus de la présentation des rapports nationaux détaillés et des articles techniques habituels, et la réunion de six ateliers, on a aussi présenté aux délégués les différents aspects du programme namibien de conservation des rhinos sur le terrain, dans trois zones à rhinos.

LE NOMBRE DES RHINOS AFRICAINS EN LIBERTE ATTEINT 11.000

Les dernières statistiques rassemblées au moment de la réunion, pour le continent tout entier, révèle que les rhinos africains ont augmenté dans la nature et comptent plus de 11.000 individus. Après être restés stables depuis 1992, les rhinos noirs sont passés de 1.995 à près de 2.600 en 1997. L'augmentation du nombre de rhinos blancs dans la nature continue et, en 1997, l'espèce comptait 8.400 animaux. Près d'un quart des rhinos blancs d'Afrique appartiennent et sont gérés par des particuliers. Malgré ces tendances positives, la dernière population de rhinos blancs du Nord en République Démocratique du Congo et les rhinos noirs de l'Ouest, au Cameroun restent en situation précaire.

RHINO BLANC DU NORD

On a entrepris deux recherehes en avril et en juin 1998 qui ont montré que la plupart des derniers rhinos blancs du Nord ont survécu à la guerre de libération qui a renversé l'ex-Président Mobutu. Les deux études ont indiqué qu'il reste an moins 25 animaux. Mais Ia sécurité à la Garamba reste précaire car les braconniers ont pénétré maintenant bien à l'intérieur de la zone centrale des rhinos, et de grands nombres d'éléphants et de buffles ont été braconnés depuis 1995. La dernière guerre civile qui se déroule dans le pays menace une fois de plus les derniers rhinos et les efforts de conservation dans le Parc.

RHINO NOIR DE L'OUEST

La menace qui pèse sur les derniers rhinos noirs de l'Ouest connus *(D.b. longipes),* au Cameroun, continue à augmenter car on sait que deux rhinos ont été braconnés depuis février 1996 et qu'on a perdu la trace de dix autres dans leur habitat. Les données actuelles indiquent qu'il en reste seulement entre l0 et, au maximum, 18, éparpillés en petits groupes isolés de un à quatre animaux dans une zone de 3.200km^2 incluse dans un territoire de 25.000km^2. Cette situation est déplorable tant du point de vue démographique que génétique. Pourtant, toute consolidation du statut des rhinos restants serait logistiquement difficile, coûteuse et pourrait accroître le risque de voir ces animaux braconnés à moins de mettre en place des mesures de sécurité appropriées. Un des ateliers de la réunion d'avril du GSRAf recommandait la mise au point d'un projet spécifique pour les rhinos pour créer un plan de sauvetage au niveau du Gouvernement camerounais par l'intermédiaire du Président, avec le WWF/FAC comme interlocuterurs qui pourraient fournir les premiers financements. L'implication fortement accrue du Gouvernement dans la conservation des rhinos était considérée come essentielle au succès de l'entreprise. Les recomrnandations à court terme incluent l'acquisition d'un support politique de haut niveau, la nomination d'un comité de direction de haut niveau et le recrutement d'un personnel plus nombreux pour la lutte antibraconnage, la création de deux zones de protection spéciales pour protéger la reproduction, l'amélioration de la récolte d'informations et une surveillance continue. Il dépendra largement des changements nécessaires au sein du ministère (MINEFF) de permettre de réels efforts antibraconnage et la poursuite du support accordé à l'actuel projet de savane GEF.

BAISSE DU BRACONNAGE

D'après les rapports nationaux à la réunion du GSRAf, il semble que le niveau de braconnage soit généralement en baisse, bien que des enquêteurs travaillant en secret dans le domaine de la faune disent qu'il existe toujours un intérêt considérable pour le braconnage des rhinos et/ ou la vente de cornes. On espère que 1' application croissanter de peines sévères dans certains Etats de l'aire de répartiton, comme 20 ans de prison en Namibie et dix ans en Afrique du Sud, aura un effet dissuasif.

STATUT DES RHINOS AFRICAINS EN CAPTIVITE

A la fin de 1997, il y avait environ 900 rhinos africains en captivité dans le monde entier.

Trois quarts des 240 rhinos noirs en captivité en 1997 étaient des rhinos noirs de l'Est *(D.b. michaeli),* et le quart restant se composait de rhinos noirs du Centre-sud *(D.b. minor).* ll n'y a pas de rhinos noirs de l'Ouest *(D.b. longipes)* ni du Sud-ouest *(D.b. bicornis)* en captivité. La mortalité qui touche les rhinos noirs en captivité rester élevée; mais, au cours des deux dernières années, la performance obtenue par la métapopulation plus jeune et plus récemment établie de rhinos noirs du Centre-sud AZA SSP *(D.b. minor)* a été encourageante, le nombre des naissances ayant dépassé celui des morts de 13 à six. Si ce progrès peut durer, pour la première fois, le succès de la reproduction en captivité s'approchera du taux de croissnce des populations saines en liberté.

ll y a environ 650 rhinos blancs du Sud *(C.s. simum)* et neuf rhinos blancs du Nord *(C.s. cottoni)* en captivité dans le monde. De 1995 à 1997, la population captive des rhinos blancs du Sud a diminué de 14 environ et celle de rhinos blancs du Nord est restée inchangée. La population captive de rhinos blancs du Sud poursuit ses maigres performances et c'est une population vieillissante. ll faut remarquer que les cinq intitutions américaines qui s'occupent actuellement de la reproduction de rhinos blancs du Sud, disposent de plus grands groupes de rhinos dans des enclos relativement plus spacieux. Malgré des accouplements récents, les neuf rhinos blancs du Nord n'ont eu aucun petit depuis 1989.

MISE AU POINT DES INDICATEURS DE SUCCES

Je suis heureux de faire savoir qu'une réunion du Comité permanent de la C1TES a approuvé le financement d'un séminaire destiné à mettre au point des indicateurs standards des niveaux de chasse illégale et du statut des populations de rhinos, ainsi que l'avait demandé la Résolution Conf. 9.14. On a décidé que TRAFFIC deviendrait l'organisation maîtresse dans le choix des indicateurs avec, si nécessaire, l'aide des Groupes de Spécialistes des Rhinos Africains et Asiatiques. Dans la perspective d'un séminaire d'experts pour mettre au point ces indicateurs (prévu provisoirement pour fin 1998), un groupe de travail s'est réuni lors de la réunion d'avril du GSRAs pour clarifier la raison d'être du concept des indicateurs et pour apporter un soutien technique quant à de possibles indicateurs (variables dependantes) et aux facteurs qui pouraient modifier les indicateurs sur le terrain dans les Etats de l'aire de répartition des rhinos (variables explicatives) en ye d' apporter ceci comme information de base pour aider lors des délibérations du séminaire des experts.

Implication du GSRAf dans les cas de commere de corne et de braconnage

Les peines infligées dans deux autres cas où le Responsable scientifique a été appelé en Afrique du Sud comme expert ont aussi été sévères, établissant de nouveau un précédent pour les sentences appliquées en Afrique du Sud, qui sort proportionnelles à la gravité de ces crimes. A la demande du Groupe chargé de la Sécurité des Rhinos et des Eléphants en Afrique du Sud, le Responsable scientifique a donné une présentation sur ses expériences au tribunal et il a distribué des copies des décisions de justice afin d'aider les autres enquêteurs chargés de la faune à se préparer à d'autres cas soumis à la justice.

PROJET REVISE DU PLAN D'ACTION POUR LE RHINO AFRICAIN

Un nouveau projet complètement révisé d'un plan d'action pour les rhinos africains a été terminé par le GSRAf de la CSE/UICN et il intègre toutes les dernières informations et statistiques issues de la réunion d'avril du GSRAf. Celui-ci a été soumis à l'UICN qui l'a fait circuler pour susciter les commentaires des éditeurs avant publication.

COORDINATION NATIONALE ET REGIONALE

Les membres du GSRAf sont toujours actifs dans les comités de coordination national et régional pour les rhinos et ils continuent à partager dans le réseau les informations pour le plus grand bien des rhinos. Le plus récent exemple de cette collaboration s'est observé lorsque cinq membres du GSRAf basés en Tanzanie, au Kenya et en Afrique du Sud ont pris part récemment (octobre 1998) à un aterlier sur la conservation du rhino en Tanzanie, qui révisait les progrès de la conservation et aidait à la révision et à la remise à jour du plan de conservation du rhino noir en Tanzanie. Un projet de plan révisé, mis au point lors de l'atelier, est actuellement rédigé par le coordinateur tanzanien pour les rhinos avant l'approbation et la ratification officielles.

LE FINANCEMENT PAR LES DONATEU RS

Le bureau du GSRAf continue à aider régulièrerment les organismes donateurs à reviser les projets et leur classement par ordre de priorité pour s'assurer que le financement limité des donateurs est utilisé efficacement.

LES SPONSORS DU GSRAF

En plus de la sponsorisation généreuse qui nous a permis de tenir la réunion 1998 du GSRAf en Namibie, le WWF a aimablement alloué des fonds pour la parution d'une édition de Pachyderm ainsi que pour le démarrage du projet d'identification des cornes. Le WWF sudafricain continue son support au Président. Merci aussi au Département de l'Environnement britannique qui nous a fourni des fonds pour couvrir le poste du Responsable scientifique jusqu' à la fin de juin 1998, et à l'International Rhino Foundation pour son support du Responsable Scientifique pendant trois mois à partir d'octobre 1998. Cependant, cela reste difficile de trouver un financement à long terme pour ce poste.

CHAIRMAN'S REPORT: ASIAN RHINO SPECIALIST GROUP

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Developing further on the Javan Rhino Colloquium conducted under AsRSG auspices in July 1997, the AsRSG provided technical assistance for an intensive track survey of rhino in Cat Loc Nature Reserve, Vietnam. The survey was conducted in May 1998 by Vietnamese scientists and rangers from the Forest Protection Department (FPD) and the Institute of Ecology and Biological Resources (IEBR). Both the previous Javan Rhino Colloquium and the Vietnamese survey were supported by grants from the Rhino and Tiger Conservation Fund (RTCF) of the U.S. Fish & Wildlife Service (USFWS); the International Rhino Foundation (IRF), Fauna and Flora International (FF1), and The Indonesian Institute of Sciences (LIPI}. The track survey of rhino in Cat Loc Nature Reserve has revealed a population of five to seven individuals. This number is lower than previous estimates of 10-20 from the early-1990s and reflects the fact that perhaps 85% of rhino habitat has been lost over the last five years due to human settlement and utilization within Cat Loc. These rhino are definitely of the Javan species *(Rhinoceros sondacius)*, however they appear to be significantly smaller in size than individuals in the only other know population of this species which occurs in Ujung Kulon National Park on Java in Indonesia This difference in size supports previous evidence that these two populations represent different subspecies of Javan Rhino. Cat Loc has recently been incorporated into Cat Tien National Park. An action plan for the rhino has been formulated at a workshop conducted in Hanoi at the end of May 1998 and is currently under review by Vietnamese authorities (central and provincial). A major project for Cat Tien National Park being supported by the Netherlands Government through WWF will enhance these efforts but more support will probably be needed. Three major components of the action plan are: (I) provide more guards for Cat Loc; (2) attempt to maintain surviving and recover some recently lost rhino habitat (3) try to improve the quality of the habitat.

In Indonesia, the rhino protection units (RPUs) for Javan rhino in Ujung Kulon will be activated in September as also recommended by the Javan Rhino Colloquium. These RPUs are being established by another grant from the USFWS RTCF. These RPUs and the RPUs for Sumatran rhino *(Dicerorhinus sumatrensis)* in southern Sumatra operate under an M.O.U. among PHPA, AsRSG, IRF, and YMR. There are currently 12 RPUs operating in three Parks: Three RPUs in Way Kambas; Six RPUs in Bukit Barisan Selatan; and three in Kerinci Seblat. There is need to increase the number of RPUs for Sumatran Rhino. Support for these RPUs derives from a coalition of sources including IRF, USFWS RTCF, and the Bowling for Rhinos Program of the American Association of Zoo Keepers. Recently, WWF-Indonesia Program has indicated its interest to become part of the coalition of partners for this program In Malaysia, despite the economic crisis, both the federal and state governments have reaffirmed their commitment to provide funds for operation of the RPUs.

The first three rhino (one male from England and two females from Indonesia) moved from zoos to the Sumatran Rhino Sanctuary or Suaka Rhino Sumatera(SRS) in Way Kambas National Park, Sumatra, Indonesia in January 1998, being slightly delayed by the drought and fires caused by El Niño. One of the two females is definitely cycling and introductions of the male to this female have commenced with some courtship activity but no copulation yet. Introductions of females and males continue at the Sungai Dusun Rhino Conservation Center in Peninsula Malaysia Meanwhile, a pair of Sumatran rhino at the Cincinnati Zoo in the United States continue their reproductive activities. The female has been pregnant several times in the last year but has not yet managed to sustain a pregnancy beyond three months.

The AsRSG has reorganized. In addition to the Chair and two Deputy Chairs (one for S.E. Asia and one for the Indian Subcontinent), there is now an Executive Committee that comprises an additional five principal representatives from the six significant range states for Asian rhinos: India; Nepal; Indonesia; Peninsula Malaysia; Sabah; and Vietnam. AsRSG has decided to concentrate on regional, rather than global meetings, i.e. for India/Nepal and for S.E. Asia The first regional meeting for India/Nepal will be conducted in Kaziranga National Park in February 1999.

The AsRSG has a subpage on the IRF website at http://www.rhinos-irf.org.

RAPPORT DU PRESIDENT: GROUPE DES SPECIALISTES DES RHINOS ASIATIQUES

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Suite au Colloque sur le Rhinocéros de Java qui a été mené sous les auspices du GSRAs en juillet 1997, le Groupe a founi une assistance technique pour une recherehe intensive des traces de rhinos dans la Réserve Naturelle de Cat Loc, au Vietnam. La recherehe a été réalisée en mai 1998 par des scientifiques et des gardes vietnamiens du Département de la Protection des Forèts (FDP) et de l'Institut des Ressources Ecologiques et Biologiques (IEBR). Et le Colloque sur le Rhino de Java et l'étude vietmamienne ont reçu des subsides du Fonds de Conservation du Rhino et du Tigre (RTCF) du Fish and Wildlife Service américain (USFWS), du 1' International Rhino Foundation (IRF), de Fauna and Flora International (FF1) et de l'Institut des Sciences Indonésien (LIP1). L'étude des traces de rhinos dans la Réserve Naturelle de Cat Loc a révélé une population de cinq à sept individus. Ce nombre est inférieur aux estimations précédentes de 10 à 20 animaux, au début des années 1990 et répond au fait que près de *85%* de l'habitat des rhinos a été perdu au cours des cinq dernières années, suite aux installations et aux utilisations humaines àl'intérieur de la réserve. Ces rhinos sont flnalement bien de l'espèce de Java *(Rhinoceros sondaicus),* bien qu'ils seumblent être significativement plus petits que les animaux de la seule autre population connue de cette espèce, qui vit dans le Parc National d'Ujung Kulon, à Java, en Indonésie. Cette différence de taille ètaie l' évidence énoncêe précédemment que ces deux populations représentent des sous-espèces différentes de Rhinocéros de Java Cat Loc a été rêcemment intégrée au Parc National de Cat Tien. Lors d'un atelier qui s'est tenu à Hanoï à Ia fin mai 1998, on a formulé un Plan d'Action pour le rhino que les autorités vietnamiennes (centrale et provinciales) sont actuellement en train de réviser. Un projet majeur pour le Pare National de Cat Tien, supporté par le gouvernerment hollandais par l'intermédiaire du WWF, va amplifier ces efforts mais une aide supplémentaire sera sans doute nécessaire. Les trois composantes majeures de ce plan d'action sont : (1) mettre plus de gardes à Cat Loc; (2) tenter de garder l'habitat existant et essayer d'en récupérer de celui qui a été perdu; et (3) essayer d'améliorer la qualité de l'habitat. En Indonésie, les unités de protection des rhinos (RPU) destinées au Rhinocéros de Java d'Ujung Kulon seront mises en service en septembre, ainsi que le recommandait aussi le Colloque sur le Rhinocéros de Java. Ces RPU sont créées grâce à un autre don du USFWS RTCF. Ces RPU et celles qui sont chargées du Rhinocéros de Sumatra *(Dicerorhinus sumatrensis)* dans le sud de Sumatra dépendent d'un M.O.U. entre PHPA, GSRAs, IRF et YMR. ll y a actuellement 12 RPU qui fonctionnent dans trois parcs : trois à Way Kambas, six à Bukit Barisan Selatan et trois à Kerinci Seblat. ll faut augmenter le nombre de RPU pour le Rhinocéros de Sumatra. Le support accordé à ces RPU provient d'un ensemble de sources comprenant IRF, USFWS RTCF et le Bowling for Rhinos Program de l' Association Américaine des Gardiens de Zoo. Le programme WWF-Indonésie a manifesté récemment son intérêt à faire partie de la coalition des partenaires de cc programme. En Malaisie, malgré la crise êconomique, les gouvernements national et fédéral ont réitéré leur engagement à apporter des fonds pour le fonctionnement des RPU.

Les trois premiers rhinos (un mâle venu d'Angleterre et deux femelles d'Indonésie) sont arrivés des zoos au Sanctuaire pour les Rhinos de Sumatra ou Suaka Rhino Sumatera (SRS), dans le Parc National de Way Kambas, à Sumatra, en Indonésie, en janvier 1998, retardês légèrement par la sêcheresse et les feux provoqués par El Nino. Une des deux femelles présente à coup sûr un cycle, et les introductions du mâle auprès d'elle ont fait apparaître un comportement de cour mais pas encore d'accouplement. Les introductions de femelles et de mâles continuent au Centre de Conservation des Rhinos de Sungai Dusun, dans Ia Péninsule malaise. Pendant ce temps, un couple de Rhinos de Sumatra continue ses activités de reproduction au zoo de Cincinnati, aux Etats Unis. La femelle a été prégnante plusieurs fois l'annêe dernière mais n'a pas encore réussi à tenir plus de trois mois.

Le GSRAs a été remanié. En plus du Président et des deux Présidents adjoints (un pour l'Asie du Sud-Est et un pour le sous-continent Indien), il y a maintenant un Comité Exêcutf qui comprend aussi cinq représentants principaux venant des six Etats représentatifs de l'aire de répartition des rhinos asiatiques : l'Inde, le Népal, l'Indonésie, la Péninsule malaise, Sabah et le Vietnam. Le GSRAs a décidé de se concentrer sur les réunions régionales plutôt que globales, c.à d. sur l'Inde-Népal et le Sud-Est asiatique. La première réunion régionale pour l' Inde-Népal se tiendra au Parc National de Kasiranga, en février 1999.

Le GSRAs dispose d'une page sur le site web de IRF à http:/www.ïhinos-irf.org.

CHAIRMAN'S REPORT: AFRICAN ELEPHANT SPECIALIST GROUP

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In the last issue of *Pachyderm* (No. 24), I attempted to explain the process set in motion at the tenth Meeting of the Conference of the Parties to CITES. This process involved the application of obligatory conditions for the one-off sale of identified stocks of known origin from the populations of Botswana, Namibia and Zimbabwe and the one-off, non-commercial buyout of registered and audited stocks from these same three and 11 other Range States. There has been much progress since then. While sometimes slow and faltering, the process has been transparent, positive and productive.

Part of this process involved the active involvement of the membership of the AIESG. With the generous support of United States Fish and Wildlife Service it was possible for the vast majority of our membership to meet in the capital of Burkina Faso, Ouagadougou at the end of January 1998. The meeting took place during the height of the Harmatant winds coming off the great Sahara desert. At night the dusty skies descended like a thick, warm fog, obscuring visibility but fortunately not obscuring the vision or enthusiasm of the AIESG membership. In the tradition of the AIESG, the meeting was both positive and productive. The considerable talents of the Minister of Foreign Affairs' personal interpreter eased any linguistic difficulties, thus, ensuring total communication and having the Minister's very comfortable meeting chamber in which to hold our deliberations certainly contributed to our success.

Building on the recommendations of the December 1997 monitoring systems expert workshop, the Group discussed and made suggestions for the design of the proposed CITES system for monitoring the illegal killing of elephants (MIKE) and nominated potential sites for its eventual implementation. The Group also took the opportunity to review carefully and revise the formal terms-of-reference of the AIESG, the Data Review Task Force and the Human-Elephant Conflict Task Force and revisit the listing of the African elephant under IUCN's new criteria. A most interesting session, which fully engaged those present, debated the role of captive facilities in the *in situ* conservation of the species. Although experiences and opinions were diverse, there was a strong common thread B African elephants will best be conserved where they belong in the wild, in Africa This issue of Pachyderm highlights the major decisions and deliberations of the meeting noted above, as well as providing papers presented to the Group on topical issues in elephant conservation today These papers ranged from human-elephant conflict to the new GPS techniques for tracking elephants.

This issue of Pachyderm goes to press on the eve of the third dialogue meeting of the African elephant Range States will be held in Arusha, Tanzania from 28 September through 2 October 1998. As I write, 32 of the 37 Range States have confirmed their attendance. In addition to informing the meeting on the current status of the African elephant, the AIESG will present the delegates with a draft proposal and budget for the implementation of the required MIKE system.

The AIESG members and Secretariat have fulfilled all their obligations to the tasks set for them by the Parties in Harare in June 1997. In just one year, the system has been conceptualised, the sites have been proposed and a transparent and objective statistical process has been applied for their final selection. Three scenarios of increasing precision are being proposed. It will be for the relevant Range States, the CITES Secretariat, TRAFFIC and IUCN to agree on the final profile of MIKE and its parallel system for the monitoring of elephant products, the Elephant Trade Information System (ETIS) which builds on the existing capacity of TRAFFIC's Bad Ivory Database System (BIDS). This agreement will be reported to the 41st meeting of the C1TES Standing Committee in February 1999. At that meeting, the Standing Committee will pass judgement on progress, by the potential trading nations, against the set criteria. The decision of whether or not to allow the limited trade of agreed quotas of ivory to Japan will be taken. Much can happen between now and then. The onus to demonstrate compliance sits firmly with the relevant Range States. However, the AIESG and her sister Group, the Asian Elephant Specialist Group (AsESG) carry the unenviable burden to assist in the development and implementation of MIKE. I see it as both an honourable recognition of the wisdom and expertise contained in these two Groups and an equally major responsibility that is difficult to carry amongst a loosely knit group of volunteers. We will have a better idea of how satisfactory is our progress once the feedback is in from partners in the Range State management authorities. Arusha should provide us with a true forecast of the work before us.

Thanks to generous grants from the United States Fish and Wildlife Service and the United Kingdom's Department of Environment, we are financially in good stead through the end of 1998. The AIESG Secretariat finalised a major proposal for future support for all the core activities of the Group and it is now with the donors for their consideration. Although we have been successful in our attempts in the past, there is no cause for complacency. I send this issue of Pachyderm to the printers with a very real sense of concern for the future of the AfESG and the Secretariat's ability to support the membership. The CITES-related issues (detailed in Pachyderm No. 24 and above) have turned the attention of the donors to the pressing deadlines and unspoken financial obligations imposed by the decisions of the Parties. This leaves the AfESG in a funding environment predisposed to supporting ClTES-related actions but not terribly conducive to the ongoing, day-to-day functional aspects of running this very active Group. At this stage, it is difficult to predict the future or the receptivity of the donors. We live in hope.

It is this hope and our raw determination that pays off in the end. The AfESG's Human Elephant Conflict Task Force (HETF) has finally succeeded in securing a generous support grant from the World Wide Fund for Nature (WWF) to begin on their most pressing priority issues. The grant will allow the Task Force to move forward on a number of fronts. This support will enable us to carry out a number of actions in parallel which will then be pulled together to help move the agenda on human-elephant conflict forward. The HETF will examine a number of important issues related to human-elephant conflict, including the determination of factors in human-elephant conflict, control of problem elephants, and spatial analysis of human-elephant conflict. Like myself, some of you may have read some rather curious statements in the press and in the newsletters of various NGOs querying the very existence of any such conflict between people and elephants throughout their shared range in Africa. Although there are a number of other pressing issues of importance to the conservation and management of the African elephant (as highlighted in the AfESG's January 1998 release of Review of African Elephant Conservation Priorities—a working document of the IUCN/SSC African Elephant Specialist Group), I am in no doubt that the mitigation of human-elephant conflict sits firmly among them.

In my experience, there is never a year without controversy for the African elephant and so far 1998 has been no exception. One, in particular, with which members of the Group have been involved in, springs to mind. As I write, many of you have contacted me about the capture and removal of 30 (with plans for an additional 20) post-weaning, juveniles from free-ranging herds in the Tuli Block of Botswana to be reared and trained in South Africa. With food in short supply, obvious signs of habitat alteration, and elephants wandering further afield to South Africa in search of sustenance, the question of population regulation in the Tuli Block no doubt enters the minds of its managers. But the capture of dozens of young animals and separation from their family groups hardly seems a way to address such problems. Although the question of legality may well be covered, the question of humane treatment surely should enter a decision of this nature.

Some of our members are currently grappling with the answers to these questions. The Elephant Managers and Owners Association in South Africa are undertaking the development and drafting of guidelines for such removals and eligibility criteria for potential recipients. I have appreciated the open and candid manner with which concerned members have tackled this issue and kept me closely briefed. Perhaps more professional advice might have been sought before such potentially controversial actions were undertaken. In future I would hope that the technical strength within the AIESG membership could always be brought to bear on such issues - preferably “before the fact”.

This has been a good year for the AfESG and there are many exciting issues on the horizon where our members are engaged and contributing in a significant way. Before I next write, there will be a census of Mozambique's largest remaining population in Niassa; a subsequent national elephant management planning exercise; technical input to the Range State Dialogue meeting; the development of a sub-regional elephant strategy for West Africa and, hopefully, the completion of the 1998 African Elephant Database update. For the membership of AfESG, there is much to be proud of in our achievements to date but many more challenges lay awaiting behind every bush. Seek them out, take them on and rejoice in your accomplishment.

RAPPORT DE LA PRESIDENTE: GROUPE DES SPECIALISTES DES ELEPHANTS AFRICAINS

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Dans le derniér numéro de Pachyderm (N^0 24),j'ai essayé d'expliquer le processus mis en route à la Dixième Réunion de la Conférence des Parties à la CITES. Ce processus comprenait l'application de conditions obligatoires pour la vente unique des stocks identifiés, d'origine connue comme provenant des populations du Botswana, de Namibie et du Zimbabwe, et de 1'achat non commercial, unique, des stocks enregistrés et audités venant de ces mêmes trois pays ainsi que des ll autres Etats de l'aire de répartition. Il y a eu beaucoup de progrès depuis. S'il a été parfois lent et hésitant, le processus a aussi été transparent, positif et productif.

Une partie du processus nécessitait 1'implication active des membres du GSEAf. Grâce au soutien généreux du Fish and Wildlife Service américain, une grande majorité de nos membres ont pu se rencontrer à Ouagadougou, capitale du Burkina Faso, à la fin de janvier 1998. La réunion s'est déroulée à la période culminante de l'Harmattan venant du grand désert du Sahara. Pendant La nuit, les nuages de poussière descendaient tel un brouillard épais et chaud, réduisant la visibilité mais certes pas le sens visionnaire et l'enthousiasme des membres du GSEAf. Conforme à La tradition du GSEAf, la réunion fut positive et productive. Le talent considérable de l'interprète personnel du Ministre des Affaires Etrangères a aplani toutes les difflcultés linguistiques et garanti une communication parfaite, et la mise à notre disposition de la salle de réunions du Ministre pour la tenue de nos délibérations a certainement contribué à notre succès.

A partir des recommandations issues de l'atelier des experts de décembre 1997 sur les systèmes de contrôle, le Groupe a discuté et émis des suggestions pour la création du système proposé par La CITES pour contrôler le massacre illégal d'éléphants (MIKE) et avancé quelques sites potentiels pour son implantation. Le Groupe a aussi profité de l' occasion pour revoir soigneusement les termes de références officiels du GSEAf, de Ia force chargéc de la révision des données et de celle chargée des conflits hommes-éléphants; il a aussi revu le classement de l'éléphant africain en fonction des nouveaux critères de l'UICN. Une séance des plus intéressantes, qui engagea complètement tous ceux qui étaient présents, a débattu du rôle des installations en captivité dans la conservation *in situ* de l'espèce. Malgré la diversité des expériences et des opinions, les avis étaient unanimes pour dire que les éléphants africains seraient toujours mieux préservés là où ils vivent dans La nature, en Afrique. Ce numéro de Pachyderm souligne les décisions et les délibérations principales de La réunion citée plus haut et parle des articles présentés au Groupe sur des questions précises de la conservation des éléphants aujourd'hui. Ces articles vont des conflits hommes-éléphants aux nouvelles techniques GPS pour suivre les éléphants.

Ce numéro part à l'édition à la veille de la troisième réunion-dialogue des Etats de l'aire de répartition des éléphants qui se tiendra à Arusha, en Tanzanie, du 28 septembre au 2 octobre 1998. Au moment où j'écris, 32 des 37 Etats ont confirmé leur participation. Le GSEAf va informer la réunion du statut actuel de l'éléphant africain mais aussi présenter aux délégués un projet de proposition et de budget pour La mise en application du système MIKE demandé.

Les membres et le Secrétariat du GSEAf ont rempli toutes les obligations que leur avaient confiées les Parties à Harare en juin 1997. En un an très précisément, le système a été conceptualisé, les sites, proposés, et un processus statistique transparent et objectif a été appliqué pour La sélection finale. On a proposé trois scénarios de précision croissante. Il revient aux Etats concernés, au Secrétariat de La CITES, à TRAFFIC et à l'UICN de se mettre d'accord sur le profil final de MIKE et de son système parallèle pour le contrôle des produits tirés des éléphants, le Système d'Jnformation sur le Commerce de l'Eléphant (ETJS = Elephant Trade Jnformation System) qui s'élabore à partir de l'actuel potentiel de TRAFFIC qu'est le Bad Ivory Database System (BIDS). Cet accord sera rapporté à la 41 ème Réunion du Comité permanent de la CITES, en février 1999. Lors de cette réunion, le Comité Permanent donnera son avis sur les progrès, auprès des pays potentiellement intéressés par le commerce, contre les critères proposés. Ils prendront la décision de permettre ou non le commerce limité de quotas agréés d'ivoire au Japon. ll peut se passer beaucoup de choses d'ici là. Les Etats de l'aire de répartition doivent faire la preuve de leur respect des règles. Cependant, le GSEAF et son groupe frère, le Groupe des Spécialistes de l'Eléphant Asiatique (GSEAs), ont la charge, peu enviable, d'aider au développement et à la mise en route de MIKE. Je considère ceci comme la reconnaissance honorable de la sagesse et de l'expérience de ces deux groupes et aussi comme une responsabilité majeure, difficile à assumer dans un groupe de bénévoles peu soudés. Nous aurons une meilleure idéé de la satisfaction apportée par notre processus lorsque nous connaîtrons la réponse de nos partenaires au sein des autorités de gestion des Etats de l'aire de répartition. Arusha devrait nous donner une vraie perspective du travail qui nous attend.

Grâce aux dons généreux du Fish and Wildlife Service américain et au Département de l'Environnement britannique, nos finances sont bonnes jusqu'à la fin de 1998. Le Secrétariat du GSEAf a finalisé une proposition importante pour le support de toutes les activités de base du Groupe, et elle est maintenant soumise à la considération des donateurs. Le succès rencontré par nos demandes passées ne doit pas nous inciter à une confiance exagérée. J'envoie ce numéro de Pachyderm aux éditeurs avec une très réelle inquiétude quant à l'avenir du GSEAf et de la capacité de son Sécrétariat à soutenir ses membres. Les questions relatives à la CITES (décrites dans Pachyderm N⁰ 24 et avant) ont attiré l' attention des donateurs sur les délais urgents et sur les obligations financières nouvelles imposées par les décisions des Parties. Ceci met le GSEAf dans un environnement plus disposé à financer des actions liées à la CITES mais moins enclin à satisfaire les frais de fonctionnement quotidiens de ce Groupe très actif. Actuellement, il est difficile de prédire l'avenir ou la réceptivité des donateurs. Nous vivons d'espoir.

Ce sont cet espoir et notre détermination absolue qui paient en fin de compte. La foree du GSEAf chargée des conflits hommes-éléphants a finalement réussi à s'assurer le support généreux du Fonds Mondial pour la nature (WWF) pour aborder les questions les plus urgentes. Ce don va permettre à la Force de progresser sur un certain nombre de fronts. Ce soutien nous permettra de mener à bien un certain nombre d'actions en parallèle qui seront ensuite rassemblées pour faire avancer le calendrier sur les conflits hommes-éléphants. Comme moi, certains d'entre vous ont peut-être lu certaines délarations plutôt curieuses dans la presse et dans la revue de diverses ONG qui mettent en doute l'existence-même de ces conflits entre les hommes et les éléphants dans les zones qu'ils partagent en Afrique. Bien qu'il y ait un grand nombre d'autres questions urgentes et importantes dans la conservation et la gestion de l'éléphant africain (comme souligné dans la Revue des Priorités en matière de Conservation de l'Eléphant Africain, par le GSEAf en janvier 1998 - un document de travail du Groupe des Spécialistes des Eléphants Africains de la CSE/UICN), je ne doute pas que l'atténuation des conflits entre les hommes et les éléphants n'ait sa place parmi elles.

Croyez-en mon expérience, aucune année ne passe sans controverses au sujet de l'éléphant africain, et jusqu'à présent, 1998 ne fait pas exception. Une en particulier, qui a impliqué des membres du Groupe, vient à l'esprit. A l'heure où je vous écris, beaucoup d'entre vous m'ont contactée au sujet de la capture et du déplacement de 30 (20 de plus sont prévus) jeunes éléphants sevrés venant de troupeaux sauvages de Tuli Block, au Botswana, pour être élevés et entraînés en Afrique du Sud. Certes, la nourriture se fait rare, l'habitat montre des sigues évidents d'altération, et les éléphants s'aventurent plus loin en Afrique du Sud à Ia recherehe de nourriture. La question de la régulation de la population à Tuli Block se pose donc certainement à ses managers. Pourtant la capture de dizaines de jeunes animaux et la séparation d' avec leur groupe familial ne semblent pas une bonne façon de régler ce problème. Bien que l'aspect légal soit peut-être bien respecté, 1'aspect traitement humain devrait sans doute intervenir dans une décision de cette nature.

Certains de nos membres sont actuellement aux prises avec la réponse à donner à ces questions. L'Association des Gestionnaires et des Propnétaires d'éléphants d'Afrique du Sud est en train de mettre au point et de rédiger des directives pour de tels déplacements et des critères d'éligibilité pour les récipiendaires potentiels. J'ai appréié la manière ouverte et candide avec laquelle des membres inquiets ont abordé cette question et m'ont tenue au courant. ll est probable qu'il aurait fallu solliciter des conseils plus professionnels avant d'entreprendre des opérations aussi sujettes à caution. A l'avenir, j'éspère que la force technique que représentent les membres du GSEAf pourra toujours être consultée sur de telles questions- si possible «avant qu'il soit trop tard».

Cette année a été bonne pour le GSEAf, et nos membres se sont engagés et collaborent significativement à de nombreux aspects excitants. Avant que je ne reprenne la plume, il y aura eu un recensement de la plus grande population restante au Mozambique, à Niassa; suite à cela, un exercice de programmation de gestion des éléphants au niveau national; un apport technique à ha réunion-dialogue des Etats de l'aire de répartition; la mise au point d'une stratégie régionle pour l'é1éphant en l' Afrique de l'Ouest et, espérons-le, la fin de la mise àjour de la Banque de Données pour l'Eléphant Africain de 1998. Nous, les membres du GSEAf, avons toutes les raisons d'être fiers de ce que nous avons accompli, mais de nombreux autres défis nous attendent au tournant. Cherehons-les, prenons-les à bras le corps et réjouissons.nous de pouvoir les relever.

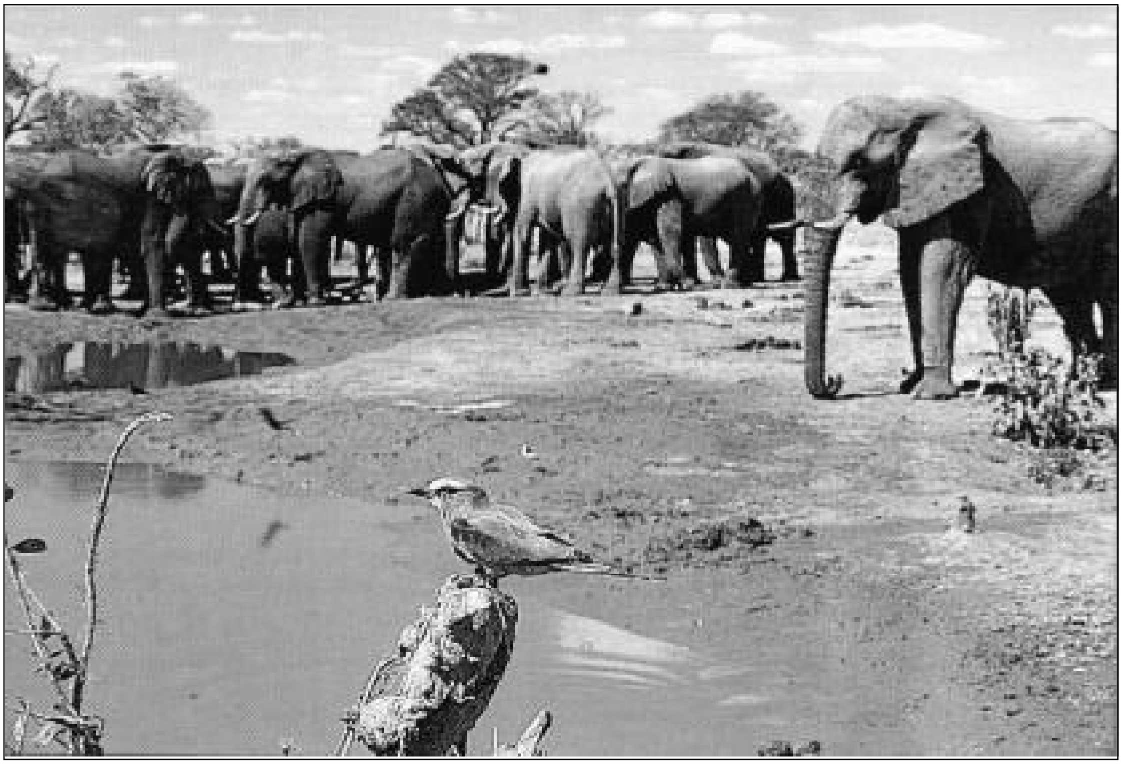

Photo Credit: Clive Walker

TRENDS OF THE ELEPHANT POPULATION IN NORTHERN BOTSWANA FROM AERIAL SURVEY DATA

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SUMMARY

Aerial surveys of elephants in northern Botswana have been taking place since the early 1970s. While it is not possible to use all of the data from these surveys, they provide evidence to suggest that since 1987 the population of elephants in northern Botswana has increased to its present level of around 80,000 animals at a rate of around 6% per annum. Their range, which has expanded south and westward, changes seasonally but is largely outside protected areas (Figure 1).

This paper summarises the methods and results of aerial surveys since 1973 and presents a history of the elephant population in Botswana with estimates of recent trends provided by survey data.

RESUME

ll est évident que la population d’éléphant du nord du Botswana a connu une croissance pour atteindre son niveau actuel de 80000 têtes avec environ un taux de croissance de 6% l’an. Leur zone de distribution s’est accru du sud vers l’ouest, avec des changements saisonnniers.

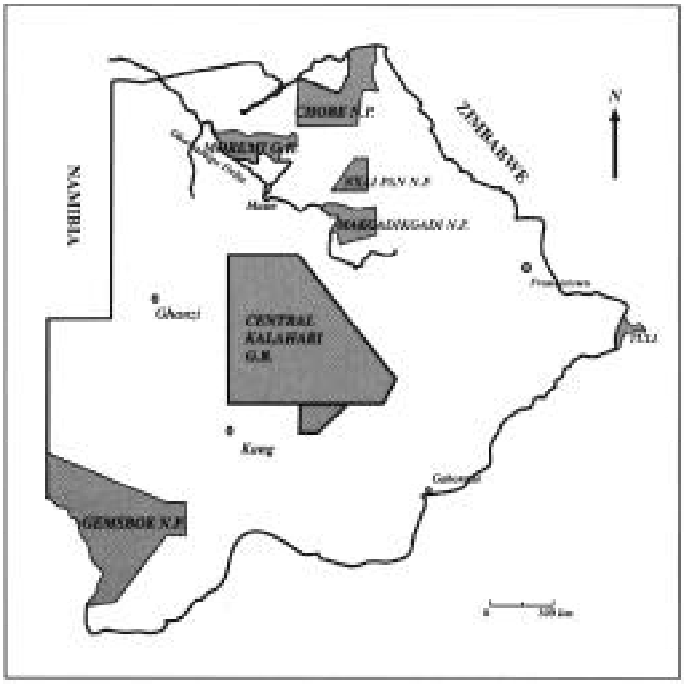

Figure 1. Map of Botswana showing protected areas (shaded)

INTRODUCTION

Botswana supports one of the largest populations of elephants in Africa Most occur outside protected areas in the north (Figure 1) where they form part of a larger population spreading from Zimbabwe through Botswana to Namibia. In addition, a population of up to 1,000 animals is found in and around the Northern Tuli Game Reserve, a small private reserve in the east of the country.

Most of the information about the size and distribution of the elephant population in northern Botswana comes from aerial surveys which have been taking place since the early 1970s. It is not possible to use the data from all of these surveys to obtain estimates of overall population trends because of variations in coverage and quality. A summary of these surveys is included in this paper, however, because they could be used, for example, for obtaining information about elephant numbers within specific areas (such as Chobe National Park) and about their distribution.

Historical trends in elephant distribution

In the past, surface water occurred more widely throughout Botswana than it does today and wild animals, including large species such as the elephant and rhino, were able to survive even in the Kalahari, at least during the rainy seasons. Elephant were probably distributed almost throughout the country and there may have been as many as 400,000 animals (Campbell, 1990) at the beginning of the 19th century. It is thought that the country began to dry up from about 1870 (Campbell, 1990) but before this happened, elephants had been reduced to low numbers by uncontrolled commercial hunting for ivory. By the beginning of the present century the elephant population had been reduced to a remnant population inhabiting only the north of Botswana, and elephants had become very rare even in what is now Chobe National Park. Measures imposed in 1893 to reduce this trend included establishing hunting quotas, and implementing a system whereby foreigners had to buy a licence and local people had to have written permission to hunt elephants (Campbell,

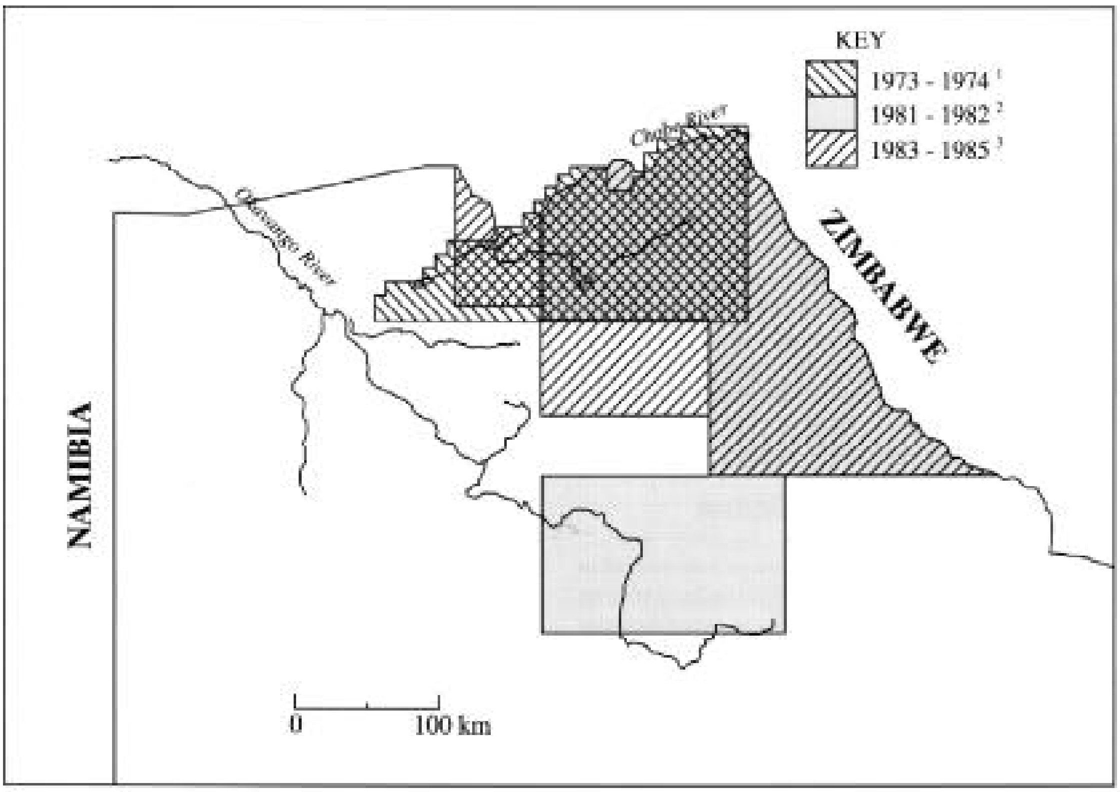

Figure 2. Areas surveyed for elephants from 1973 to 1985 ([1]Sommerlatte, 1976; [2]Melton, 1985; [3] Work, 1986).

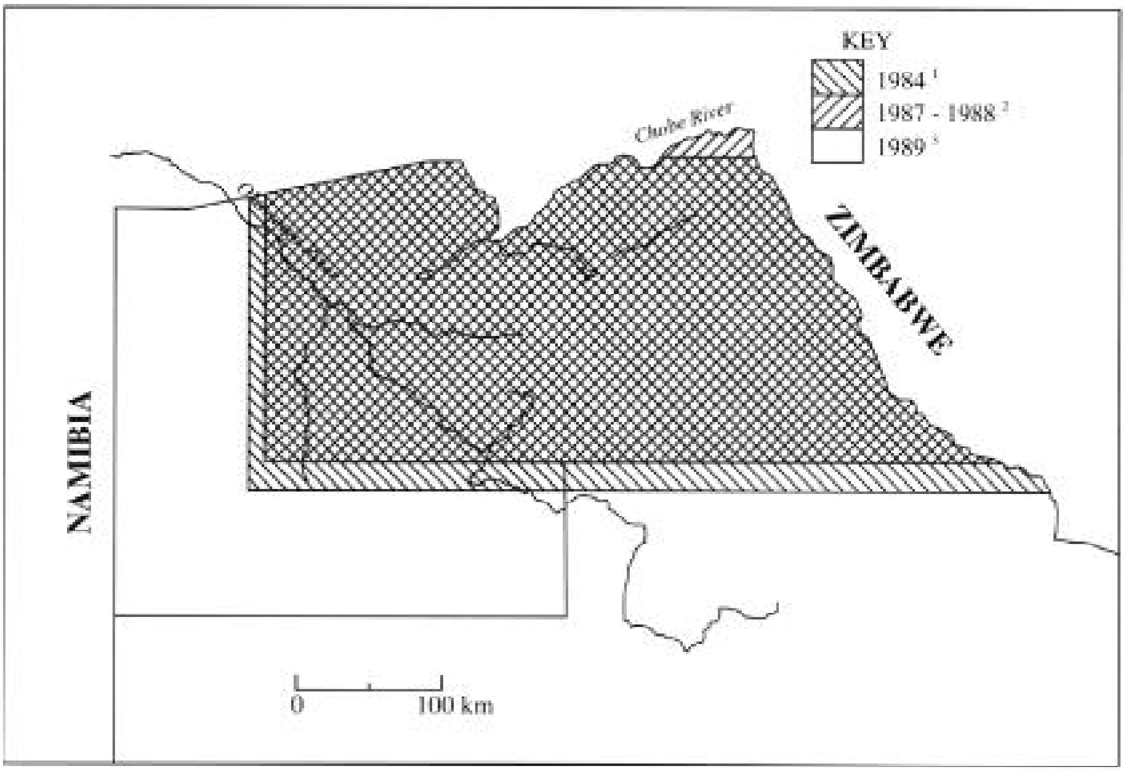

Figure 3. Areas surveyed for elephants from 1984 to early 1989 ([1]KCS, 1985; [2]Gavor, 1987; Calef 1988; [3]Calef 1988).

1990). By about 1930, increases in the population were observed, although numbers were still low (Child, 1968) and their distribution restricted mainly to the north and north-east of Botswana In the late 1950s, a rapid increase in elephant numbers was observed with the population perhaps being augmented by immigration from neighbouring countries (Child, 1968). Hunting increased until it was banned in 1983 (Melton, 1985) in response to concerns that tusk weights were declining.

AERIAL SURVEYS IN BOTSWANA

By the late 1960s damage to vegetation was evident in the Chobe National Park (Child, 1968) in the north-east of the country. This was attributed to an overabundance of elephants and an aerial survey (Figure 2) was undertaken in 1973 (Sommerlatte, 1976) to estimate the size of the elephant population. This was complemented by studies of vegetation in part of the area and concentrated on Chobe National Park and its surrounds.

Spinage (FGU-Kronberg, 1987) reports surveys of the Okavango Delta and Chief's Island by Astle and Graham (1976) and Biggs (1979). More extensive surveys were done by the Department of Wildlife and National Parks (DWNP) (Melton, 1985) in 1981 and 1982 (Figure 2).

None of these surveys covered the same areas (although there was some overlap) and much of the area in which elephants were known to occur was omitted from them (eg. the Okavango Delta). This prevented comparisons or trends from being obtained and consequently, in 1983, surveys were designed specifically to obtain "a good estimate of elephant numbers" (Work, 1986). However, as can be seen in Figure 2, these did not improve coverage greatly and neither were they completed during a single season.

The next surveys, completed in 1984 and 1985 (KCS, 1984 and 1985) came close to the required coverage (Figure 3) although the Chobe river front was omitted despite the fact that this area was known to be particularly favoured by elephants during the dry season.

In the 1980s, the focus of wildlife management changed from the state of the vegetation to concerns about the effects of illegal hunting on the status of wildlife populations in northern Botswana. The DWNP (Calef, 1988 and 1990, Gavor, 1987) therefore carried out extensive aerial counts in 1987 and early 1989 (Figure 3).

In September 1989, a programme of countrywide surveys (Bonifica, 1992) was started and the entire elephant range in northern Botswana has been covered at least once a year since then (Figures 4 and 5).

METHODS

Survey methods

Aerial surveys in Botswana have generally used the standard technique of aerial transect sampling (Norton Griffiths, 1978). Briefly, this entails counting animals along transects placed at a predetermined distance apart to give the required sampling intensity. A pair of observers in the aircraft count animals seen between markers (rods or lines attached to the lift struts of the aircraft). The markers are separated at a distance that gives a predetermined "strip width" on the ground when flying at the chosen height above ground.

It is important that a constant height above ground level (a.g.l.) is maintained using a radar altimeter although some surveys have been attempted using the pressure altimeter and subtracting the altitude of the ground to calculate the height above ground. Much of Botswana is featureless and accurate navigation is difficult. However, position on the transects was maintained using an OMEGA navigation system. After 1991 GPS satellite navigation systems were used, enabling very accurate navigation.

Later surveys have common standards of height above ground level (300 feet), strip width (200m per side or less) and information to be recorded. Records are made of the positions (grid coordinates from the GPS) at which sightings are made, the number of animals in each group and whether the group is a family group or a group of bulls. Other wild mammal species, domestic livestock and ostriches are also recorded. Heights above ground are read from the radar altimeter every minute of latitude (0.01670) (on very long transects this is reduced to a reading every two minutes) for later calculation of sample area and notes of open water and fires are also kept.

Jolly's Method 2 for sampling units of unequal size (Jolly, 1969) has been used consistently to obtain estimates and variances.

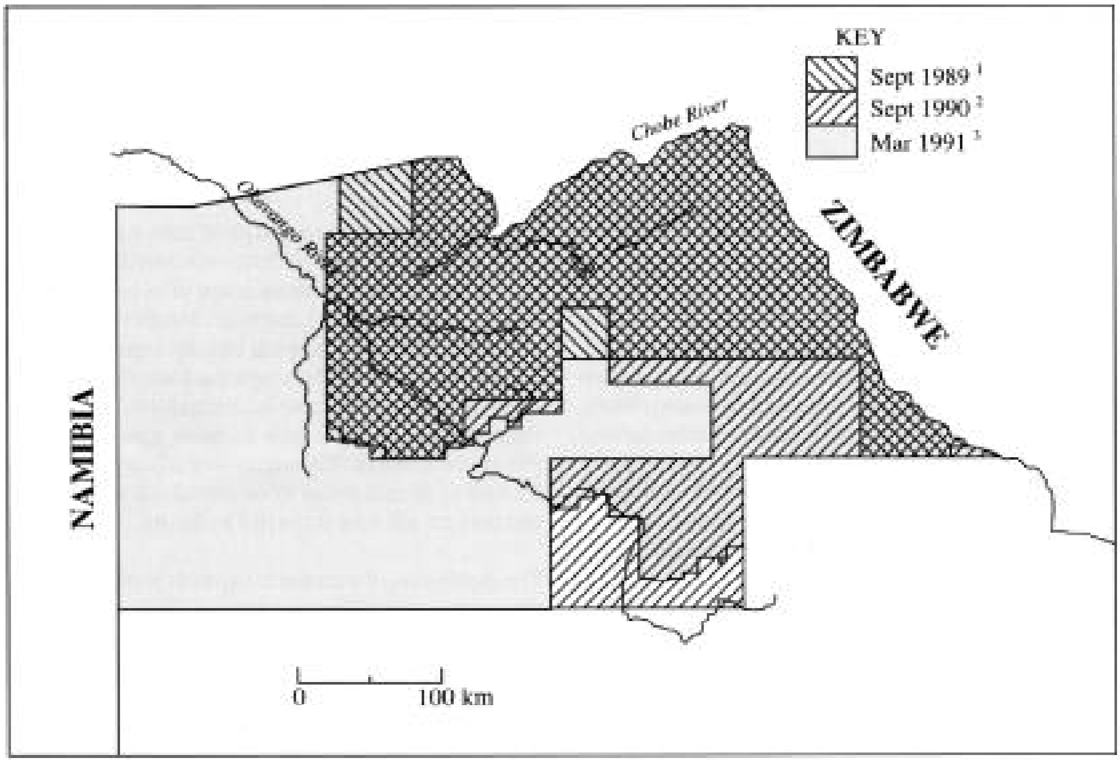

Figure 4. Areas surveyed for elephants from Sept 1989 to April 1991 ([1]Bonifica ,1992; [2]Bonifica, 1992; [3]Bonifica, 1992).

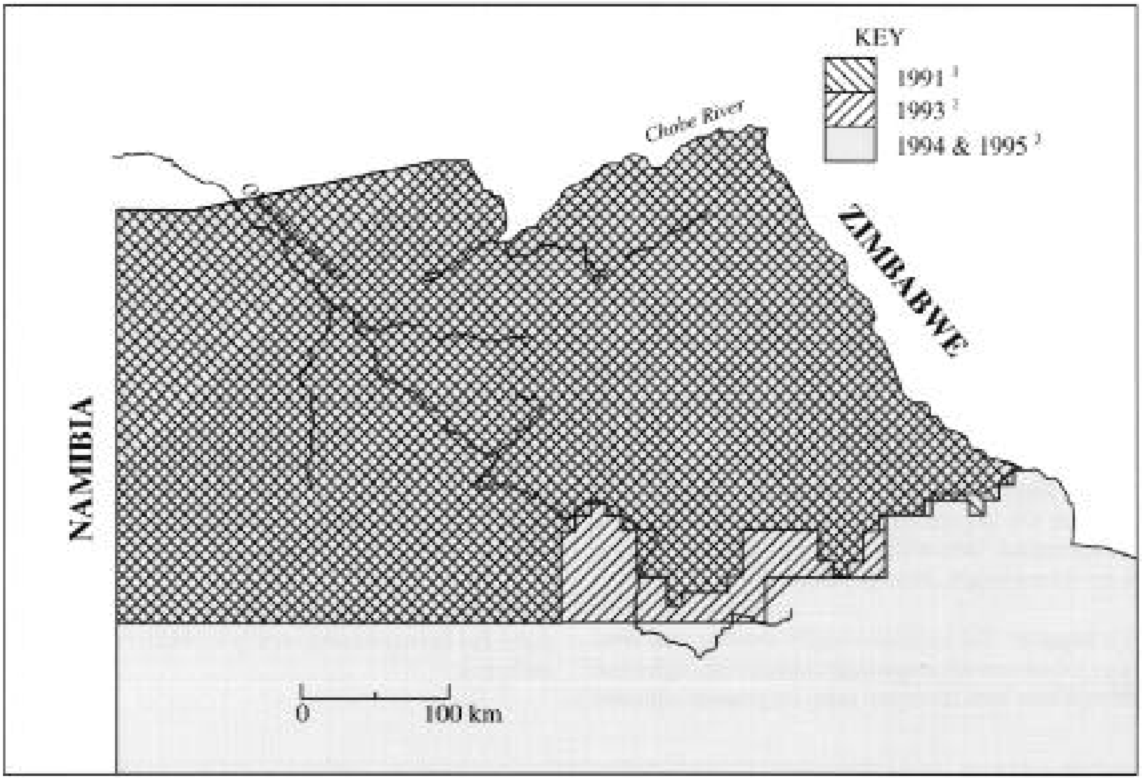

Figure 5. Areas surveyed for elephants from Sept 1991 to Sept 1995 (1 Craig, 1991; [2]ULG, 1993; [3]ULG, 1994; DWNP, 1995; Craig, 1996).

Data sources

Most of the surveys attempted to follow standard procedures (summarised in Table 1). However, constraints of equipment and time in some cases reduced their quality. For instance, not keeping a constant height above ground level due to the lack of a radar altimeter (Sommerlatte, 1976) or an inability to complete an entire survey within a reasonable time or even within the same season (Work, 1986), have prevented the use of estimates in more detailed analyses. In other cases, the data quality has been reduced because the surveys did not cover an adequate amount of the elephant range in northern Botswana (eg. Melton, 1986) or because it was not possible to ascertain exactly what area was covered or even the techniques used, say for calibrating strip widths (eg. KCS, 1984).

Because of this, early survey data are not considered adequate for inclusion in analysis of trends for the elephant population in northern Botswana, although they are of general interest. There is now a reasonable set of data collected from 1987 from which elephant population estimates and trends were examined (Table 2).

Distribution maps

Elephant distributions were mapped from survey data by summarising numbers of animals seen into cells of 0.1 by 0.1 degrees making up a raster image of 94 cells across by 93 cells high (9.4 by 9.3 degrees). Numbers of animals seen were corrected for sampling intensity to give a predicted density for each cell. The image was then filtered using a moving average. This removed unimportant differences in value between adjacent cells to create a more coherent picture of distribution. Cell values were adjusted to preserve the total of all cells (equal to the overall estimate) and the numbers per cell were converted to density.

The distribution of densities is too wide to permit it to be displayed meaningfully using linear density increments and the cells were therefore shaded according to log (density).

Analysis of population trends

Exponential regression was used to describe population increase of the northern Botswana elephant population (Caughley and Birch, 1971). This presents population

Work, D.R. (1986) Summary report of aerial surveys conducted in 1983, 1984 and 1985, Typed manuscript.

Table 1. Summary of the equipment and field parameters used during aerial surveys of northern Botswana from 1973 to 1995.

Year (ft)	Location (m)	Area (km^2) Height/Nav	Height a.g.l.	Strip Width	Equipment	Author
1973/74	Chobe plus surrounds (Figure 2)	22,500	490-660	800	press alt/?	Sommerlatte 1976
1981/82	NE Bots (not all in 1 season) (Figure 2)	54,977	250	500	radar alt/ GNS	Melton 1985
1983 dry	NE Bots (partial) (Figure 2)	4,125	300-350	?	radar alt/ GNS	Work 1986
1984 wet	NE Bots (partial) (Figure2)	42,971	300-350	?	radar alt/ GNS	Work 1986
1984 Apr/May	N. Bots excluding Chobe R. (Figure 3)	72,000	300	600	radar alt/ GNS	KCS 1984, 1985
1984 Oct/Nov	N. Bots excluding Chobe R (Figure 3)	72,000	300	400	radar alt/ GNS	KCS 1984, 1985
1985 wet	NE Rots (partial Chobe) (Figure 2)	2,230	300-350	?	radar alt/ GNS	Work 1986
1987 Jan/Feb	N. Bots (Figure 3)	119,774	300	500	radar alt/ GNS	Gavor 1987, Calef 1988
1987 May/Jun/Jul	N. Bots (Figure 3)	119,774	300	500	radar alt/ GNS	Gavor 1987, Calef 1988
1989 Jan/Feb/Mar/Apr	N. Bots (Figure 3)	132,016	300	500	radar alt/ GNS	Calef 1990, 1993
1989 Sep	N. Bots (Figure 4)	60,878	300	500	radar alt/ GNS	Bonifica 1992
1990 Apr	N. Bots (Figure 4)	140,387	300	500	radar alt/ GNS	Bonifica 1992
1990 Sep	N. Bots (Figure 4)	67,206	300	500	radar alt/ GNS	Bonifica 1992
1991 Mar	N. Bots (Figure 4)	150,448	300	500	radar alt/ GNS	Bonifica 1992
1991 Sep	N. Bots (Figures)	154,919	300	?400	radar alt/ GNS	Craig 1991
1993 May	N. Bots (Figures)	143,943	300	?400	radar alt/ GNS	DWNP 1993
1993 Sep	N. Rots (Figure 5)	166,236	300	340	radar alt/ GNS	ULG 1993

Table 1 Continued

Year	Location	Area (km²)	Height a.g.l. (ft)	Strip Width (m)	Equipment Height/Nav	Author
1994 Apr	Countrywide (Figure 5)	573,694	300	400	radar alt/ GNS	ULG 1994
1994 Sep	Country wide (Figure 5)	579,049	300	400	radar alt/ GNS	ULG 1994
1995 Apr	Countrywide (except E Bots) (Figure 5)	?	300		radar alt/ GNS	DWNP 1995
1995 Sep	Countrywide (except E Bots) (Figure 5)	122,922	300	?	radar alt/ GNS	Craig 1996

change in terms of proportional or percentage change per unit time and is the easiest to justify in the absence of evidence of more complex patterns of change. Linear regressions of the natural logarithms of survey estimates versus time (Caughley, 1977) between 1987 and 1995 were used to determine the rate of population increase and its 95% confidence limits.

Modelling approach to estimating rate of increase and its precision

There are differences in sampling intensity and precision among the various estimates. As a result, the use of regression analysis is not strictly valid. The possible range of results was therefore modelled using a Monte Carlo simulation (eg. Sokal and Rohlf, 1995) as follows: for every survey result, a normal distribution was constructed using the estimate and its standard error. A possible estimate was drawn at random from each of these distributions to provide a set of results simulating possible estimates for the whole period in question. A regression coefficient was derived from the set. This was repeated a million times and the results were used to calculate a mean regression coefficient and its variance.

RESULTS AND DISCUSSION

Distribution

Surveys suggest that in 1984 the elephant range was a fairly restricted area in the north of Botswana (Figure 6). Since then the range has expanded substantially (Figure 7). Most elephants in northern Botswana now occur outside protected areas and there are very marked differences between their wet and dry season ranges. Their wet season range is large (about 100,000 km²) and extends almost throughout the north (Figure 8). It shrinks to about 60,000km² in response to the drying-up of seasonal pans and streams when the animals concentrate (Figure 9) near the major rivers in northern Botswana (the Chobe, Linyanti and Kwando rivers) and in the Okavango Delta. Densities in some areas can be extremely high at this time of the year - for example 7/km² and 4/km² along the Linyanti and Chobe rivers respectively. In the wet season, when elephants disperse, densities in these two areas are reduced to 2/km² and 0.5/km² respectively, although there are a few other areas in which there appear to be high densities throughout the year. When pans persist well into the dry season following a good rainy season, however, elephants may remain widely dispersed throughout the year.

Surveys show general population movements but may miss important minor details: following particularly good

Table 2. Estimates of elephant numbers in northern Botswana from 1987 to 1995 using aerial surveys.

Date	Estimate	95% Range		
1987 (January)	50,440	40,352	-	60,528
1987 (June)	40,530	26,750	-	54,310
1989 (February)	66,051	45,554	-	86,548
1989 (September)	59,896	42,806	-	76,987
1990 (April)	49,064	37,276	-	60,878
1990 (September)	55,835	35,635	-	76,036
1991 (March)	64,916	44,864	-	84,968
1991 (September)	68,771	50,571	-	86,971
1993 (May)	73,901	44,052	-	103,751
1993 (September)	79,033	65,364	-	92,701
1994 (April)	54,927	41,082	-	68,772
1994 (September)	78,304	61,477	-	95,131
1995 (April)	81,041	64,371	-	97,711
1995 (September)	77,916	59,918	-	95,925

rainy seasons, extremely long-distance movements of small numbers of elephants have been recorded. For example, in February 1997 a pair of elephants moved from the north through the Central Kalahari Game Reserve until they were shot as problem animals by the Department of Wildlife and National Parks (DWNP) staff in the Kang area of south-west Botswana. They had traveled a distance of more than 44)0km. Shortly after this another elephant, which may also have originated in the north, was shot south of the Gemsbok National Park close to the South African border, and nearly 1,000km from the Chobe river (Nagafela, 1998). Tracking the progress of the animals which villagers reported had passed derived this information. While elephants have been known to move very long distances elsewhere in Africa (eg. Thouless and Dyer, 1992) in response to season, the significance of the movements reported here is that the animals traveled through regions that have not been occupied by elephants for perhaps a hundred years.

Family groups of elephant appear to have slightly different ranges from bull groups and tend to occur in habitats with easier access to water than do bulls (Figures 10 and 11). Bulls are generally more widely dispersed, especially around the periphery of the range.

The number and trend of elephant populations

The estimated rate of increase from the regression is 6.0% per annum (Figure 12). Although this is statistically significant ($t = 4.3165$, $P<0.01$), there is a wide range of uncertainty around the actual estimated value, with a 95% probability that the rate of increase is between 2.9% and 9.2%. The estimated rate of increase obtained by the Monte Carlo simulation was 6.05% (range 3.1% to 9.1%). This result is sufficiently close to that from the regression analysis to give confidence that the violations of assumptions involved in using the latter are not serious.

This estimate is fairly close to predictions from other sources for northern Botswana (Calef, 1990, calculated a growth rate of 5.7%) and for adjacent Zimbabwe (rates of between 4% and 5% were estimated by Cumming, 1981 and Craig, 1989). It is also well below the theoretical maximum instantaneous rate of increase for elephants (r_{max}) calculated as, for example, 7.4% per annum (FGU Kronberg, 1988). The latter figure should be taken as a realistic upper limit in preference to the upper confidence limit of 9.2%. It can be expected that as the time-series of available data lengthens, the precision of the results will increase and it will become possible to state the estimate of the rate of increase with more confidence.

When interpreting such data, the possibility of bias exaggerating the trend should be borne in mind. When monitoring takes place over many years, there can be a drift in procedural standards (eg. transect strip widths have changed; control of height may have improved; accuracy of navigation certainly has improved) which could cause a false trend in numbers. Improvements in techniques are aimed at eliminating bias (especially under-counting) because where there is a bias, that bias may change and produce spurious increases or decreases. However, the endeavour to achieve perfection in this could itself produce an upward trend in estimates. This possibility, however remote, can never be ruled out until there are sufficient data that the detected increase exceeds any possible false trend.

A second caution is that population increase, even if real, does not necessarily imply natural increase through breeding. The northern Botswana population is not closed and net immigration or emigration could occur from neighbouring countries. A measure of the intrinsic rate of increase of the population is not possible until a time-series of estimates of the entire regional population becomes available. Although simultaneous surveys of neighbouring Namibia and Zimbabwe have been carried out, (Craig, 1996), the available data are insufficient to determine an overall trend.

Finally, it is worth repeating that one cannot use estimates of Botswana's elephant numbers prior to 1987 to demonstrate a trend over a longer period. Results before 1987 are not useful and cannot be made useful in an analysis of trends, because no complete and objective surveys were done. Any estimate of trend based on these would be no better than a guess. This emphasises the value of complete, repeated and standardised surveys.

ACKNOWLEDGEMENTS

This paper is published with the permission of the Director of the Department of Wildlife and National Parks, Botswana.

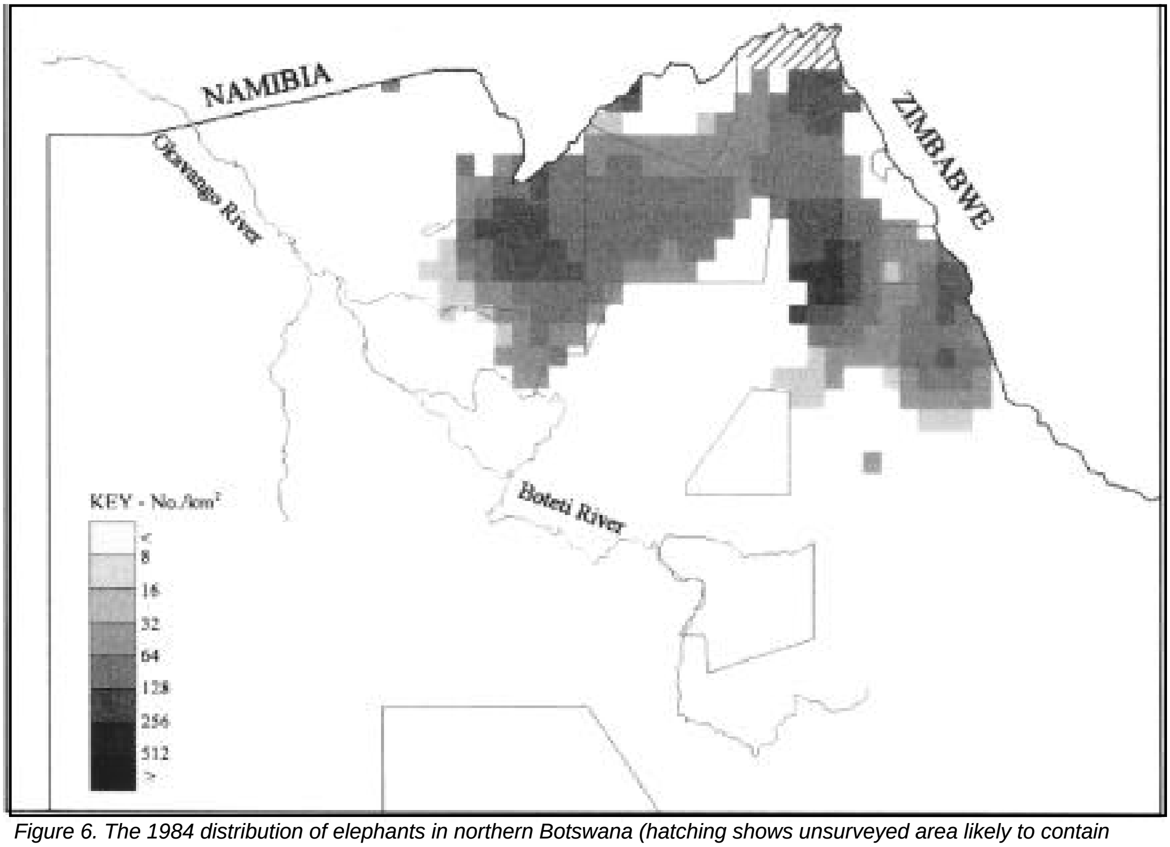

Figure 6. The 1984 distribution of elephants in northern Botswana (hatching shows unsurveyed area likely to contain elephants).

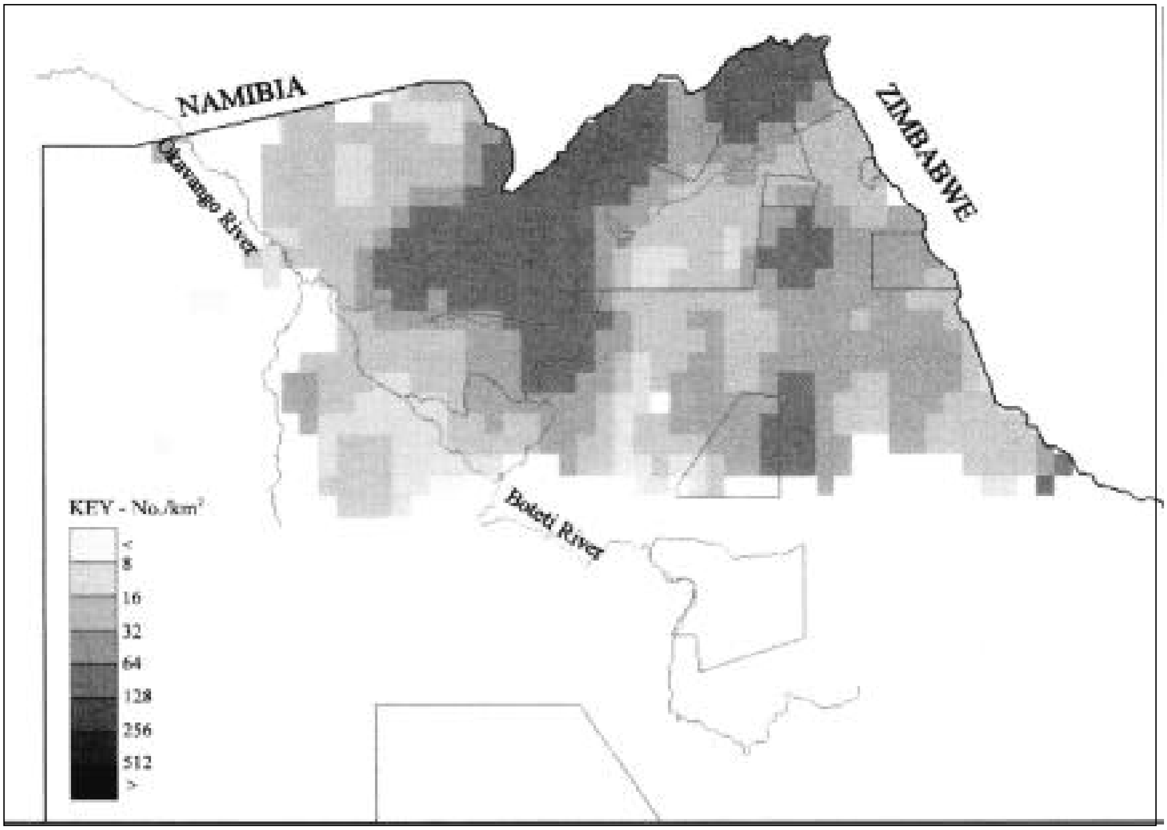

Figure 7. Mean distribution of elephants in northern Botswana from 1989 to 1995.

The contributions of the many participants in surveys over the years are appreciated.

REFERENCES

Astle, W.L. and Graham, A. (1976) Ecological investigations of the UNDP in the Okavango Delta, In: *Symposium on the Okavango Delta,* Botswana Society, Gaborone.

Biggs, R.C. (1979) *The ecology of Chief's Island and the adjacent flood plains of the Okavango Delta, Botswana* MSc thesis, University of Pretoria

Bonifica (1992) *Aerial Surveys,* Final Report to Dept Willdlife and National Parks, Ministry of Commerce, Botswana.

Calef, G.W (1988) Aerial census of large mammals in northern Botswana 1987, *Internal Report, Dept. Wildlife and National Parks, Botswana.*

Calef, G.W (1990) Elephant numbers and distribution in Botswana and north-western Zimbabwe, *Management of the Hwange Ecosystem,* Workshop sponsored by USAID.

Calef, G.W (1993) Numbers and distribution of wildlife and domestic stock in Ngamiland and Chobe Districts January to April 1989, *Internal Report, Dept Wildlife and National Parks, Botswana.*

Campbell A.C. (1990) History of Elephants in Botswana, *The Future of Botswana's Elephants,* Workshop of the Kalahari Conservation Society and Dept. Wildlife and National Parks.

Caughley, G. (1977) *Analysis of vertebrate populations,* John Wiley and Sons Ltd, Chichester, New York, Brisbane, Toronto.

Caughley, G. and Birch, L.C. (1971) Rate of increase, *J. Wildl. Mgmt.* 35(4): 658 - 663.

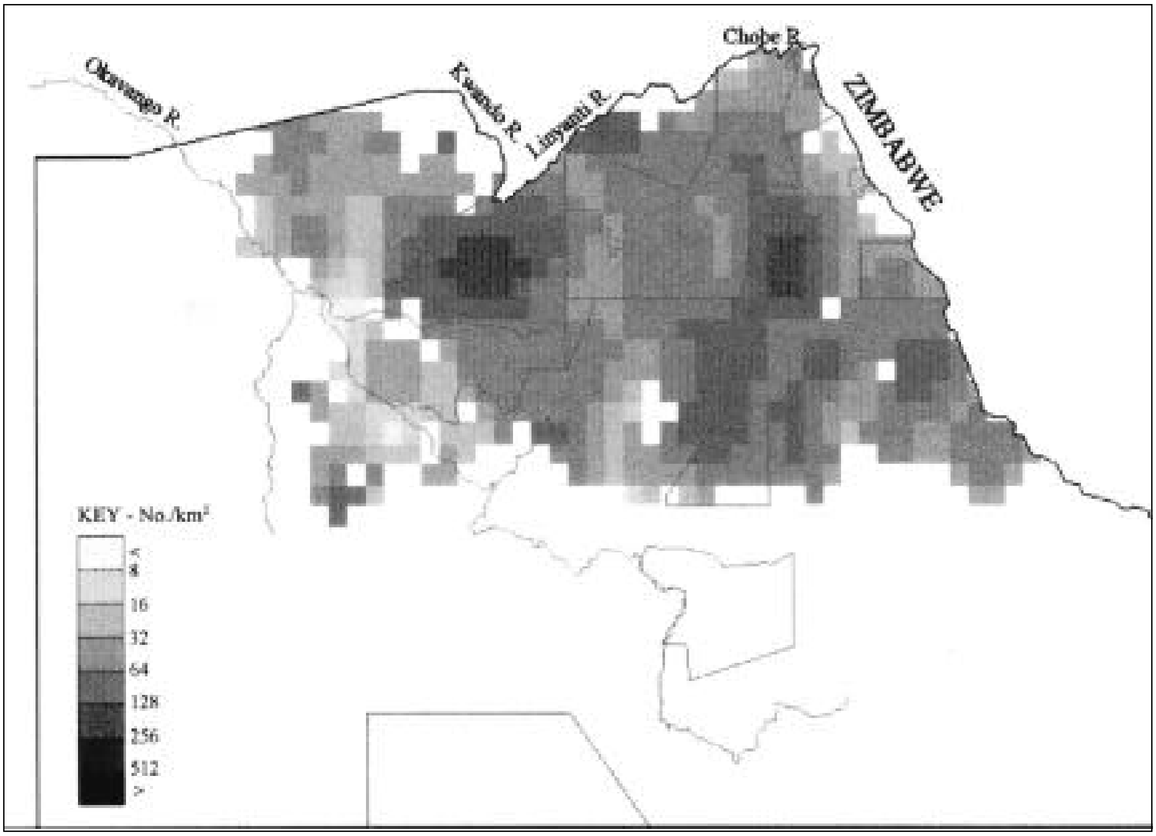

Figure 8. Mean wet season distribution of elephants in northern Botswana.

Caughley, G. and Krebs, C.J. (1983) Are big mammals simply little mammals writ large? *Oecologia* 59: 7- 17.

Child, G.F.T. (1968) An ecological survey of northeastern Botswana, Report to the Government of Botswana, F.A.O. Report No. TA 2563.

Craig G.C. (1989) Population dynamics of elephants, In: Eds R.B. Martin, G.C. Craig and V.R. Booth, *Elephant Management in Zimbabwe,* Dept National Parks and Wildlife Management, Zimbabwe.

Craig G.C. (1991) 1991 dry season survey of northern Botswana, *Report to Dept. Wildlife and National Parks, Botswana.*

Craig G.C. (1996) *ELESMAP Project: Final Technical Report,* CEC project No. B7-5040, Namibia Nature Foundation.

Cumming D.H.M. (1981) The management of elephant and other large mammals in Zimbabwe, In: *Problems in management of locally abundant wild mammals,* Eds. P.A. Jewell and S. Holt, Academic Press, New York.

DWNP (1993) Aerial survey results, *Internal Report, Dept Wildlife and National Parks, Botswana.*

DWNP (1995) Results of a wet season aerial survey of 1995, *Dept. Wildlife and National Parks, Botswana.*

FGU-Kronberg (1987) *Special Report: Review of the aerial monitoring programme,* Report to Dept Wildlife and National Parks, Ministry of Commerce.

FGU-Kronberg (1988) *Estimation procedures for the setting of controlled hunting area quotas,* Report to Dept Wildlife and National Parks, Ministry of Commerce.

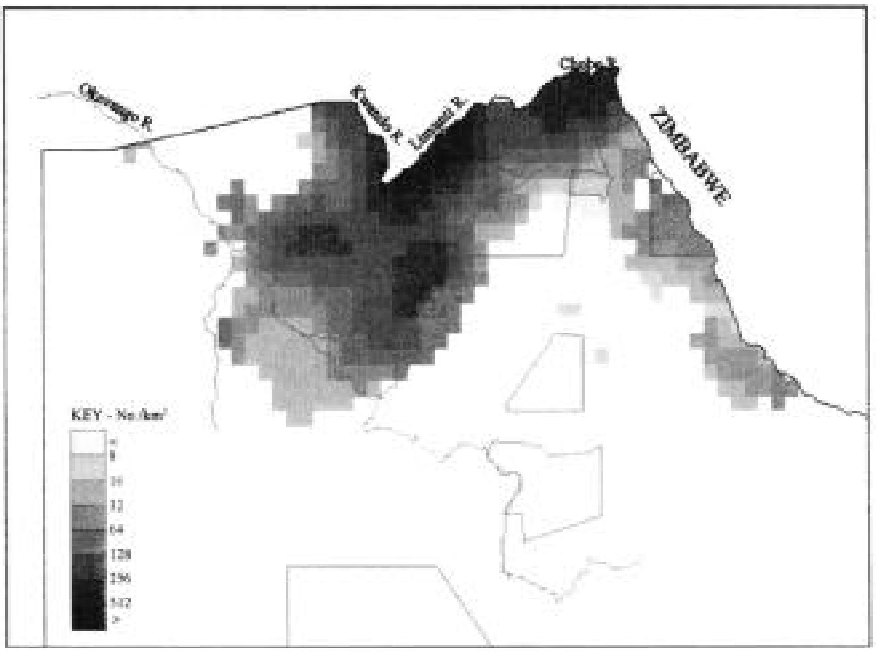

Figure 9. Mean dry season distribution of elephants in northern Botswana.

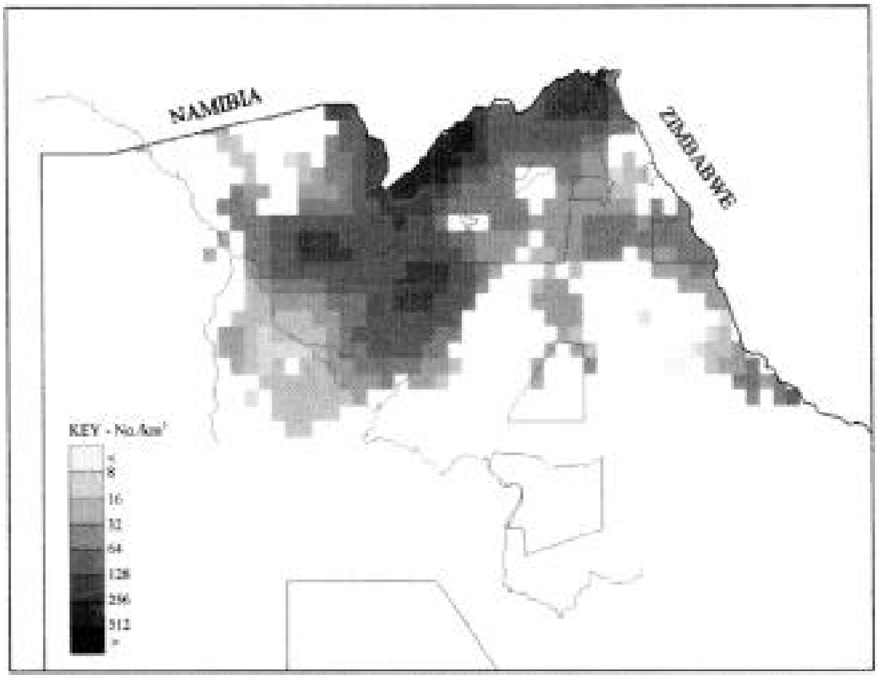

Figure 10. Mean distribution of elephant family groups in northern Botswana.

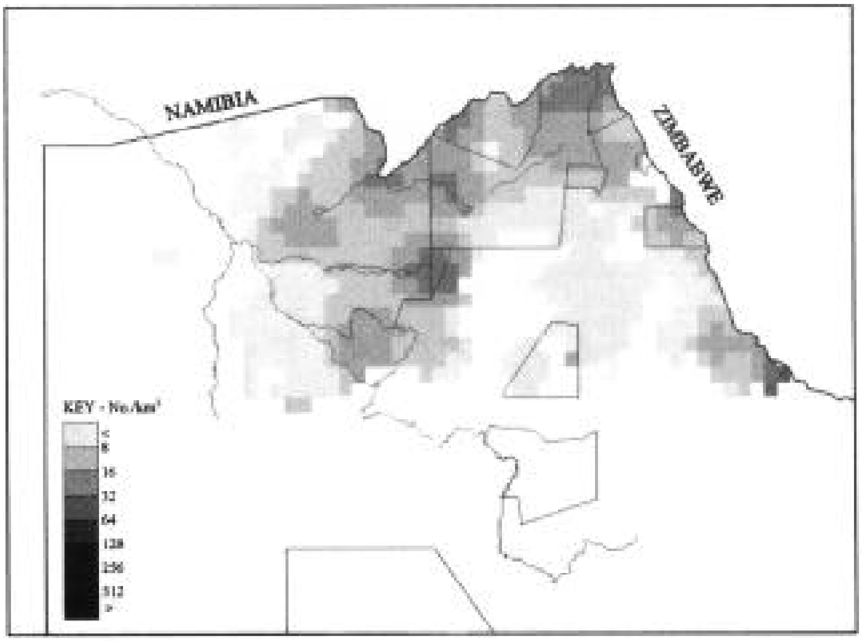

Figure 11. Mean distribution of elephant bull groups in northern Botswana.

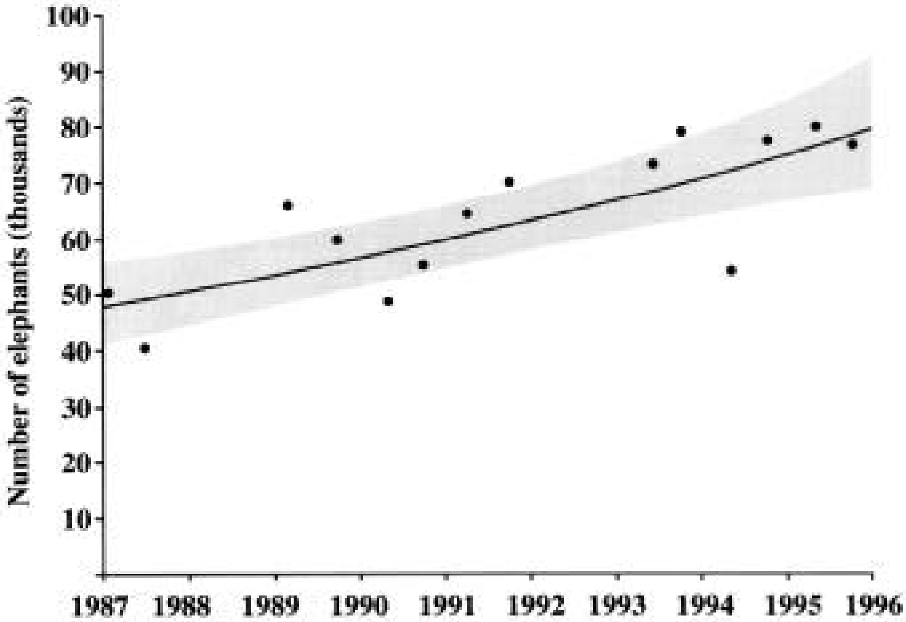

Figure 12. Trend of northern Botswana's elephant population ($y = 10.7732\ e^{0.05826x}$). Shaded area indicates 95% confidence limits for the estimate derived from the regression.

Gavor, I.K.N. (1987) Aerial surveys in the Chobe District: Wildlife Data 1987, *Internal Report, Dept Wildlife and National Parks, Botswana.*

Jolly, G.M. (1969) Sampling methods for aerial censuses of wildlife populations, *E Afri. Agricultural and Forestry Journal - special issue:* 46-49.

KCS (1984) *Aerial monitoring of major wildlife species in Northern Botswana,* Kalahari Conservation Society, report to Dept. Wildlife and National Parks, Botswana

KCS (1985) *Aerial monitoring of major wildlife species in Northern Botswana, The second survey: Oct/Nov 1984,* Kalahari Conservation Society, report to Dept. Wildlife and National Parks, Botswana

KCS (1985) *Aerial monitoring of major wildlife species in Northern Botswana, The third survey: March 1985,* Kalahari Conservation Society, report to Dept. Wildlife and National Parks, Botswana

Melton (1985) The status of elephants in northern Botswana *Biol. Conserv. 31:* 317-333.

Nagafela, N.V. (1998) Annual report of Kgalagadi District, *Internal report, Dept Wildlife and National Parks, Botswana.*

Norton-Griffiths, M. (1978) *Counting Animals,* African Wildlife Foundation, Nairobi, Handbook No. l, pp 139.

Sokal R.R. and Rohlf, F.J. (1995) *Biometry,* W.H. Freeman and Co. New York.

Sommerlatte, M.W.L. (1976) *A survey of elephant population in north -eastern Botswana,* Report to Dept. Wildlife and National Parks, Botswana.

ULG (1993) *Aerial Census of animals in northern Botswana, September 1993,* Report to Dept. Wildlife and National Parks, Ministry of Commerce, Botswana.

ULG *(1994a) Aerial Census of animals in Botswana, wet season 1994,* Report to Dept. Wildlife and National Parks, Ministry of Commerce, Botswana

ULG (1994b) Aerial *Census of animals in Botswana, dry season 1994,* Report to Dept. Wildlife and National Parks, Ministry of Commeree, Botswana.

Work, D.R. (1986) Summary report of aerial surveys conducted in 1983, 1984 and 1985, Typed manuscript.

THE RHINOCEROS FIGHT IN INDIA

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The rhinoceros is often alleged to be aggressive, not only to humans, but also to other animals. In the early Greek and Roman literature, the rhinoceros was said to be the true enemy of the elephant, always ready to fight. On the few occasions that *a* rhinoceros was imported into Rome, its supposed aggressive nature was used to make it fight against elephants (Pliny), bears (Martialis) or the gladiators. The first rhinoceros to arrive in post medieval Europe, in Lisbon in June 1515, was made to enter a battle-field against an elephant. In this case, the rhino only had to lift its front leg to make the elephant run away, probably scared away by the noise of the spectators. With the advent of privately owned menageries and zoological gardens, the owners were obviously reluctant to risk their valuable beasts in any kind of battle and the rhino had to be satisfied with lesser evils like smoking a pipe or drinking a glass of wine to entertain the visitors.

In India, closer to the regions inhabited by the rhino, the tradition of the fight continued in the courts of the Mogul emperors and later of the native kings and rajahs. Actually, there are many allusions to such fights, but it is difficult to find the evidence as to when and where they would have taken place. Fray Sebastien Manrique traveled in India between 1629 and 1643 during the reign of the Mogul Emperor Shah Jahan (1627-1658) and mentioned that the emperor appeared daily around lunchtime “to witness contests between elephants and other wild animals, such as lions, tigers, *abbadas* or rhinoceros, and wild buffaloes” (Manrique, 1 927) A few details are known however about rhino fights in

Phito Credit: Lucy Vigne

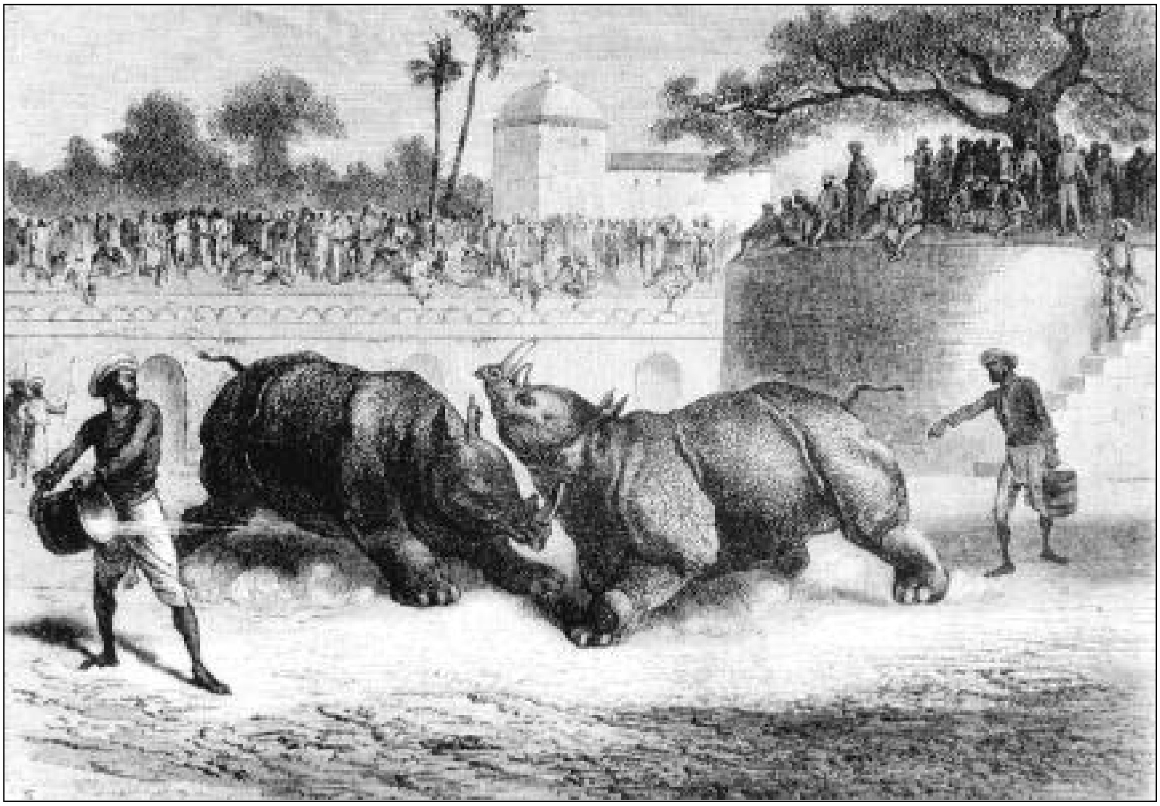

Figure 1. These rhinos were sketched in 1864 in Baroda at the time of their fight. The folded skin resembles that of the Indian species, but Indian rhinos have only one horn not two!

Lucknow around 1820 and Baroda in 1864 and 1875.

The kings or nawabs of Oudh had their capital in Lucknow, Uttar Pradesh. William Knighton recorded the adventures of an anonymous courtier of Nasir ud-Din Haidar in the 1820s. During those years, the King had some 15 or 20 rhinos (Rookmaaker, 1997). These were made to fight against each other, but only the males were "always ready to engage in combat at particular seasons ... duly prepared by stimulating drugs". This seems to have been a regular pastime in those days (Knighton, 1900).

In June 1864 in the state of Gujarat, the French traveller Louis Rousselet (1845-1929) was visiting Baroda, where he witnessed two rhinos fighting each other; in paraphrase: the two animals are chained at opposite ends of the arena, one painted black, the other red, to distinguish them easily. They are released and run around the field until finally they meet and attack. Horn against horn, they hit each other until one manages to get its horn below the head of the other, but then they turn away. This continues for an hour until their horns hurt, their lips are covered with foam and their foreheads are covered in blood. Servants throw buckets of water at them to help them recuperate and continue. At last, the King orders the fight to end and the animals return to their stables (Rousselet, 1877). This event is illustrated by an engraving (13 x 17cm) made after a drawing by E. Bayard in Rousselet's book published in 1877 with the French title *Combat de Rhinoceros Baroda* (Figure 1). The drawing appears in the English translation and in later editions of this work. The picture is also found with a German title, *Rhinoceros-Zweikampf* in Schlagintweit (1881). It is remarkable that the rhinoceroses both are double-horned, while one would expect to see the single-horned Indian species. It is impossible to say if this is inadvertent artistic licence or actual fact

Once more in Baroda, in November 1875, the Rajah entertained the Prince of Wales and his party. Again two rhinoceroses pitched battle, perhaps the same animals as nine years previously. 'They came nose to nose, as if to exchange civilities, but the attendants began to excite ill-

Phito Credit: Kees Rookmaaker

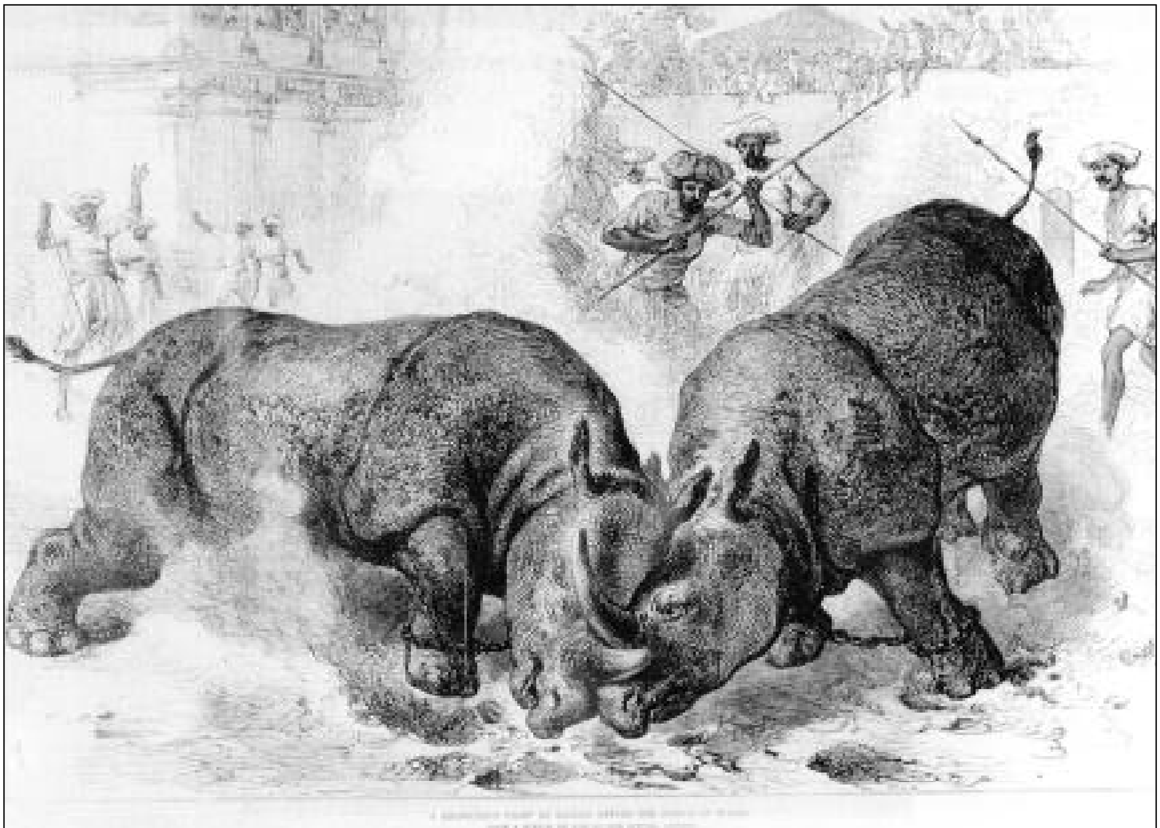

Figure 2. The Prince of Wales was entertained in Baroda by a rhino fight in 1875. The many attendants tried to keep the rhinos fighting by goading them with spears.

Photo Credit: Lucy Vigne

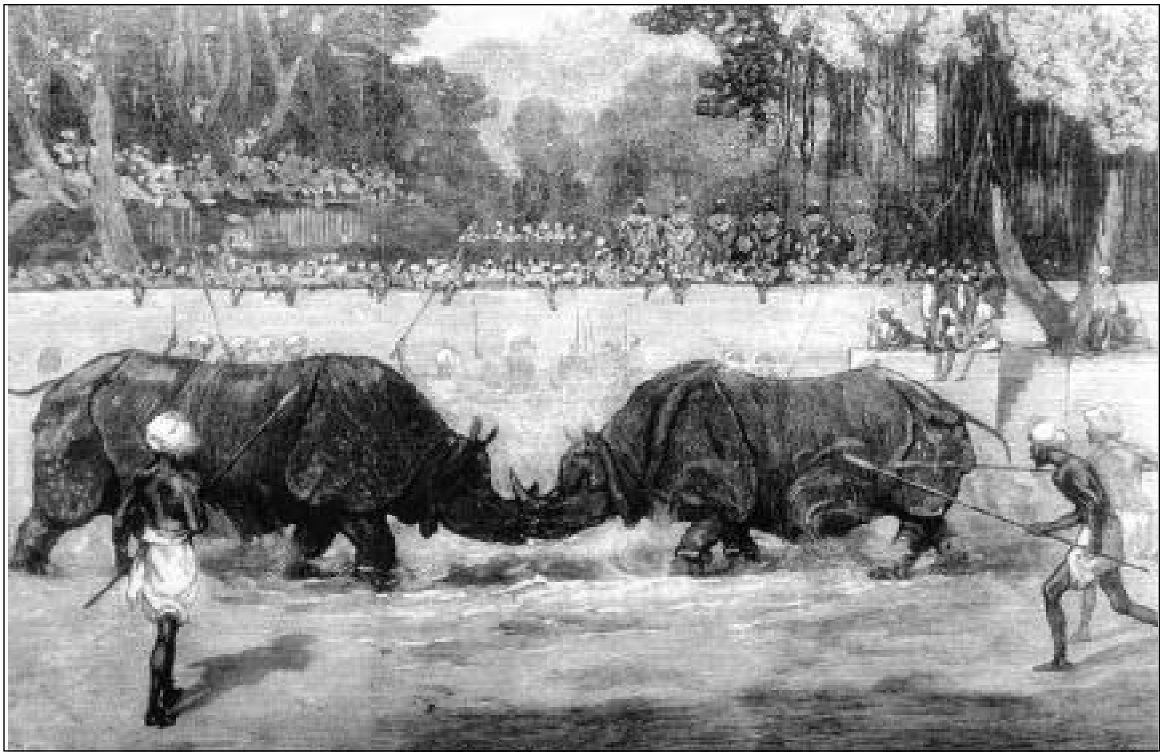

Figure 3. This second sketch of the 1875 rhino fight shows the occasion was very popular with many spectators surrounding the arena.

Photo Credit: Esmond Bradley Martin

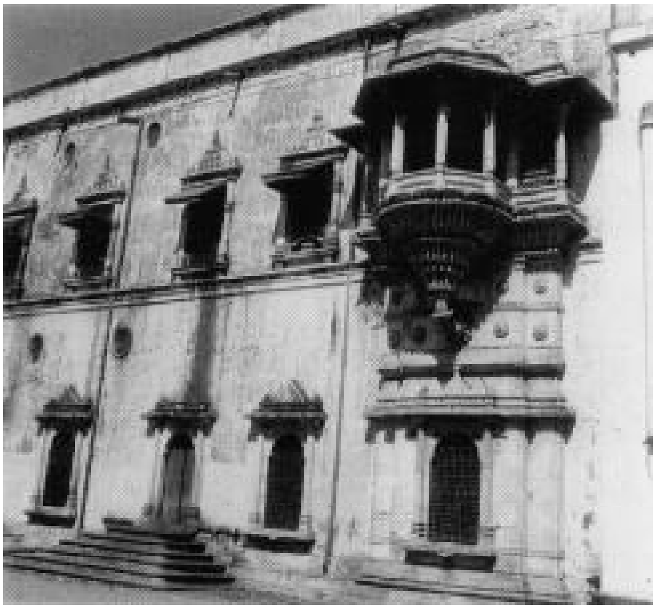

Figure 4. Around Baroda's rhino fight arena, some old buildings remain, as photographed here in 1980. Situated near the Land Revenue Office near Pani Gate, most of the arena in 1980 had been filled with modem buildings.

feelings by poking and patting them alternately, and by horrid yells, and one rhinoceros...made a thrust with his snout at his friend". They exchanged a few blows with their heads, but soon one turned away. They were "deluged with cold water to keep up their courage by the attendants", but to no avail, they could not be made to fight each other again, "exeunt two degraded rhinoceroses..." (Russell, 1877). This official account of the tour has no illustration, but a drawing was published twice in the *Illustrated London News*, firstly on *25* December 1875 (Vol.67 page 621) as shown in Figure 2, and secondly in May 1876 (Vol 68, page5). The illustration is entitled "A rhinoceros fight at Baroda before the Prince of Wales. From a sketch by one of our special artists". Each animal's front legs are chained together, they are quite adult and clearly single horned. Also on *25* December 1875 another picture of the fight was published, in Britain, in the *Graphic* (page 650), including text. Here, the fight is described as "somewhat unsuccessful, as the animals declined the combat, despite vigorous lance thrusts and buckets of cold water showered upon them by the attendants. They at first exchanged, as in our illustration, a few passes with their horned snouts, and then one ran away and could in no way be induced to come again up to time". This illustration was produced from a sketch by Mr H. Johason (Figure 3). The rhino fight, or non-fight, as they refused to oblige, perhaps reflects the gentler nature of these rhinos than many wished to believe.

With the current threat of extinction of all rhinoceros species, one hopes that such fights, exciting as some may wish them, will be a thing of past days.

REFERENCES

Knighton, W. (1900) *The private life of an eastern king,* edited by S.B. Smith. London (first edition 1833/1834), pp 162-164.

Marrique, S. (1927) *Travels 1629-1643,* edited by C.E. Luard, The Hakluyt Society, second series, Vol. 61, London, p *2.*

Rookmaaker, L.C. (1997) The Royal Menagerie of the King of Oudh, *Back When ...* & *Then,* Newsletter of the
Society for Promotion of History and Zoos and Natural History in India, Coimbatore, Vol.11, No. l,August, p 10.

Rousselet, L. (1877) *L'Inde des Rajahs,* Paris (first edition 1875, English translation 1876), pp 123-124.

Russell, W.H. (1877) *The Prince of Wales 'Tour,* London, pp 198-199.

Schlagintweit, E. (1881) *Indien in Wort und Bild,* Vol. 1, Leipzig, p229.

CHEMICAL IMMOBILIZATION OF AFRICAN ELEPHANT IN LOWLAND FOREST, SOUTHWESTERN CAMEROON

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ABSTRACT

The chemical immobilization of free ranging African elephant *(Loxodonta africana cylcotis)* in the lowland forest of southwestern Cameroon was undertaken as part of a long term investigation of elephant ecology. Such capture and tagging (with satellite/VHF transmitter units) of African forest elephant had not been accomplished prior to this work. Dense vegetation, diverse topography and severe climatic conditions caused the darting and post-darting location of the subject animal to be difficult and hazardous to both man and elephant. Innovation of methodology and strategy brought about six immobilisations. Etorphine and carfentanil (with their antagonists diprenorphine and naltrexone) were employed as immobilizing agents. Various delivery systems and technological aids were field tested. The lessons learned by this project may be useful to anyone wishing to undertake large mammal chemical immobilization under similar dense forest conditions.

RESUME

L'immobilisation chimique de l'éléphant d'Afiique *(Loxodonta africana cyclotis)* en liberté dans les forêts de basse altitude au sud ouest du Cameroun avait été menée après une série d'investigations sur l'écologie de l'éléphant. Aucune action de capture et de marquage (par satellite/VHF avec émetteur) de l'éléphant de forêt n'avait été entreprise avant ce travail d'investigation. La densité de la végétation et la diversité topographique ainsi que les conditions climatiques difficiles, causent des difflcultés pour viser et retrouver les animaux atteints. Ce qui est également hasardeux à la fois pour l'homme et l'éléphant. L'innovation de ha méthodologie et de la stratégie a permis environ six immobilisations. L'etorphine et Ia carfentanil (associés à leur neutralisant diprenorphine et naltrexone) ont été utiuisés comme agents immobilisants. Des systèmes et technologie diverses bénéfiques ont été testés sur le terrain. Les leçons tirées de ce projet sont utiles pour toute personae qui envisage l'immobilisation chimique des grands mammiféres dans les mêmes conditions en forêts denses.

INTRODUCTION

The chemical capture of free-ranging African elephants, *Loxodonta africana africana,* in open and semi-wooded habitats has been well documented and protocol has been developed to the point where such procedures are carried out quite routinely in eastern and southern Africa (Pienaar *et al.,* 1966; Woodford *et al.,* 1972; Alford *et al.,* 1974; Ebedes, 1975; Schmidt in Fowler, 1986; Kock *et al.,* in Fowler, 1993). However, such an operation in dense equatorial forest with completely unhabituated forest elephants, *Loxodontus africanus cyclotis,* had not been attempted prior to this study. Low visibility, high variability of terrain, dense vegetation, and lack of points of consistent elephant activity in the area created unique problems that needed to be addressed. With the objective of fitting the elephants with Satellite/VHF transmitter collars ('Telonics, Mesa, Arizona, U.S.A.) to gather elephant movement information, capture attempts were made intermittently from December1990 to April 1993 in the region of Korup National Park and Banyang Mbo Forest Reserve, South West Province, Cameroon. Initial setbacks due to various factors brought about innovation of methodologies and equipment, resulting in six immobilisations. In this paper we examine the specific difficulties encountered in conducting chemical immobilization of elephant in dense forest conditions and discuss how these issues may be managed in order to reduce risk and increase capture success rate.

METHODS

Capture team

The capture team was usually composed of: a shooter (the veterinarian in nine of 12 shot attempts), a veterinarian, a chief tracker, a local guide, one or two project biologists and two assistant tracker/porters. A veterinarian was not present for procedure III. Two different chief trackers were employed, the second being more skilled and experienced (attempts nine to 12).

Delivery system

Cap-chur darts (usually 3cc) (Palmer Chemical and Equipment Company, Inc., Douglasville, GA, 30133, USA) were fitted with Palmer elephant needles. They were projected either by a crossbow (Barnett International, Inc., Odessa FL, 33556, USA) equipped with a laser-dot sight (Aimpoint, Herndon, VA, 22070, USA) or a .22 cartridge fired dart rifle (Model No. 1820 No.308N, Pneudart, Inc., Wrlliamsport, PA, 17703, USA). A CO_2 powered projector with 3cc syringes (Telinject, Romerburg, Germany, model Vario 4 V) was used in procedure IV The ducts of all needles were covered by a silicone "cap" to prevent leakage, as the loaded darts were carried and subsequently shaken during the days/weeks of attempted immobilization.

Drugs and other medicine

Etorphine hydrochloride ("Immobilon LA", C-Vet, Suffolk, UK) was administered at dosages ranging between 4.9 and 6.125mg per animal in procedures II-VI. These dosages were based on field observations and known weights of zoo animals. Carfentanil (Wildnil, Wildlife Laboratories, Inc., Fort Collins, CO 80524, USA) was used in procedure I. Azaperone ("Stresnil", Janssen, Paris, France) was added to the etorphine in 4 and 7cc darts in procedures V and VI respectively.

The reversal agent employed in each etorphine procedure was diprenorphine ("Revivon", C-Vet), a dose being administered through i.v. route and an additional half dose s.c. or i.m. The antagonist naltrexone hydrochloride (ICN Biochemicals, Inc. Cleveland, OH, 44128, USA) was administered i.v. in the carfentanil procedures. Any injury was treated using an antibiotic/anti-inflammatory ointment ("Cortamycetine", Distrivet, Paris, France). The same medicine oran antibiotic ointment (Parke-Davis/ WarnerLambert Co. Morris Plains, NJ, 07950, USA) was used on the eyes to reduce irritation due to drying or foreign matter. Cortamycetine or Penicillin Mastitis Treatment cream (Aveco, Co., Inc., 800 5th St N.W. Fort Dodge, IO, 50501) was applied to the needle wound to help prevent infection. If the respiratory rate became lower than 5 breaths/min, Doxapram ("Dopram V", A.H. Robbins Co., Richmond, VA, 23220, USA) was injected i.v.

Measurements/samples

Precise anatomical measurements were taken and blood, skin biopsy (for genetic analyses), external parasites (ticks, mites, etc), and ivory (cut from tip of tusk with a hacksaw blade) samples were collected to contribute to baseline forest elephant studies. A weight estimate was made for each elephant and compared with shoulder height: body weight correlation made in past studies of captive savanna elephants (Woodford *et al.*, 1972).

Darting strategies

To gain darting opportunities elephant paths and hunting trails were walked with the team pausing periodically to listen for elephant activity or fresh spoor was followed until meeting elephants. Silence was maintained, quiet and accurate communication being facilitated by hand signals and hand-held radios. A lighter was used to indicate wind direction, which greatly influenced the approach. For darting the team separated into two groups, the shooter and chief tracker moving ahead for the approach and darting.

Locating the subject post-darting

Two technological aids were applied in attempt to facilitate locating the subject animal post-darting. A transmitter dart (Wildlife Materials, Inc., Route 1, Box 427A, Carbondale, IL, 62901) and tracker line (Gametracker, Flushing, MI, 48433) served as indicators of the animals' initial direction of flight. The VHF transmitter unit facilitated the location of the elephant in procedure IV, when she was re-tagged due to the satellite unit's battery failure nine months after initial tagging (the VHF unit continued to function properly).

Post-reversal, the elephant was followed for l00-200m to observe its condition as it moved away. It was then monitored via the VHF unit for one to two hours. Further efforts were made to VHF track the elephant from nearby points of elevation during the days following capture.

RESULTS

A total of 87 days in the field were spent in capture attempt in and around Korup National Park and the Banyang-Mbo Forest Reserve. Sixty-three days over the period of July 1990 - October1992 produced eight darting attempts resulting in two immobilisations (Table 1 attempts one to eight). Twenty-four field days during January -April 1993 produced four darting attempts that resulted in four immobilisations (Table 1 attempts 9-12).

The outcomes of the twelve darting attempts in relation to the delivery system and tracking aids employed are shown in Table 1. Seven shots resulted in successful injection of the drug, six of which resulted in immobilization of the subject The mean shooting distance was 11m (3-25m). Mean time to find the elephant post-darting was 33.5 minutes with a range of 13-63 minutes. When used (seven of 12 shot attempts), the tracking siring broke after 30-70m. The transmitter barrel, along with the entire dart, fell out in attempts nine and 12.

Of the six elephants immobilized two were found dead (procedures VI and I). In procedures 11-V elephant respiration was four to ten breaths per minute, heart rate of 38-60 beats per minute, temperature around 36-37^{O} C, and mean duration of immobilisation was 75 ± 2 min with a range of 51.5-98 minutes.

In procedure III there was no observed change in the elephant's position eight minutes after iv administration of the antagonist, therefore a second i.m. injection was given. Ten seconds after the second i.m. injection there was movement of the tail and the elephant was standing after two minutes.

DISCUSSION

The immobilization of free-ranging elephants in open terrain has been well documented and dosage protocol for etorphine established (Pienaar *et al.,* 1966; Alford *et al.,* 1974; Ebedes, 1975; Haigh *et al.,* 1979; Schmidt in Fowler, 1986). Those circumstances and environmental factors are completely different than those encountered while conducting similar immobilization of entirely unhabituated elephants living in dense lowland forest The mechanical complexities of immobilizing elephants in such an environment were addressed in this study. Over the course of many efforts various personnel sought to correct the problems through innovation in both methodology and equipment.

The elephants in the study area usually fled as soon as they sensed human presence, this may have been attributed to high poaching levels (Elkan, pers. obs.). 'This behavior compounded the difficulty of darting and a quiet approach from downwind was crucial. Because of the quickly changing drafts found in the forest a rapid but cautious approach may also facilitate obtaining a good shooting opportunity. Dense vegetation reduces the range from which one is able to shoot (mean of 11m in this study). The chief tracker played an important role in guiding the shooter towards the subject elephant under these circumstances. The second tracker employed in this study (who had been recently active in elephant poaching- skills fresh and fear limited) made the close approach required safer and more efficient than with the earlier tracker.

It is impossible to predict the aftermath of darling a wild elephant and the least sound or scent can indicate to the elephant the location of the shooter at close range, therefore increasing the danger of being charged. The Pneudart gun was efficient in delivering the dart to the target but was noisy and produced a gun powder odor. Both the noise and smell of the gun contributed to elephant stress and directed charges. In one case an aggressive elephant kept the tracker and veterinarian/shooter hidden behind a tree for over five minutes. Although the choice of delivery system depended largely on the preference of the shooter, the crossbow delivery system was introduced to reduce risk.

The advantages of the crossbow were that is was quiet and without the smell of gunpowder. Its power aided in forcing the dart through vegetation. The laser-dot sight mounted on the crossbow was a reliable indicator of whether the shot was clear in low light conditions of the forest when the elephant was less than twenty meters away. However, in case of darting in lighted "open" areas, secondary forest and at longer range the laser-dot would have been difficult to see without a standard sight The crossbow's main drawback was that it was more cumbersome to carry in vegetation than the dart gun.

The Telinject system was quiet, ligh tto carry and predictive of correct function through its manometer and transparent dart. The telinject's thin needle and lightweight dart resulted in a less subject-disturbing injection than the heavier Cap-chur darts with Palmer elephant needles. Drawbacks to this system were that the dart was easily sent off course upon contact with vegetation and that tracker string cannot be attached to the dart without hindering its flight

Locating the elephant after the shot was the greatest difficulty of the capture operation. 'Technological aids produced various degrees of success. The Gametracker string was found to be a good indicator of the subject's initial flight direction but usually broke or stopped where the dart fell out The string hindered the flight of the dart at distances greater than 15m. and when shooting through narrow openings in vegetation. As with the line, the transmitter-dart assembly was attached to the syringe dart and fell out when it did.

Table 1. Elephant** darting attempts in lowland forest using various delivery techniques and tracking aids **(1990-93).

At No.	Delivery System	Range (in)	Tracking Aids	Locating Time	Outcome
1.	.22 Pneudart Rifle/ Cap-chur dart	?	transmitter	n.a. dart	2 guns used (1 for drug, 1 for transmitter) Drug dart hit vegetation.
2.	.22 Pneu. Rifle/ Cap-chur dart	?	trans. dart	n.a.	2 guns used (1 for drug, 1 for transmitter) Uncertain if drug dart hit subject
3.	Crossbow/ Cap-chur dart	3	tracking	31 min string	Dart hit subject String broke after 50m Subadult male elephant found dead Procedure I.
4.	Crossbow/ Cap-chur dart	?	string	n.a.	Dart hit vegetation.
5.	22 Pneu. Rifle/ Cap-chur dart	6	_______	n.a.	Dart hit subject. Trackers unable to locate elephant.
6..	.22 Pneu. Rifle/ Cap-chur dart	25	string	63 min	String broke after 70m. Adult female elephant tagged. Procedure II.
7.	.22 Pneu. Rifle/ Cap-chur dart	10	string	n.a.	.22 charge misfired.
8.	.22 Pneu. Rifle/ Cap-chur dart	25	string	n.a.	Dart hit subject String broke after 30m. Trackers unable to locate elephant
9.	Crossbow/ Cap-chur dart	12	trans. dart string	36 min	String broke after 50m. Trans. dart fell out after 70m. Adult female elephant tagged Procedure III.
10.	Telinject Rifle/ Telinject dart	15	VHF tag	26 min	VHF tag facilitated location of subject post darting. Adult female elephant re-tagged. Procedure IV.
11.	Crossbow/ Cap-chur dart	10	string	13 min	String broke after 5m. Adult male elephant tagged. Procedure V.
12.	Crossbow/ Cap-chur dart	7	trans. dart	32 min	Trans. dart fell out after 50m. Adult male elephant found dead in sternal recumbency. Procedure VI.

The transmitter-dart was of help in attempt 12 as an indicator of the initial direction of flight of the subject Through the combination of these tracking aids (string and transmitter) the task of finding the elephants was facilitated. Although the two aids functioned worse than expected in each case, which might be considered technical failure, they proved useful in directional indication of the subject post-darting. The partial technical function of the tracking aids was thought to have contributed significantly to the locating of the elephant.

The inability of the team to locate the subject elephants post-darting in attempts five, eight and perhaps two may be attributed to partial injection of the drug and or quality of the trackers. The darts recovered in attempts two, five, and eight had discharged their contents. Partial injections can considerably affect the animal's response, the induction period being very long and the animal remaining nervous, moving and potentially dangerous during that time (Planton and Michaux, 1993). *Woodford et al.* (1972) found in elephant that subcutaneous and partial injection probably occurred in seven of fifty-three cases, mechanical failure of the dart being the cause in fourteen. This is supported by the mechanical failures, which Planton (1987) reported in one out of ten cases. Another possible factor may have been leakage. Leakage was observed at the collar wields of the needle on several occasions when the darts had been pre-loaded and carried while stalking (as was mostly the case). The chief tracker for attempts two, five and eight was not as skilled as his later replacement. The morale of the trackers was very important to their desire to find the elephant after darting. It was found that a cautious yet rapid tracking regime with the presence of the shooter up front with the trackers provided significant encouragement

The observations made at the end of procedure III are typical of what happens to animals of any species that receive a relative overdose. The response to the reversal agent is not as rapid as expected and, if left alone and quiet, they remain lying down for along time. The second i.m. injection of antagonist acted as a mechanical stimulus that woke the elephant. Hand clapping can have the same effect, however, in such cases an additional dose of antagonist helps to prevent further renarcotisation.

The necropsy following procedure I indicated that the probable cause of death was "respiratory compromise resulting from anesthesia and non-dependent lung pathology" (Karesh, 1991). The elephant in procedure VI was judged to have died from "anoxia and congestion of the vena cava with probable cardiac congestion"(Haigh, 1993). This was most likely a direct result of the elephant having fallen in sternal recumbency.

During procedures II-V the elephants were found in lateral recumbency. The danger that the elephant may fall in sternal recumbency and die before it is found and can be assisted is encountered in all types of habitat (Pienaar *et al.,* 1966; Schmidt, 1986). The difficult terrain compounds this possibility and vegetation found in equatorial forest regions. In procedure VI the elephant ran in a near straight line for 700-l000m after being darted. It was estimated that the team arrived five to seven minutes too late. The pursuit after darting had been conducted efficiently and rapidly.

In dense forest habitat the increased chance of an elephant going down in sternal recumbency makes it vital to locate the animal as quickly as possible in order to correct its position. The position of the elephant in procedure IV, resting on a small tree was impossible to ameliorate and probably hindered the elephant's respiration. This underlines the fact that in such habitat/topography physical interference is a real possibility and sometimes impossible to avoid. Although it is seldom to be fired, Planton (1993) recommends that a dart filled with reversal agent be ready in the dart projector as soon as the drug injection is likely to have been completed. If the animal is in difficulty and cannot be handled for any reason the drug can be antagonized from a distance.

By attempting to locate the elephant quickly there is a compromise of human safety. Rapid tracking of the elephant greatly increases the danger of coming too close to the subject animal and or its group members. Low visibility, thick vegetation, and changing terrain magnify the difficulty of tracking both rapidly and safely. Under these adverse conditions there is significant risk of human injury (or death) as a result of elephant attack or flight.

A short induction period would limit the distance of the post darting travel and therefore help make location of the elephant faster. Studies undertaking capture under similar conditions should consider use of Hyaluronidase (Wyeth Laboratories Inc., Philadelphia, PA, 19101) in solution with the immobilizing agent (Morton *et al.*, 1991). It was not used in this study because it is unstable and the infrequency of darting opportunities dictated the carrying of loaded darts over the course of many days in most cases.

The protocol established through this project has shown that successful chemical immobilization of elephant in dense lowland forest habitat certainly is possible. Danger to man and elephant can be reduced, but not eliminated, through the proper team, equipment, and strategies. The risk of the elephant falling in sternal recumbency and respiratory failure before the team can reach the elephant may be unavoidable.

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REFERENCES

Alford, B.T., Burkhart, R.L., and Johnson, W.P (1974) Etorphine and diprenorphine as immobilizing and reversing agents in captive and free-ranging mammals, *J. Am. Vet. Med. Assoc.* 1,702-705.

Ebedes, H. (1975) The immobilization of adult male and female elephant *Loxodonta africana* Blumenbach with etorphine and observation on the action of diprenorphine, *Madoqua*, 9(2), 19-24.

Haigh, J. C., Parker, I.S. C., Parkinson, D.A., and Archer, A. L. (1979) An elephant extermination, *Envir. Conserv.* 6(4), 305-310.

Haigh, J.C.(1993) Necropsy Report, Unpublished report to Wildlife Conservation Society.

Heard, D. J., Kollias, G. V., Buss, D., Caligiuri, R. and Coniglario, J. (1990) Comparative cardiovascular effects of intravenous etorphine and carfentanil in domestic goats, *J. Zoo and Wildl. Med.* 21(2), 166-170.

Jacobsen, E. R., Kollias, G. V, Heard, D. J. and Caligiuri, R. (1988) Immobilization of African elephants with carfentanil and antagonism with nalmefene and diprenorphine, *J. Zoo Anim. Med.* 19,1-7.

Karesh, W.B. (1991) Necropsy Report. Unpublished report to Wildlife Conservation.

Kock, R.A., Morkel, P, and Kock M.D., (1993) in M. E. Fowler, ed, *Zoo and Wild Animal Medicine Current Therapy*, 3rd edition, W B Saunders Co., Philadelphia

Morton, D. J., Pharm, B. and Kock, M.D. (1991) Stability of hyluronidase in solution with etorphine and xylazine, *J. Zoo and Wildl. Med.* 22(3), 345-347.

Pienaar, U. De V, Van Niekerk, J.W., Young, E., Van Wyk, P and Fairall, N. (1966), The use of oripavine hydrochloride (M-99) in the drug immobilization and marking of wild African elephant (Loxodonta *africana* Blumenbach) in the Kruger National Park, *Koedoe* 9, 108-123.

Pienaar, U. de V (1968) Recent advances in the field immobilization and restraint of wild ungulates in South African National Parks,*Acta Zoot Pathol Antverp.*,46,17-38.

Planton, H.P (1987) Campagne panafricaine de lutte contre la peste bovine: programme de recherches sur la faune sauvage, *Institut d'Elevage et de Médecine Vétérinaire des Pays Tropicaux,* Maisons-Alfort (France)/ Serengeti Wildlife Research Institute, Seronera ('Tanzania).

Planton, H.P et Michaux, 1.G., (1993) Capture chimique de grads ongulés sauvages au Nord Cameroun. IN: Techniques de Capture et de marquage des ongulés sauvages, *Actes du Symposium de Meze,* mares 1990 (éd. D. Dubray) Office National de la Chasse/ Ministère de L'Environnement 65-71.,

Powell, J. A., Powell, M., Usongo, L. ad Elkan, P W. (1994) Korup Forest Research Project: Report on Research ad Conservation Activities of the Cameroon Biodiversity Project, Final Report to Wildlife Conservation Society and the United States Agency for International Development

Schmidt, M. J. (1986) Elephants, in M. E. Fowler, ed. *Zoo and Wild Animal Medicine*, 2nd edition. WB Saunders Co., Philadelphia, 883-923.

Woodford, M. H., Eltringham, S. K. and Wyatt, J. R. (1972) An analysis of mechanical failurc of darts and costs involved in drug immobilization of elephants and buffalo, *East Afr. WildI. J.* 10:279-285.

AFRICAN ELEPHANT SPECIALIST GROUP MEETING

Ouagadougou, Burkina Faso, 26 to 31 January, 1998

SESSION TITLE: CURRENT ISSUES

Chairs: E Abe, M Okua

Rapporteurs: M Chambal, I Ndunguru, J Mshelbwala

ABSTRACTS

ECOLOGY OF CROP RAIDING ELEPHANTS

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The purpose of this study was to examine the ecology of elephants that mid crops adjacent to the Sengwa Wildlife Research Area (SWRA) in north-western Zimbabwe.

Since male elephants arc solely responsible for the crop loss in this area, research focused on their ecology. An effort was made to identify the causes of elephant/human conflict, and data were collected on a broad range of environmental factors which influence bull elephant behaviour. A 'multi-disciplinary' approach was adopted to include information on human settlement patterns and socio-economic impacts of crop loss in addition to data on the ecology of elephants which cause crop damage.

The feeding and movement patterns of bulls were monitored for three years in an attempt to identify the reasons why elephants leave the SWRA. The movement of elephants into the surrounding communal lands coincided with the peak harvest period for crops, but continued after all crops were removed from the fields. This observation prompted an examination of 'post crop raiding' foraging in this area Long term vegetation changes within the SWRA and communal lands were analysed to assess the effect of elephants on forest structure.

The two general conclusions were:

1) Crop raiding is triggered by a decline in the quality of wild grass inside SWRA. rather than the condition of crops outside it.
2) Elephants feed on wild browse in the communal lands because fire and elephants have reduced the availability of preferred tree species within the SWRA.

Conflict between people and elephants is an important issue for wildlife managers, and attention was directed toward possible methods for limiting crop losses to elephants. A capsicum-based repellent was tested and found to be a potentially effective alternative to traditional deterrents.

L'objectif de cette étude était d'examiner l'écologie des éléphants qui dévastent les cultures dans la limite de la zone de Recherche sur la Faune sauvage de Sengwa au Nord Ouest du Zimbabwe.

Depuis que les éléphants mâles sont les seuls responsables de la destruction des cultures dans cette zone, la recherche s'est focalisée sur leur écologie. Un effort a été fait pour identifier les causes du conflit honmme/éléphant, et des données ont été collectées sur les divers facteurs environnementaux qui influencent le comportement de l'éléphant mâle. Une approche multidisciplinaire a été adoptée en tenant compte de l'information sur le mode d'installation de la population humane et des impacts sociaux économiques de la destruction des récoltes, en plus des données sur l'écologie des éléphants qui causent la destruction des cultures.

L'alimentation et les modes de déplacement des mâles ont été suivis pendant trois années dans le but d'identfier les raisons pour lesquelles les éléphants sortentdu SWRA. Le mouvement des éléphants dans les alentours des terres communales coïncidait avec la pleine période de récoltes, mais continuait après que toutes les récoltes aient été enlevées des champs. Cette observation indiquait un examen de fouille sur la zone après les dégâts de cultures. Les changements de la végétation à long tenne à l'intérieur du SWRA et dans les terres communales ont été analysés pour évaluer l'effet des éléphants sur la structure de la forêt.

Les deux conclusions générales étaient:
l. Les dégâts sur les récoltes étaient liés à une dïminution de la qualité de l'herbe à l'inténeur de SWRA. plutôt qu'à une préférence par rapport aux récoltes à l'extérieur.

2. Les éléphants s'alimentaient sur les terres communales parce que le feu et les éléphants ont réduit la disponibilité des espèes d'arbres préférés à l'intérieur de SWRA.

Le conflit entre l'homme et les éléphants est une importante question pour les gestionnaires de la faune, et l' attention avait été dirigée vers des méthodes possibles pour limiter la perte des récoltes par les éléphants. Un refoulant à base de capsicum avait été testé et trouvé efficace comme alternative potentielle par rapport aux méthodes de dissuasion traditionnelle.

TRENDS OF ELEPHANT POACHING IN KENYA THE ELEPHANT MORTALITY DATABASE

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There has been much speculation over the number of elephants poached in Africa since the CITES meeting held in Harare in June 1997 when elephant populations from Botswana, Namibia and Zimbabwe were down listed to Appendix II to allow limited trade in ivory if certain criteria were met. Kenya in particular was the target of adverse press reports that elephants were being "massacred" at rates reminiscent of the holocausts of the 1970s. The report continued to be widely publicised internationally despite lack of corroborative evidence from the field. It was not until KWS convened a meeting for all interested parties in November 1997 to scrutinise the KWS elephant mortality database and get authenticated reports from the field security network and private land owners that the speculations ended.

KWS established an Elephant Mortality Database in 1992 for monitoring all incidents of elephant mortality to enable the relevant departments to respond appropriately to each particular circumstance. The database has information on poaching, illegal trafficking of ivory, patrols, surveillance, problem animal control, etc. From this data, it is possible to organise effective anti-poaching operations and elephant management programmes. It is possible to respond to unfounded reports, considering that elephant poaching is an emotive issue which attracts international concern.

The purpose of this paper is to share information on monitoring of elephant poaching in Kenya with other Range States and to examine ways of improving the overall elephant security network by establishing efficient collaborations and other relevant mechanisms with other countries. The paper also demonstrates the importance of establishing a wide and efficient information system within countries, regions and Range States.

It is very difficult for an elephant in Kenya to die and not be recorded in the database. It would be desirable to say the same for every country within the Range States.

Il y a eu beaucoup de spéculations sur le nombre d'éléphants braconnés en Afirique pendant la réunion de la CITES à Harare en Juin 1997, au moment où les populations d'éléphants du Botswana, de la Namibie et du Zimbabwe ont été déclassées à l'annexe Il pour permettre un commerce llmité de l'ivoire., Le Kenya en particulier était visé par la presse adverse qui rapportait que les éléphants étaient massacrés à un taux destructeur comparable à celui des années 1970. Le rapport continuait d'être largement publié au niveau international en dépit d'une évidence confirmée sur le terrain. Ce n'est pas parce que KWS a tenu une réunion avec toutes les parties intéressées en novembre 1997 pour examiner la banque des données sur la mortalité de l'éléphant et obtenir des rapports authentiques provenant du contrôle sur le terrain et des propriétaires du domaine privé que les spéculations ont pris fin.

KWS a établi une banque de données sur la mortalité del'éléphant en 1992, pour suivre tous les incidents de mortalité des é1éphants et permettre aux départements concernés de donner une réponse appropriée à toute circonstance particulière. La banque de données a des informations sur le braconnage, le trafic illégale de l'ivoire, les patrouilles, La surveillance, le problème de contrôle des animaux, etc. A partir de ces données, il est possible d'organiser de manière effective, des opérations de lutte contre le braconnage et de gestion des programmes. Il est possible de répondre aux rapports sans fondement, étant donné que le braconnage des é1éphants est une question émotive qui attire l'attention internationale.

L'objectif de ce rapport est de partager l'information sur le suivi du braconnage de l'éléphant au Kenya avec d'autres pays de l'aire de répartition et d'examiner comment améliorer le réseau de sécurité d'ensemble de l'éléphant, en établissant des collaborations efficaces et autres mécanismes appropriés avec les autres pays. Le rapport aussi demontre l'importance de l'établissement d'un système d'information large et efficace à l'intérieur des pays, des régions et des états de l'aire de répartition.

Il est très difficile au Kenya, qu'un éléphant mort ne soit pas enregistré dans la banque de données. Il serait souhaitable de dire la même chose pour chaque pays de l'aire de répartition.

HUMAN-ELEPHANT INTERACTIONS AT THE ECOSYSTEM LEVEL

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Savanna elephant populations in the Sebungwe region of north-west Zimbabwe were studied over a large range (15,000km^2) consisting of spatial mosaics of natural habitat and human land use. Abundance, spatial organisation and social ecology of elephants were compared between populations resident in (a) areas protected for wildlife and (b) communal lands with human populations. The interface of human-elephant interaction was described and processes which contribute to the erosion of elephant numbers and range by expanding human activities were evaluated.

Trends in elephant population numbers and densities were updated for the last 16 years (1980 - 1996) and were either stable or declining, contrasting with steadily rising trends in the previous 25 years (1955 - 1980). Mean crude densities of elephants outside protected areas (0.46km^2) rose significantly when converted to ecological densities (0.68km^2) by excluding areas of human settlement. This narrowed the density differential with protected areas, where elephant densities have consistently been higher (1.15km^2). The results of an aerial census were estimated to be missing 15% of elephants which was within stated levels of regional census accuracy (20%) but the appropriateness of current census techniques in the communal land elephant range was questioned.

Elephant population decline in elephant range outside protected areas was proportionately linked to agricultural expansion. In communal lands, individual female elephant home ranges (x = 143 km^2) were estimated to have been compressed by 58% due to human settlement expansion over a decade. Widespread displacement of unprotected elephant populations into available refuges in the region, could not, however, be demonstrated. Within populations, elephant social organisation, herd structure and habitat occupancy showed homogeneity at exposure to all measured levels of anthropogenic range loss and disturbance in the region. The intensity of direct conflict between humans and elephants was quantified and the behavioural ecology of individual elephant bulls was postulated to be its principal determinant.

The prevailing "linear model" of human-elephant interaction, whereby elephant population density on a national scale is inversely related to human density, was not found to be applicable in the Sebungwe ecosystem. At an ecosystem scale in the savanna component of the African elephant's range (a scale more appropriate to elephant management), an alternative 'flip model' of interaction is proposed. With this model, elephant and humans coexist at variable levels or abundance until a threshold of land cover transformation is reached in the natural habitat matrix, whereafter elephants disappear. Conservation applications of this model useful to a predictive understanding of human-elephant coexistence in African ecosystems were proposed. These are the natural carrying capacity for elephants and the 'flip values' of human density and human settlement coverage at the threshold of an elephant population crash.

Les populations d'éléphants de savane dans la région de Sebungwe au nord ouest du Zimbabwe ont été étudiés sur une grande superficie (15000 km^2) constituée de mosaïque spatiale et de terres communales. L'abondance, l'organisation spatiale et l'écologie sociale des é1éphants résidant dans les aires où la faune est protégée ont été comparées à ceux qui résident dans les terres communales. L'interface de l'interaction homme-éléphant a été décrite et le processus qui contribue à la diminution du nombre des é1éphants et à leur zone de distribution à cause de l'expansion des activités humaines a été évalué.

Les tendances des effectifs et des densités des populations d'éléphants ont été revues pour les 16 dernières années (1980-1996) et il n'y avait ni stabilité ni déclin contraimement aux tendances croissantes des 25 années d'avant (1955-1980). Le moyenne brute des densités d'éléphants à l'extérieur des aire protégées (0.46km^2) augmente de manière significative, si on la converti aux densités écologiques (0.68) en excluant les zones d'occupation humane. Cela réduit la densité différentielle avec les aires protégées où les densités des é1éphants ont été régulièrement hautes (l.15km^2). On a estimé que les inventaires aériens ont commis des erreurs de l'ordre de 15% des é1éphants qui étaient donnés aux niveaux de la précision (20%) des inventaires régionaux, mais l'appropriation des techniques d'inventaire actuelle au niveau des é1éphants des terres communales a été remise en cause.

Le déclin de la population d'éléphants dans les zones non protégées est proportionnellement lié à l'expansion agricole.

Au niveau des terres communales, la zone de distribution nécessaire à chaque éléphant femelle individuellement (x=143km^2) a été réduite de 58% depuis une décennie à cause de l'expansion de l'installation humaine. Cependant, on ne peut pas démontré d'important déplacement d'éléphants des zones non protégés vers des zones de refuge disponibles dans la région. Al' intérieur des populations, l'organisation sociale de l'éléphant, la structure du troupeau et 1' occupation de l'espace présentent une homogénéité qui permet de résister à la perte de l'aire de distribution occasionnée par l'homme et aux perturbations dans la région. L'intensité du conflit directe entre les hommes et les é1éphants a été quantifiée et le comportement écologique des é1éphants mâles est avancé comme étant la principale cause.

Le "modèle linéaire" actuelle de l'interaction homme-éléphant, selon laquelle la densité de la population d'éléphants à l'échelle nationale est inversement liée à la densité de la population humaine n'a pas été trouvé applicable dans le cas de l'écosystème du Sebnngwe. A l'échelle de l'écosystème dans la composante savane de l'aire de répartition de l'éléphant d'Afrique (échelle moins appropriée pour la gestion de l'éléphant), une alternative 'flip model' à l'interaction est proposée. Selon ce modèle, l'éléphant et les hommes coexistent à des niveaux variables ou abondance jusqu'à un seuil où la transformation du couvert végétal atteint la structure de l'habitat naturel et après, les é1éphants disparaissent. Les applications de conservation par cc modèle, utiles pour une meilleure compréhension de la coexistence homme-éléphant dans les écosystèmes d'Afrique sont proposées. Ceux-ci constituent la capacité naturelle de résistancc des é1éphants face aux "flip values" de la densité et de l'occupation humane rapporté au seuil d'extinction de la population d'éléphants.

SOCIAL ORGANISATION IN TRANSLOCATED JUVENILE AFRICAN ELEPHANTS; THE DOMINANCE HIERARCHY AND AN INTRIGUING BEHAVIOUR

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Five groups of penned and four groups of free ranging translocated juvenile African elephants were studied in order to assess whether they establish a dominance hierarchy, whether this hierarchy is transitive, and whether their dominance can be measured by the direction of aggressive and submissive behaviour. The relationship between the behaviour "trunk-over-back" and dominance was investigated. In two penned groups and three free-ranging groups there was a negative correlation between the ranks of "aggressor"

and "recipient of aggression", in addition one group showed similar patterns when the data was analysed by sex. In two penned groups and three free ranging groups there was a positive correlation between the ranks of "aggressor" and "recipient of submissive behaviour" and similar patters were seen in two rather groups. "Trunk over-back" was shown mainly by males or by the most dominant individual in a group. In two groups there was a positive correlation between the ranks of "aggressoi-" and "trunk-over-back". Linearity was established for two or the boma and two free ranging groups, where data were sufficient for a test.

The question was raised whether the behaviour of placing the trunk-tip into a partner's mouth (trunk-mouth-contact or tmc) was a behaviour of submission or appeasement. Trunk-mouth-contact was seen mainly within the context of play and play-fighting and was performed most by those individuals involved in play-fighting and aggressive behaviour. There was not linearity to suggest that the behaviour follows the dominance hierarchy, neither is the behaviour used more by lower ranking animals, and therefore is not a behaviour of submission.

There were no correlations between tmc and investigating what the other is feeding, neither were there any correlations between these two behaviours and aggressive or affiliative behaviour. It is suggested that the behaviour is one of appeasement to reduce aggressive motivation and prevent it from escalating to harmful levels, and that the behaviour is ritualised. Four possible evolutionary steps are presented.

Cinq groupes de jeunes é1éphants d'Afrique en enclos et quatre autres groupes de jeunes é1éphants en liberté et transloqués ont été étudiés pour comprendre si ces é1éphants établissent une dominance hiérarchique, si cctte hiérarchie est transitive, et si la dominance peut être mesurée par le comportement d' agressivité et de soumssion.

La relation de comportement entre "trompe - sur - le dos" et la dominance a été étudiée. Dans deux groupes des é1éphants en enclos et trois des é1éphants en liberté, il y avait une corrélation négative entre les classes 'd'agresseur" et "d'agressé". En plus, un groupe a présenté les mêmes résultats quand les données ont été analysées par sexe. Dans deux groupes d'éléphants en enclos et trois des é1éphants en liberté, il y avait une corrélation positive entre classes "d'agresseur" et "de docile". Des résultats similaires ont été observés dans deux autres groupes. "La trompe - sur le dos" a été montrée principalement par les mâles ou par l'individu le plus dominant dans le groupe. Dans deux groupes, il y avait nne corrélation positive entre les classes "d'agresseur" et "la trompe - sur le dos". Une linéarité a été établie pour deux groupes en liberté où les données obtenues étaient suffisantes pour un test

La question à savoir si le placement de la trompe dans la bouche d'un partenaire (contacte - trompe - bouche) était un signe de soumission ou d'apaisement a été posée. Le contacte - trompe - bouche est principalement observé dans le contexte du jeu et de lutte, et est surtout développé par des individus en situation d'agressivité ou de lutte-jeu. Il n'y avait pas de linéarité indiquant que le comportement suit la hiérarchie dominante, ou que cc comportement est adopté plus par les animaux de classe faible. Ce n'est donc pas un comportement de soumission. Il n'y avait aucune corrélation entre tmc et l'investigation sur ce que 1' autre est en train de manger. De même, il n'y avait aucune corrélation entre ces deux comportements et le comportement agressif ou affilié. Il est supposé que le comportement soit celui d' apaisement qui vise à réduire la motivation agressive en la préservant de toute situation incontrôlable, et ainsi, le comportement est ritualisé. Quatre étapes d'évolutions possibles sont présentées.

ELEPHANTS AND HUMAN ECOLOGY IN NORTHEASTERN GHANA AND NORTHERN TOGO

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There is considerable pressure on land as human populations continue to grow and soil fertility declines through over-use. The amount and quality of habitat for elephants depends upon the needs of the human population. Fluctuations in rainfall affect crop yields, and elephants destroy crops - usually just before harvest time. If elephants are to survive in a crowded landscape, then there must be a land-use plan. Preparation of a land use plan requires a detailed study of agriculture, human ecology, and assessment of how many people the land can support.

La croissance continue de la population humaine entraîne une pression considérable sur les terres et une diminution de la fertilité des sols en raison de leur surexploitation. La quantité et la qualité de l'habitat des é1éphants dépendent des besoins des populations humaines. Les fluctuations pluviométriques affectent la production et généralement, les é1éphants détruisent les cultures avant la période des récoltes. Pour permettre aux é1éphants de survivre clans ce contexte, il faut un plan d'utilisation des terres. La mise en place d'un tel plan nécessite une étude détaillée dans le domaine de l'agriculture, de l'écologie des populations et une évaluation du nombre de personnes pouvant être supportées par le milieu.

THE DISTRIBUTION OF ELEPHANTS IN NORTHEASTERN GHANA AND NORTHERN TOGO

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A preliminary study of the status of elephants in northeastern Ghana and northern Togo was undertaken in April-June 1996. We describe the recent history and the current distribution of elephants. There was a major change in elephant distribution on both sides of the border in 1990-92, and an increase in crop-raiding in the Red Volta valley of Ghana We describe the threats to an important elephant migration corridor between the two countries.

Une étude préliminaire sur le statut des éléphant au nord est du Ghana et au nord du Togo a été menée d'Avril à Juin 1996. Selon les récentes observations, la distribution des é1éphants a connu un changement important de chaque côté de la frontière entre 1990 et 1992, suivi d'une augmentation des dégats de cultures dans la vallée de la volta rouge au Ghana. Nous décrivons les menaces exercées sur un important couloir de migration des é1éphants entre les deux pays.

FULL PAPERS

ELEPHANT CONTRACEPTION RESEARCH IN THE KRUGER NATIONAL PARK

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ABSTRACT

Two methods for contraception in elephants have received research attention in the Kruger National Park (KNP) over the past 12 months. These are “immuno-contraception” which uses porcine zona pellucida immuno-contraceptive vaccine (PZP), and hormonal control using subcutaneous oestradiol-17ß (oestrogen) implants.

The immunocontraception technique has been demonstrated to be effective in other locations, but after 12 months, some of the treated cows were pregnant. Further research is needed to determine the reasons for some of the treated cows returning to breeding condition.

The oestradiol implants proved successful in the KNP as a contraception technique as none of the treated cows was pregnant after six months (at the end of the expected life of the implant). Even after 12 months none were pregnant, which may have been due either to sufficient amounts of oestrogen still being released by the implants preventing ovulation or a more permanent effect on the ovaries.

However, elephant cows treated with oestradiol-17ß showed behavioural aberrances which probably resulted in substantially increased stress levels on the treated cows and their calves. Although behavioural abnormalities ceased approximately six months after implantation, the project was suspended (pending submission of another proposal by the research team) as it was considered unacceptable on both humane and ethical grounds.

RESUME

Deux méthodes de contraception des é1éphants ont préoccupé la recherche au PNK pendant les 12 derniers mois. Ce sont, “l’immuno-contraception” utilisant le vaccin (PZP) immuno-contraceptif à base de la porcine zona pellucida, et le contrôle hormonal utilisant l’oestradiol - 17ß (oestrogen) sous-cutané.

La technique immuno-contraceptive a été employée, mais 12 mois après, 40% des femelles traitées étaient en gestation. D’autres recherches sont nécessaires pour déterminer les misons pour lesquels les femelles traitées sont retournées dans des conditions leur permettant de se reproduire.

L’implantation de l’oestradiol comme moyen de contraception a eu du succès. Sur 10 femelles traitées, aucune n’était à mesure de produire après six mois(jusqu’à la fin de la durée de vie de l’implantation). Même après 12 mois, aucune femelle n’a présenté des signes de gestation, ce qui explique qu’une quantité suffisante d’oestrogen apportée par l’implantation empêche l’ovulation ou a des effets permanents sur les ovaires.

Cependant, on a pu noté que les é1éphants femelles soumis à l’oestradiole - 17ß présentaient un certain comportement de stress. Bien que cette anomalie cessait six mois après l’implantation, le projet a été suspendu (identification d’une autre proposition de projet par l’équipe de recherche) car il était considéré inacceptable à la fois pour des raisons humains et éthiques. Ces animaux seront semestriellement examinés pour déterminé si et quand ils pourront retrouver les conditions normales de reproduction.

INTRODUCTION

Since 1967, when the culling of elephants was initiated in the Kruger National Park (KNP), many South Africans came to accept the policy and the reasons proposed by earlier managers for its necessity. But this policy has not been without controversy, and in late 1994 the issue was again raised when certain animal rights groups challenged the rationale for culling and the ethical morality of killing elephants. This challenge resulted in the holding of a public debate on the issue in May 1995, at which the South African National Parks (SANP) agreed to review the elephant management policy of the KNP. This review is almost complete (Whyte *et al.*, 1997). One of the principles accepted is that wherever possible, management of the South African elephant population will be conducted by non-lethal means (translocation and/ or contraception). However, where neither of these options is possible, culling is the only remaining option available and will be used.

In accordance with this principle, SANP is supporting research on contraception. Two methods have received research attention in the KNP over the past 12 months. The first is the "immunocontraception" method and the other uses hormonal control through subcutaneously inserted oestradiol (oestrogen) implants. The status of contraception technology is not yet at a level where it can be used as a measure to control elephant populations (Whyte, van Aarde and Pimm, In press). By supporting this research, SANP hopes that it may lead ultimately **to** an ethically acceptable method to all parties, which is logistically feasible on a large elephant population in an area the size of KNP.

It is not the intention of this paper to report on the research findings of the two research groups. Any of their results mentioned here have previously been publicised in media releases. We have tried to put the issue in perspective from a SANP point of view only, and to report on behavioural data collected by SANP staff.

IMMUNOCONTRACEPTION

The originators of the immunocontraception project are the Science and Conservation Biology Program, Montana; Faculty of Veterinary Medicine, Pretoria University; and the Humane Society of the USA.

Immunocontraception uses porcine zona pellucida immuno-contraceptive vaccine (PZP) to stimulate the target animal's immune system to prevent sperm penetration of the ovum (Kirkpatrick *et* ***al.,*** Undated). A sample of 21 adult elephant cows was given an initial inoculation of PZP vaccine at the time of immobilisation, followed by a second inoculation given three to five weeks later. In two of these, collars malfunctioned leaving a research sample of 19 animals. This treatment was not expected **to** induce behavioural side effects as the hormone system of the target animal is not affected. No adverse side effects have been recorded and this project is continuing.

OESTRADIOL - 17ß IMPLANTS

The originators of the oestradiol-17ß implant project are the Institute for Zoo and Wildlife Research in Berlin.

A second sample of ten adult cows was treated with an anti-ovulatory "negative feedback" application of oestradiol-17ß. These cows each received five slow-release oestradiol-17ß implants, inserted subcutaneously behind the ear in the neck area (Meyer *et al.*, Undated).

After six months, oestrogen levels were expected **to** decline and the cows were to receive a second implant. This second phase was not implemented and the project has been temporarily suspended by SANP due to behavioural aberrances which were induced by the high levels of oestrogen. These are discussed later in this report. The project may be reinstated on receipt of a new proposal with revised and improved protocols.

CONCERNS WITH REGARD TO THE POTENTIAL NEGATIVE EFFECTS OF THE RESPECTIVE PROJECTS

Both of these projects had certain potential associated problems which were either addressed in the project protocols or were expressed by members of SANP's Department of Scientific Services (DSS) at the time the projects were initiated. These could take the form of social disruption, threats **to** the health and welfare of the treated animals and/or their calves, or behavioural aberrations. These are described below.

Immunocontraception

There is some concern over a possible permanent effect on the cows' ovaries which may cause permanent sterility, as has been the case in dogs and rabbits. Research will be directed to determining if this occurs in elephants or not. Mating in elephants is a dramatic affair **in** which the cow is chased by the bull. This chasing can be extensive, with a certain amount of disturbance to other members of the family unit, and ends when the bull catches up to the cow and lays his trunk along her back. At this point (if she is ready to mate) she will stand and allow the bull to mate with her. If she is not ready to mate, she will try to prevent him from mounting and the chasing continues until she becomes receptive. Normally an adult cow would come into oestrus and be mated and conceive, and this would not be repeated until her next oestrus period after her calf was born. This would happen about once in four years. In the case of the inmunocontraception, the cow will mate normally but will not conceive, and will then "cycle" and return to oestrus in about 15 weeks. The frequency of mating and its accompanying disturbances would be far more frequent, and the possible effects are not known, though negative social or behavioural effects are not expected.

Oestradiol implants

Oestrogen is a known carcinogen in humans and monkeys when used in the dosages required to prevent conceptions. No information is available on the potential effects on elephants.

Oestrogen is also an agent which induces abortions in pregnant females and abortion of a near full-term foetus could have serious consequences for an elephant cow. The research group intended to treat non-pregnant elephant cows and they used an ultrasonic scanner to determine pregnancy in proposed research animals prior to insertion of implants. There was some concern as to whether the scanner would be a reliable indicator of pregnancy, but these concerns now appear to have been without foundation as the team conducting the scanning have shown that a foetus would not have escaped detection.

As the oestrogen implants would induce abortion in pregnant cows it was necessary to implant them in non-pregnant animals. Cows with very small calves are the only ones which are likely to be non-pregnant and thus they were selected as study animals, and all ten of the cows implanted had very young calves at foot. Treated elephant cows would absorb high levels of oestrogen from the implants and would pass much of this out through their urine in a metabolised form, incorrectly signaling to bulls that they were sexually receptive. The courtship behaviour and its accompanying disturbances described above would have been a condition which lasted as long as the implants were active (six months). Cows in this condition of 'false oestrus" would not be sexually receptive and continual chasing or harassment by the bulls would likely be the result. This would almost certainly be highly stressful for the adult cows and even more so for the calves. Calves of less than a year old are very seldom found more than a few metres from their mothers (Moss, 1988). If these cows were continually chased by attendant bulls, the calves would be in danger of: being trampled by bulls (or by the mothers themselves in their efforts to avoid the bulls); or being unable to suckle adequately while their mothers were harassed by bulls, possibly resulting in malnutrition and death from starvation.

The following are also considerations:

- High levels of oestrogen are known to have a suppressive effect on milk production. This type of contraception is not used on human females for this reason. This may also lead to malnutrition and possible death of these calves should this be the case in elephants.

- Concern has also recently been expressed over a possibility that high levels of oestradiol may cause permanent damage to the ovaries and thus permanent sterility.

- High levels of oestrogen in mares are known to induce diarrhoea in foals through ingestion of the milk -another possible health risk to the calves.

- Concems have also been expressed over the possible effects that elephant cows in false oestrus may have on bulls and on their behaviour such as heightened aggression (Whyte, van Aarde and Pimm, In Press).

MONITORING OF BEHAVIOUR

Immunocontraception

Since it was not expected that the immunocontraception vaccine would have any significant adverse effects on behaviour, no provision was made for subsequent monitoring in the project protocols which were accepted by NPB staff. Follow up work would have been at regular intervals requiring only that the animals be immobilised for clinical examination. However, once the monitoring program had been instituted for the oestradiol implanted animals, the PZP animals were also occasionally visited.

Oestradiol implants

No provision for the monitoring for adverse behavioural and other negative side effects were made in this project's protocols either. As members of DSS staff felt that this was imperative, it was instituted after the animals had already received their initial treatments. As this had not been foreseen, most of these research animals were unfortunately selected in areas which proved largely unsuitable for this work due **to** thick bush and mountainous terrain, which is evident from the results presented here. Elephants

Table 1. Results of ground and helicopter tracking of PZP treated elephant cows.

Collar Frequency	Times tracked	Cow seen?	Cow with herd?	Calf present?	Bulls present?	Harassed by bulls?
9165	1	0	-	-	-	-
4436	Collar ceased functioning					
4561	Collar ceased functioning					
9070	2	0	-	-	-	-
9080	11	6	11	6	2	-
9090	2	1	2	1	1	-
9160	3	0	3	-	-	-
9170	2	1	2	1	1	-
9180	0	Tracked only from the air				
9670	2	2	2	2	-	-
9680	3	0	3	-	-	-
9700	1	0	1	-	-	-
9710	3	2	3	2	1	-
9720	1	1	1	1	-	-
9750	2	2	2	2	-	-
9780	1	0	-	-	-	-
9790	11	6	11	6	2	-
9810	2	1	2	1	1	-
9820	4	1	4	1	1	-
9830	3	0	3	-	-	-
9840	3	0	-	-	-	-
Totals	57	3	56	23	9	0
%	100	40.4	98.2	100.0	15.8	0

were often tracked but the research animals could not be observed due to the thick bush and the danger of approaching these animals on foot. On more than one occasion, while “homing in” on the collared animal, the observers found themselves amongst the rest of the herd which they had passed unnoticed before the research animal could be seen, and had to retire hastily before any observations could be made, and the cows were thus tracked more often than they could be observed.

Table 2. Results of ground and helicopter tracking of oestradiol- 17ß treated elephant cows.

Frequency	**Times tracked**	**Cow seen?**	**Cow with herd?**	**Calf present?**	**Bulls present?**	**Harassed by bulls?**
8270	14	7	14	7	8	-
8620	8	5	8	1	3	-
8110	13	7	3	7	8	2
8130	11	**7**	10	6	8	3
8200	21	14	12	12	13	5
8810	17	9	17	9	10	-
8170	18	6	18	6	8	3
8100	4	2	4	2	2	-
8220	5	4	5	4	3	-
8660	11	6	11	6	4	1
Totals	122	67	112	60	67	15
%	100	54.9	91.8	89.6	100.0	22.4
- No data						

Table 3. Comparisons between tracking data from Immuno- and Oestrogen treated elephant cows.

Observation type	**Immuno**			**Oestrogen**			**Chi-squared**	**p**
	Yes	No	n	Yes	No	n		
Times tracked	-	-	57	-	-	122	-	-
Cow seen?	23	34	57	67	55	122	2.05	<0.1
Cow with herd?	56	1	57	112	10	122	1.79	<0.1
Calf present?	23	0	23	60	7	67	3.49	<0,1
Bulls present?	9	14	23	67	0	67	24.94	<0.001
Harassment?	0	23	23	15	52	67	4.67	<0.05

RESULTS TO DATE

Immunocontraception

A sample of 19 adult elephant cows was immobilised and fitted with radio-collars to facilitate relocation and identification of each animal. All animals were given an initial inoculation of PZP vaccine at the time of immobilisation, followed by a second inoculation given three to five weeks later by remote delivery in the rump area of target animals by darts fired from a capture gun from a helicopter.

As was expected, no behavioural or other negative side effects have been recorded from this treatment, as the hormone system of the target animals is not affected. Results of tracking of these animals are presented in Table 1.

This table shows that the research animal could only be observed on 23 (40.4%) of the 57 times these animals were tracked from the ground. In 56 of the 57 times (98.2%), it was determined that the cow was with the herd. Of the 23 times that the respective research animal was seen, their calves could be recorded with them on all occasions (100%). Bulls were recorded with the herds on only 15.8% of occasions (nine out 57 times).

The fixed-wing aircraft was used only to track these animals to establish their locality so as to facilitate their subsequent capture by helicopter. From a fixed-wing aircraft it was not easy to actually see the collared cow in the herd or to determine whether her calf was with her. The data from these flights were not considered comparable and have not been included in the above table.

After 12 months ultrasonographic examination revealed that eight of the 19 treated cows were pregnant. This gives some cause for concern over the efficacy of the method but possible reasons for this are given later in this report.

Oestradiol implants

A sample of ten adult elephant cows was immobilised and fitted with radio-collars to facilitate relocation ad identification of each animal. Each animal received five slow-release oestradiol-17ß implants, inserted subcutaneously behind the ear in the neck area Certain behavioural and other negative side effects were recorded from this treatment. Results of tracking of these animals are presented in Table 2. This table shows that the research animals could only be observed on 67(54.9%) of the 122 times these animals were tracked. On 112 of the 122 times (91.8%), it was determined that the cow was with the herd. Of the 67 times that the respective research animals were seen, their calves were seen with them on 60 occasions (89.6%). Bulls were recorded with the herds on 100% of occasions (67 times) and harassment of cows by these bulls was observed 15 times of the 67 occasions (22.4%) that the cows were seen.

There are clear differences between the data presented in Tables 1 and 2, particularly with respect to the relative number of times that calves were recorded with the treated cows, the number of times bulls were recorded with them and the number of times that “harassment” was recorded. An analysis of these differences is given in Table 3.

Although hormone release from the implants was expected to last for only six months, ultrasonographic examination revealed that after 12 months, none of the treated cows were pregnant. This showed that oestradiol-17ß prevents pregnancies in elephants. The examination also showed the uteruses of these cows to be still in the characteristic oestrogenic state (increased blood supply and sponginess). All blood samples taken subsequent to the initial treatment have shown that the oestrogen levels have remained within the normal rage for elephants, but the fact that the oestrogenic state has persisted for at least 12 months, suggests that elephants are extremely sensitive to increased levels of oestrogen, which raises concerns about possible long-term or even permanent damage to the ovaries.

Video material

During the initial phases of the monitoring of these animals, a video camera was used to try to record these behavioural aberrances. For reasons mentioned earlier (thick bush, difficult terrain), this was seldom possible, but recordings were made of bulls with penises erect following the treated cows, and of the red mud smears on a cows back which were clearly from the front feet of bulls trying to mate with her.

Aggression by bulls

A report was received from Scott (In Litt. D/1/1: 97.03.17) which he wrote on behalf of the Trails Rangers ad staff of the Boesma Area (a area where tourists are taken out on foot) expressing concern over an increased incidence of aggression by elephant bulls towards trailists subsequent to the commencement of this research. This was attributed to a increase in the number of “musth” bulls in the area utilised by oestrogen contracepted cows in the Matjulwane area.

DISCUSSION

Immunocontraception

The results of the tracking of the immunocontraception cows are as would have been expected from cows whose behavioural patterns were not affected by the treatment. The calves were always with their mothers and, although bulls were occasionally recorded with these herds, this is normal as bulls do enter the herds to investigate the possibility of cows being in oestrus or for other social reasons (Moss, 1988).

The efficacy of this method is somewhat under question, as after 12 months, eight of the 19 cows were pregnant. This has been attributed to two possible causes. These were:

1. The most likely cause was that pregnancy had occurred before the antibody titres had achieved levels high enough to prevent conception.

2. A less likely cause was the possibility of non-delivery of the booster doses when delivered remotely (by darting). Darting is known to be an imperfect delivery system as even when using this method for immobilisation, failures sometimes occur.

Oestradiol implants

The cows treated with the slow-release oestradiol-17ß implants showed definite behavioural aberrances. Firstly, calves were not always recorded with their mothers. This is highly unusual. Moss (1988) describes the normal situation for young calves as follows:

“The calf is very rarely more than a few feet from its mother and usually less than a foot from her, often touching her by leaning on her leg or by resting its head against some part of her body.”

Calves were not with their mothers in seven out of 67 observations and is, therefore, considered highly abnormal. Although this could not be shown to differ significantly from the immuno sample by statistical analysis, this is considered to be due to the relatively small sample size of the “immuno” sample.

There was evidence that milk production was affected as poor milk samples were obtained during some of the scheduled recapture operations.

Two of the ten calves disappeared and were presumed dead. This could not be directly attributed **to** the oestrogen treatment, but given the above results (probable poorer milk production and separation from their mothers), and the fact that none of the PZP treated animals’ calves died, it is considered probable that the disappearance of the calves can be attributed to the qestrogen treatment.

Cows were recorded to have become completely separated from their matriarchal groups on ten of the 122 occasions that they were tracked. On one occasion, the cow was tracked by fixed wing aircraft and was completely or her own (no other cows and/or calves could be seen anywhere nearby) in the company of seven bulls. This is also not normal behaviour for a cow not in real oestrus. Bulls were recorded with the herds in a far greater proportion of times (100%), and harassment of the cows was recorded in 15 out of 67 observations. There is evidence of bulls trying to mate with cows during darting and also from video material. During normal oestrous behaviour the cow does often become separated from her matriarchal group, but this lasts only for a few days during which time the cow is receptive and willing to mate. At this stage the calf is old enough to be separated from its mother for short periods. With the oestrogen treated animals, this false oestrus is a permanent condition (while the implants remain active), the cows are not receptive and willing to mate, and under these conditions, the attentions of the bulls must be considered to be harassment, particularly with the added stress of being separated from their young calves.

However, the method appears to be successful as a contraception technique as ultrasonic scans showed that after 12 months, none of the ten cows was pregnant.

CONCLUSIONS

Immunocontraception

There is no evidence to suggest that the immunocontraception technique is having any adverse effects on the behaviour of either the treated cows, their matriarchal groups or the bulls.

The efficacy of this method needs further research to determine the reasons for some of the cows returning to breeding condition.

Oestradiol implants

All of the behavioural differences discussed above must be considered as abnormal and must have placed severe stress on the treated cows which in our opinion, were unacceptable on both humane and ethical grounds. It would seem that the effects of the oestradiol are no longer having any effect on behaviour and thus do not need to be removed.

None of the treated cows is yet pregnant and so there is either still enough oestrogen being released by the implants to prevent ovulation or else there has been a more long-term or possibly permanent effect on the ovaries.

ACKNOWLEDGEMENTS

The contributions of Messrs 'JJ" van Altena, Rob Stannard and Paul Manhique are acknowledged with much appreciation. Most of the data were collected under adverse conditions, even bordering on the dangerous, and it is only through their efforts that any analysable data were available. Mr "JJ' van Altena also assisted with data analysis.

REFERENCES

Kirkpatrick, J.F., Bertschinger, H. and Fayrer-Hosken, R. (Undated) Non-lethal control of African elephant *(Loxodonta africana)* populations by means of immunocontraception. Typescript. Gaithersburg: The Humane Society of the United States, Research proposal submitted to South African National Parks.

Meyer, H.H.D., Sybille Quandt, Raath, C.P., GöRitz, F., Hildebrandt, T. and Hofmann, R.R. (Undated) Contraception in the African elephant *(Loxodonta africana)* as a possible part of future elephant management policy, Typescript, Berlin: Institute for Zoo and Wildlife Research, Research proposal submitted to South African National Parks.

Moss, C. (1988) *Elephant Memories. Thirteen years in the life of an elephant family* Elm Tree Books, Great Britain.

Whyte, I.J., Biggs, H.C., Gaylard, A. and Braack, L.E.O. (1997) A proposed new policy for the management of the elephant population of the Kruger National Park, In: *Policy proposals regarding issues relating to biodiversity maintenance, Maintenance of wilderness qualities. and provision of human benefits,*pp 1 17-139, Skukuza, South African National Parks.

Whyte, I.J., Van Aarde, R. and Pimm, S.L. (In press) Managing elephants, *Animal Conservation.*

HABITUDES MIGRATOIRES DES ELEPHANTS ET INTERACTIONS HOMME-ELEPHANT DANS LA REGION DE WAZA-LOGONE (NORD-CAMEROUN)

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RESUME

Les études entreprises depuis 1991 das la région de Waza-Logone s'inscrivent dans la recherche de stratégies pour concilier les intérêts des homes et des é1éphants dans la région. Quelque résultats sont discutés.

En 1991, la populalton d'éléphants de la région était estmée à 1.100 individus et dépasserait actuellement 1.400 individus. Trois sous-populations d'éléphants ont été identifiées au parc National de Waza. Un tiers des é1éphants de Waza est sédentaire. Son domaine vital annuel avoisine 785 km^2. Un autre tiers migre vers les Pare National de Kalamaloué situé à 80 km au nord en saison séche et ne revient vers le Pare de Waza qu'au début de la saison de pluie. Son domaine vital annuel atteint 3.066 km^2. Le dérnier tier migre au début de la saison de pluie vera le sud de Waza jusque dans la région de Kaélé situé à plus de 100km. Ces é1éphants ne rentrent au Parc National de Waza qu'au début de la saison sèche. Leur domaine vital annuel varie de 1.577 km^2 à 2.604 km^2. Les observations effectuées dans la région de Waza-Logone ont souligné que parmi les facteurs qui influencent les mouvements migratoires des é1éphants dans la région, les plus important sont l'éau et les éléments minéraux.

Depuis 1991, le nombre d'élépahnts qui maraudent au sud de Waza en saison de pluie n'a cessé d'augmenter (de 50 individus en 1991 à près de 330 en 1997) et les conflits homme-éléphant se sont sérieusement multipliés. Le sorgho pluvial est la culture la plus ravagée par les éléphants. Les statistiques officielles estiments les supefficies dévastées annuellement à près de 2.000 ha, et les pertes totales annuelles encournes suit aux dégâts d'éléphants sur les cultures sonts estmées à US$ 382.000. Ces statistiques officielles son surestimées de 46% environ. Les revenues générés annuellement part les é1éphants à travers le tourism cynégétique et le tourism annuellement qui en réalité avoisinent US$206,000. Les pertes en vies humaines sont rares et généralement liées à l' imprudence des paysons. La contribution humaine à la mortalité des é1éphants de la région rest négligeable.

Les mesures à ne pas envisager pour réduiré le conflit homme-éléphant dans la région de Waza-Logone sont 1' extermination des é1éphants maraudeurs, le transfert de ces é1éphants dans une autre région, la construction de barrière autour du Parc National de Waza et les compensations financières. Les opérations de refoulement néssite d'être améliorées et intensifiées. Un mécanisme d'évaluation des dégâts devrait être mis en place et il faudrait poursuivre les recherches scientifiques en cours dans la région et mettre un accent particulier sur la régime alimentaire des é1éphants et l'expérimentation de nouvelles méthodes de refoulement. Des réformes réglementaires sont nécessaires et il est fortment recommandé qu'une assistance humane, technique et financié soit apporter au Ministère de l'Environnment et des Forêts pour renforcer les capacités et les compétences locales en gestion et en gestion participative des ressources naturelles.

ABSTRACT

In 1991 the population of elephants in the region was estimated at 1,100 individuals and may have been more than 1,400. Three sub populations of elephants have been identfied in Waza National Park One sub population is sedentary with an annual average range of 785km^2. Another sub-population migrates around Kalamaloué National Park situated 80km north of Waza in the dry season, and returns to Waza at the beginning of the rainy season. Their range is approximately 3,066km. The last sub-population migrates at the beginning of the rainy season around the south of Waza into the Kaele region, further than 100km away. These elephants return to Waza at the beginning of the dry season. Their range vanes between 1,577km^2 and 2,604 km^2. Based on the observations in the WazaLogone region it can be stated that amongst the factors which influence elephant migratory movements in the region, the most important are water and minerals.

Since 1991 the number of crop raiding elephants in southern Waza in the rainy season has increased (from 50 elephants in 1991 to approximately 330 in 1997) and human-elephant conflict has seriously increased. Sorghum is the crop most often raided by these elephants. Official statistics estimate that the annual area is about 200ha annually and the total estimated cost of the damage is US$ 382,000. These official statistics are about a 46% overestimate. The annual revenue generated from elephants by tourism is estimated at US$51,000 and far from being able to compensate for the damage incurred, which is realistically about US$ 206,000. The loss of human life due to elephants is rare, and is generally over exaggerated by local communities, although elephant mortality caused by humans in the region is negligible.

Measures envisaged for reducing human elephant conflict in the Waza Logone region are to eliminate problem animals, translocate the elephants to another region, build a fence around Waza National Park and financial compensation. Disturbance measures need to be integrated into other activities and intensified. A mechanism for evaluating crop damage must be put in place and scientific research should be conducted in the area, particularly on elephant feeding patterns and new methods for disturbance. Legislative reforms are necessary and it is strongly recommended that financial, manpower and technical assistance be provided by the Ministry of Environment and Forests to reinforce the capacity of local competence for wildlife management and participatory natural resource management.

INTRODUCTION

Les aires protégées ont été créés et maintenues par l'application de mesures excluant les communautés locales, longtemps considérées comme ennemis de la conservation et de l'utilisation durable des ressources naturelles (McNeely, 1995). Les ressentiments occasionnés par le manque d'accês à des ressources traditionnelles sort souvent aggravés par des dégâts non-indemnisés causés aux cultures par les animaux sauvages qui entrent dans les champs en provenance des aires protégées. L'accroissement de la population humaine et les exigences en matière de terre ont maintenant atteint un tel degré que l'intégrité écologique des aires protégées ne saurait être sauvegardé indépendamment des zones périphériques, de l'appui et de la coopération des communautés locales.

L' un des éléments principaux des relations entre communautés locales et aires protégées est l'éléphant (Loxodonta africana). Le perte des habitats semble être le plus grand danger qui menace la plupart des populations d'éléphants d'Afrique, bien que le braconnage de ces animaux pour l'ivoire ou la viande soit toujours un problème sérieux dans certaines parties du continent (Dublin et al., 1995). Les é1éphants sorts une espèce grande qui nécessitent de larges espaces. Ils sont potentiellement dangereux et leur comportement et activités écologiques sont souvent incompatibles avec les exigences des écosystèmes agricoles de l'homme (Lahm 1994; Tchamba, 1996 a ;Tchamba and Nshombo, 1996).

L'accroissement considérable du phénomène de destruction des cultures par les é1éphants est dû à de nombreaux facteurs tels que l'accroissement de la population humaine, la demande accrue de terres pour l'agriculture, 1' exploitation forestière, et le manque de ressources humaines, financièrs et techniques pour traiter ce problème. Dans de nombreaux cas, l'habitat de l'éléphant a été considérablemernt réduit, les populations humaines se sont installées dans le domaine vital des populations d'éléphants environnantes, et les voies de migrations de ces é1éphants ont été bloquées, et par conséquent le conflit qui oppose les hommes aux é1éphants s' est accentué (Taylor, 1987; Bell & McShaneCaluzi, 1984; Lahm, 1994; Bames *et al.*, 1995;Tchamba, 1996 a ;Tchamba and Nshombo, 1996).

La zone de Waza-Logone au Nord-Cameroun présente un résumé typique des problèmes qui se posent en matière de gestion de la faune et des aires protégées en général, et de gestion des populations d'éléphants en particulier. Braconnage et modification des milieux menacent directment la conservation des ressources naturelles de la région. La zone de Waza-Logone se compose du Parc national de Waza, du Parc National de Kalamaloué, et d'une partie de la plaine d'inondation du Logone. Cette plane inondée quatre mois par an jouait autrefois an rôle crucial pour la faune du Parc National de Waza et pour les éleveurs nomades. Cependant, l'asséchement global de cette zone à partir des années 1970 puis la construction du lac artiflciel de Maga et d'une digue d'une vingtaine de kilomètres le long du fleuve Logone en 1979, afin d'installer de la riziculture, ont modifié le régime des crues. La diminution massive d'apport d'eau dans les temps et l'espace a entraîne le remplacement des graminées pérennes par des graminées annuelles, réduisant ansi la capacité de charge de la plaine (Van Oijen & Kemdo, 1986). Les impacts de defassa (Kobus ellipsyrimmus), la diminution des effectifs des espèces telles que le cobe de buffon (Kobus kob), et un accroissement de déplacements des certain espèces dont principalement les é1éphants qui quittent le parc à la recherche d'eau et/ou de nouveaux pâturages et occasionnent de dégâts importants sur les cultures. Dans la région de Waza-Logone, le plus grand défi actuel pour les gestionnaires de la faune et des aires protégées est de trouver des solutions aux problèmes humaines dûs à la vie commune avec les éléphants, et en même temps conserver les éléphants.

Les conflits populations locales-aires protégées ont beaucoup de caractéristiques communes. Cependant, les stratégies développées dans une région ne peuvent pas être naïvement appiquées à une autre région. Chaque conflit a ses spécifités car se développant dans un contexte écologique, poitique, économique et social particulier, et exige une analyse particulière. Avant de trouver des solutions aux problèmes du conflit homme-éléphant, il faut en avoir une bonne connaissance. Il faut connaître la nature du conflit, son étendue, son impact économique, et son impact sur les éléphants. Les efforts entrepris depuis 1991 pa le Centre d'Etude de l'Environnement et due Développment au Cameroun (CEDC), l'Université de Leiden au Pay-Bas, le Groupe des Spécialistes de l'Eléphant d'Afrique (Union Mondial pour la Nature) et le Fonds Mondial pour la Nature (WWF)- Programme pour le Cameroun ont permis d'acquérir des connaissances sur l'écologie des éléphants, et la nature et l'étendue du conflit homme-éléphant dans la région de Waza-Logone. La présente publication, fruit de ses effort, tente de résumer les données accumulées sur habitudes migratoires des é1éphants et les interactions existantes entre la présence de ces é1éphants et les activités socio-économique des populations humaines dans la région de Waza-Logone. Elle s'inscrit dans la recherche de stratégies pour concilier les intérêts des hommes et des é1éphants dans la région.

LA REGION DE WAZA-LOGONE

La région de Waza-Logone est située à l'extrême nord du Cameroun et est définit ici comme la zone qui s'étend des Départements du Mayo-Kani (Kaélé) et Mayo-Danai (Yagoua) au sud jusqu'au Lac Tchad au Nord. EIIe couvre unesuperficie d'environ 29,800km^2 (Figure 1) et est comprise entre les 10 25' et 12 50' de latitude nord et 14 05 et 15 15' de longitude est. La région inclus les Parcs Nationaux de Waza (1.700km^2) et de Kalamaloué 27km^2) et une plane périodiquement inondée (localement appelé "yaéré") par le fleuve Logone. Cette plane occupe pratiquement toute la partie comprise entre le 11 ème et le 12 èmme parallèle.

Le climat de la région varie de soudano-sahelién au sud à soudano-sahélien au nord. La saison sèche duere 6 à 8 mois et la pluviométrie moyenne annuelle varie de 1.000mm au sud à moins de 350mm au nord. La dégradation des conditions pluviométriques est fluctuante mais de manière générale progressive du Sud vers le Nord. La durée de la saison de pluie d'une année à l'autre.

Trois groupements végétaux distincts se rencontrent dans la région:

- les savanes herbeuses périodiquement inondées du Logone et Chari et les savanes herbeuses de la plaine d'inondation du Lac Tchad dominées par *Echinochloa pyramidalis, Hyparrhenia rufa, Oryza longistaminanta,* et *Pennisetum ramosum;*
- les savanes boisées à épineux dominées par *Acacia spp., Balanites aegyptiaca, Piliostigma reticulatum, Calotropis procera* et *Ziziphus spp.;*
- les savanes arbustives *à Combretum spp., Feretia apondenthera, Acacia dudgeoni* et *Anogeissu leiocarpus.*

Seules les parties de la plane sittuées à l'intérieur et à proximité du Parc National de Waza (170km^2) présente un intérêt pour la grande faune, le reste étant largement occupé par les pasteurs et agriculteurs. Les principaux mammifères sont: l'éléphant, la giraffe Giraffa camelopardalis, le damalisque Damaliscus korrigum, l'hippotrague Hippotragus equinus, le lion Panthera leo, le cob de buffon Kobus kob, la gazelle à front roux Gazella rufifrons, et l'hippopotame Hippopotamus amphibius. L'avifaune relativement diversifié de cette zone humide comporte les oiseaux de proie (vautour *Gyps reuppellii, marabout Leptoptilos crumeniferus,* serpentaire *Sagittarus serpentarious, aigle Aquila rapax,* etc.) les oiseaux d'eau (pelican *Pelecanus rufescens,* oie *Plectropterus gambensis,* dendracygne *Dendrocygna spp.,* etc.) et une borne population de pintades *Numida meleagris* et d'autruches *Struthio camelus.* Par ailleurs, la région constitue une zone d'hivernage pour des oiseaux migrateurs d'Europe.

La plaine d'inondation ou yaéré ades fonctions multiples et variées: les terres sont riches et peuvent être mises en valeu pour les culturess irriguées, les patûrage de décrues sort d'excellente qualité pour le bétail et la faune sauvage, la pêche est une source de revenu de base pour

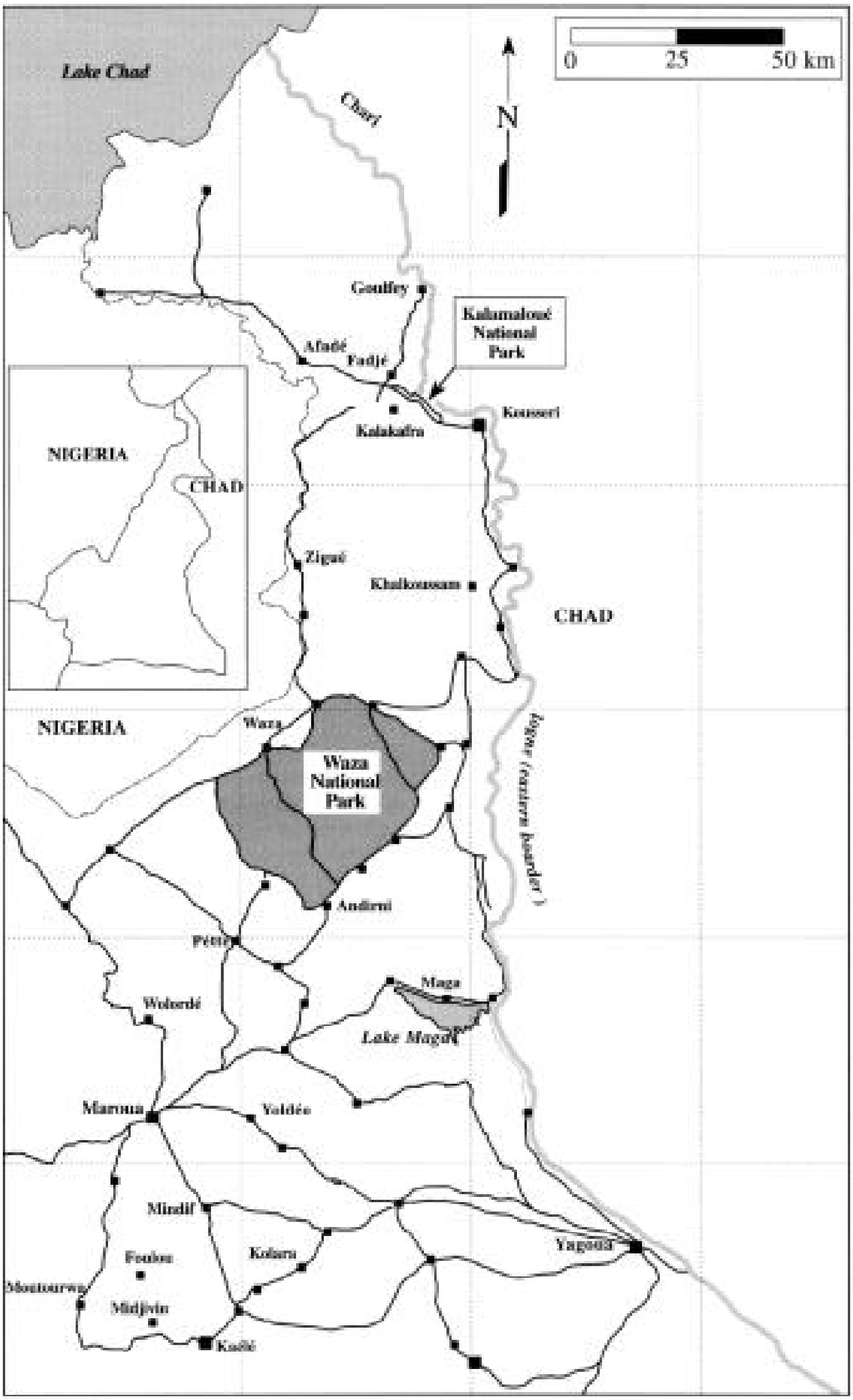

Figure 1. La Region de Waza-Logone et les trois zones de degats d'éléphants.

une partie de la population, et le potentiel touristique de la région est important quoique très faiblement exploité. Cette zone humide joue également un grand rôle dans le cycle de l'eau et des nutriments. Dans leur vie quotidienne, les populations locales tirent de nombreaux bénéfices de la diversité floristique de la région (bois de chauffage, plantes médécinales).

L'assèchement global de la plaine de Waza-Logone à partir de 1970 puis la construction du lac artificiel de Maga pour l'installation de la riziculture sur près de 7.000 ha a complètement modifié le régime des indondations de la plaine. L'impact a été une diminution à la fois de la surface et de la durée des inondations (Tchamba *et al.,* 1995 a). La rédaction massive d'apport d'eau dans le temps et l'espace a diminué de façon significative la capacité de charge de la plaine et a eu des impacts négatifs sur la faune et la flore de la région (Tchamba *et al.,* 1995 a). La dégradation de cette zone humide est également fortement ressentie par les couches les plus pauvres de la population, principaux utilisateurs de son potentiel. Face à cette situation, l'Union Mondiale pour la Nature (IUCN) a réagi et son Projet Waza-Logone vise entre autres à restaurer le cycle d'inondation de la plaine.

APERÇU DES METHODES UTILISEES

Une combinaison de méthodes est utilisée depuis 1991 pour étudier les habitudes migratoire des é1éphants d'une part, d'autre part les interactions home-éléphant dans la région de Waza-Logone. Un dénombrement aérien par échantillonnage des grands mammifères dans le Parc National de Waza en utilisant un échantillonnage systématique par transect a été effectué en 1991 (Tehamba et Elkan, 1995). Un dispositif intégrant les gardes-chasses, les responsable locaux des services agricoles et les populations locales a été mis en place afin de recueillir systématiquement les informations surs les mouvements des é1éphants dans les villages de la région (date d'arrivée, nombre d'éléphants, structure en age et en sexe du groupe, date de départ, direction de départ) (Tehamba, 1993). La statégie de collecte de données sur les mouvements des é1éphants incluent également des observations aériennes et une surveillance par télémétrie. Trois jeunes é1éphants femelles adultes appartenant à la population du Pare National de Waza ont été suivies pendant vingt et un mois, deux mois, et vingt mois respectivement, grâce à des colliers équipés de radio-VHF et d'émetteurs satellite (Tehamba *et al.,* 1994; Tchamba *et al.,* 1995 b). Un quartrième éléphant femelle adulte n'était équipé que de balise VHF et a été suivi pendant dix et huit mois. Le domaine vitale de ces é1éphants a été déterminé par la méthode de la moyenne harmonique (95%) (White et Garrott, 1990). Cette méthod non paramétrique a l'avantage de re pas souffrir de la relation entre la taille de l'échantillon et la superficie du domaine vitale comme la méthode du polygone convexe minimal.

Les enquêtes sur les interactions home-éléphants ont tiré profit de la documentation existante (article scientifiques, courriers officiels, et rapports d'activités des services publics), notamment pour cc qui concerne l'importance des dégâts sur les cultures, les pertes en vies humaines, les battues administratives, le braconnage, le tourisme de vision et le tourisme cynégétique.

Certains aspects des interactions homme-éléphant (degré de dégâts et perte économique) sont mieux recueillis pars des évaluaitons indépendentes. Soixante et quize champs sélectionnés us hasard dans la région on été estimée et exprimée en taint que fractiond de la surface total cultivée pale paysan.

APERÇU SUR LES HABITUDES MIGRATOIRES

La plaine de Waza-Logone était dépourvue d'éléphants jusqu'en 1947 quand les premiers é1éphants ont traversé le Logone près de Kousseri et se sont installés dans le Pare National de Kalamaloué (Flizot, 1948). Depuis lors, le nombre d'éléphants de la plaines n'a cessé d'acceroitre: 250 en 1961, 400 en 1964, et plus de 600 en 1969 (Flizot, 1969). La majeure partie de cet accroissement est liée à une immigration des é1éphants du Tchad vers le Cameroun, suite aux conflits armés et à la destruction de la Réserve de Faune de Mandelia (Fry, 1970). En 1991, la population d'éléphants de la plaine était estmée à 1.100 individus (Tchamba et Elkan, 1995) et en 1996 à plus de 1.400 individus (Tehamba et Hatungimana, 1996).

Trois sous-populations d'éléphants ont été identfées au Pare National de Waza (Tchamba, 1996 1). Un tiers des é1éphants de Waza est sédentaire. Leur domaine vital annuel avoisine 785km^2. Un autre tiers migre vers le Pace National de Kalamaloué situé à 80km au Nord en saison séche (Décembre-Janvier) et ne revient vers le Pare de Waza qu'au début de la saison de pluie (Mai-Juin) (Figure 2). Leur domaine vital annuel est estimé à 3.066km^2. Le dernier tiers migre au début de la saison de pluie (Mai-Juin) ver le sud de Waza jusque dans la région de Kaélé situé à plus de 100km (Figure 2). Ces éléphants ne rentrent au Parc National de Waza qu'au début de la saison séche (October-Novembre). Ce dernier tiers est celui qui a reçu le plus d'attention et de publicité du fait des dégâts importants occasionnés aux cultures pendant la saison de pluie (Tehamba et al., 1994; Tchamba et al., 1995 b).

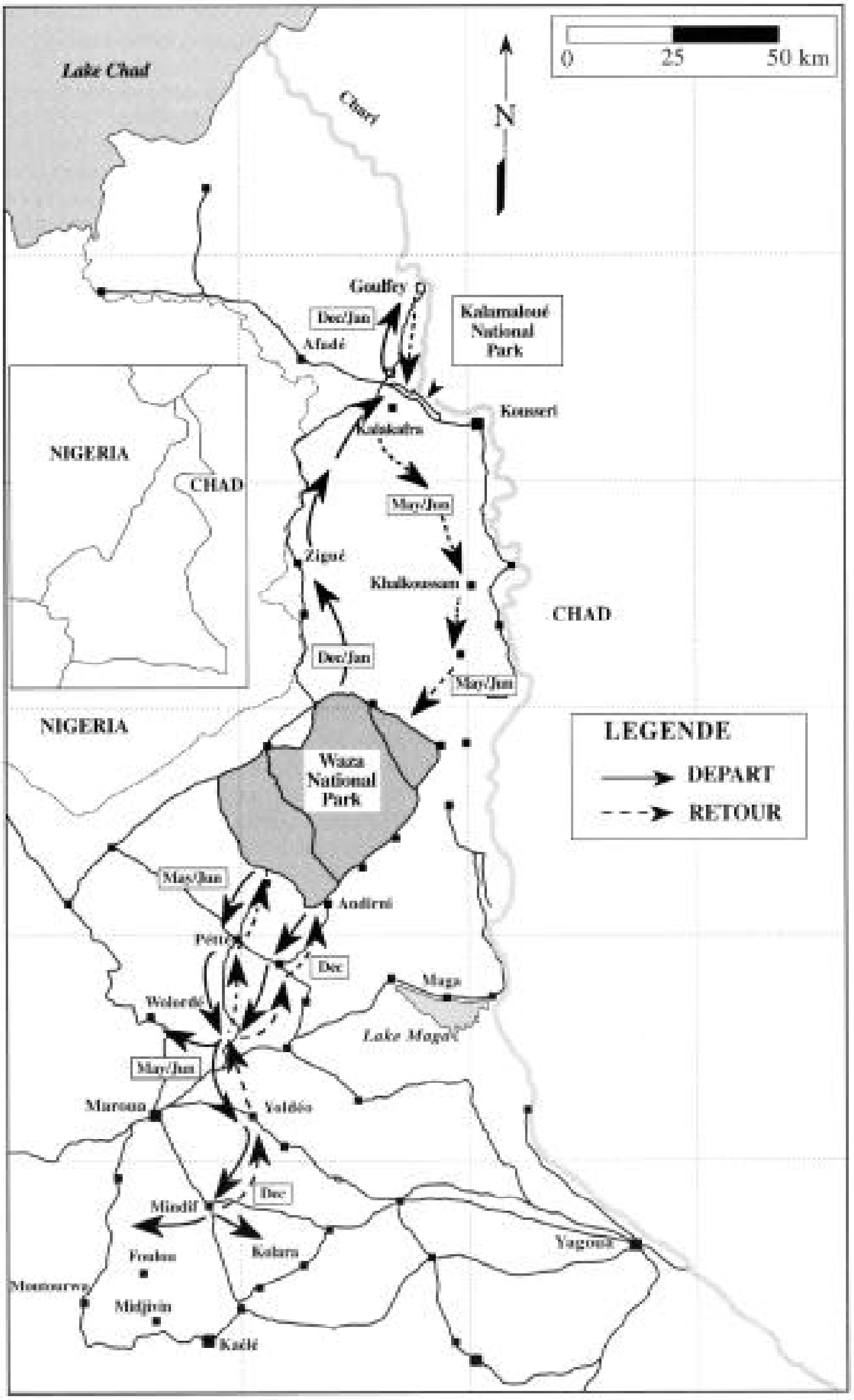

Figure 2. Voies de migration des é1éphants de Ia region de Waza-Logone.

Il ressort du Tableau 1 que le troupeau d'éléphants qui migrent au sud du Pare National de Waza en saison de pluie comprend plus de 300 individus. Des opérations intensives de refoulement ont été menées en 1997. Elles combinaient des coups de feu tirés en l'aire, l'abattage de quelques é1éphants et le jet de grenades à base de jus de piment. L'efficacité et i'intensité de ces refoulements auraient considérablement réduit le domaine vital des é1éphants et la durée de leaur séjour dans *les* zones agricoles (tableau 1), et par conséquent limité les conflits homme-éléphant. Fait tout à fait exceptionnel, les é1éphants sont rentrés dans le parc le 23 Septembre 1997, au grand boheur des pauvres paysans de la région.

Les observations effectuées dans la plaine de Waza-Logone ont souligné que parmi les facteurs qui influencent les mouvements migratoires des é1éphants vers le Parc National de Kalamaloué en saison sèche serait lié à pénurie d'eau dans le Parc de Waza et à son abondance dans le Parc de Kalamaloué du fait de la présence des fleuves Logone et Chari qui jouxent le parc. La région de Kaélé au Sud du Pace National de Waza serait très attractive en saison de pluie pour les é1éphants en raison de la présence d'une mosaïque d'habitats naturels préférés et riches en élément minéraux (concentration en calcium, sodium, et phosphore bien plus élevée à Kaélé qu'à Waza) et de champs de mils très nutritifs (bonne digestibilité et concentration particulièrement élevée en hydrates de carbone et phosphore).

Tableau 1. Principaux éléments des mouvements migratoires des é1éphants au sud du Parc National de Waza entre 1994 et 1997

Année	**1994**	**1995**	**1996**	**1997**
(km^2)Nombre d'éléphants	300	300	320	330
Date de retour au Parc de Waza	13 Juin	31 Mai	04 Juin	23 Mai
Duræe de séjour au sud du Parc de Waza (jour)	31 Octobre	18 Octobre	5 Novembre	23 Septembre
Distance maximimale parcourue au sud du Parc de Waza (km)	140	140	154	123
Domaine vitale en saison de pluie (95% moyenne harmonique) (km^2)	100,9	96,1	107,6	91,2
Domaine vitale annuel (95% moyenne harmonique) (km^2)	2.104	2.082	2.604	1.577

INTERACTIONS HOMME-ELEPHANT

Impact des éléphants sur les hommes

Dégâts occassionnés sur les cultures

Les conflits homme-éléphant se sont exacerbés depuis 1980 quand un troupeau de plus de 30 é1éphants du Parc National de Waza maraudait dans la région de Mindif au Sud de Waza. Depuis lors, le nombre d'éléphants qui maraudent au sud de Waza en saison de pluie n'a cessé d'augmenter (50 individus en 1991, plus de 320 individus cn 1992, environ 400 individus en 1993) (Tchamba, 1996 2) et *les* conflits homme-éléphants se sont sérieusement multipliés.

Les cultures de sorgho pluvial (64%), d'arachide (12, de coton (10% et de sorgho de saison sèche (9%) sont les plus souvent dévastées. Le niébé (3%), le maïs (1%), et le mil pènicillaire (1%) sont également affectées. Le broutage représente (52%) des dégâts causés aux cultures par les éléphants, le piétinement 38% et le déracinement 10%. Les dégâts sur le coton sont excelusivement faits par piétinement.

En cee qui concerne la périodicité des degâts la région de Waza-Logone peut être subdiviser en trois zones (Figure 1*)* (Tchamba, 1996 b). Dans la zone 1 (Nord du Parc National de Kalamaloué et ses environs immédiats) le maximum d'impacts d'éléphants se situe en saison sèche (Janvier à Mai) sur les cultures maraichères et les abres fruitiers. Ils sont absents le reste de l'année. Les problèmes sont très limités en zone II (partie comprise entre les Parcs Nationaux de Waza et Kalamaloué) et appraissaient tôt en saison de pluies (Mai-Juin). Les dégâts les plus importants sont enregistrés dans la zone III (Sud du Parc National de Waza) en saison de pluies (Juin à Octobre), quand les cultures sont à matûrité ou prêtes pour la récolte. La périodicité des dégâts est intimement liée aux modes de migrations des éléphants de la plaine de Waza-Logone.

Ce n'est que pour le Département de Mayo-Kani (Kaélé) que des statistiques sont disponibles pour les cinq dernières années. Plus de 96% des dégâts occassionnés pa les éléphants sont enregistrés dans le Département du Mayo-Kani (Tableau 2), en particeuliers dans les cantons de Mindif, Lara et Midjivin. L'Arrondissement de Bogo et le District de Dargala souffrent également de ces dégâts parce qu'ils sont situés sur le couloir de migration de ces éléphants. En cee qui concerne les régions située au nord du Parc National de Waza et au nord du parc National de Kalamaloué (Arrondissements de Waza et Goulfey, District de Zina) il n'existe pas de statistiques sur les dégâts occassionnés pars les éléphants. La phrase celassique utilisées dans les rapports pour signaler le passage des éléphants est: "Les éléphants ont sérieusement endommagés les cultures de..." Dans les dépatments du Diamaré, du Logone et chari, et du Mayo-Danay, les aléas climatiques, l' invasion des criquets et des oisseaux granivores sont des menaces largement plus importantes que la présence des éléphants.

D'après les statistiques des services agricoles locaux (Tableau 2) (DDAMK, 1993, 1994, 1995, et 1996; DDA, 1994 et 1995), la superficie moyenne annuelle dévastée au cours des cinq dernières années est de 1.923 ha pour le Mayo-Kani et 2.000 ha environ pour l'ensemble de la région de Waza-Logone. Le minimum de superficie dévastée dans le Mayo-Kani an été enregistré en 1994/1995 (205,70ha) et le maximum a été enregistré en 1992/1993 (5.089,25ha). Le nombre de victimes de dégâts d'éléphants a connu une baisse en 1994/1995 et depuis lors est en nette augmentation (Tableau 3). La superficie moyenne détruite par victimes est d'environ 0,88 ha. Considérés à l'échelle du paysan individuellement ces dégâts peuvent être désastreux: 23% et 27% des enquêtés perdu leurs production totales annuelles en 1992/1993 et 1993/1994 respecetivement.

Une comparaison des dégâts entre les vérifications de terrain et les délarations des paysans ont montré que cees derniers les surestimaient de 46% en moyenne (Tchamba and Hatungimana, 1996), dans l'espoir d'obtenir une potentielle compensation, en produits vivriers ou en viande d'éléphants, directement proportionnelle au pourcentage des dégâts délarés. En effet, les services agricoles manque de moyens et de motivation pour se rendre sur les lieux des dégâts pour en faire des estimations. Les procèsverbaux de constation de dégâts d'éléphants sont donc presque excelusivement basés sur les décelarations des paysans.

Sur la base des statistique des services agricoles locaux et des rendements du Mayo-Kani estimés par le Service Provincial des Statistiques Agricoles (SPSA, 1996), la production moyenne annuelle perdue au cours des cinq dernières années suite aux dégâts d'éléphants pourrait être estimé pour le sorgho pluvial, 1'arachide, le coton et le sorgho de saison sèche à 10.003 tonnes, 336 tonnes, 165 tonnes et 150 tonnes respectivement (Tableau 4). Cette production perdue réprésenterait des pertes financières totales annuells de l'ordre de US$ 382.000. Si l'on tient compte de surestimations intentionnelles des paysans et de certains autorités locales, les superficies totales dévastées par les éléphants ne dépasseraient pas 1.080 ha par an et les pertes financière annuelles avoisineraient US$ 206.000.000.

Pertes en vies humaines et autres impacts liés a la présence des éléphants

Des pertes en vies humaines suite aux attaques d'éléphants sont rares. Dans la région de Kaélé, 1 et 4 personnes ont été tués en 1992 et 1993 respecetivement.

En plus des pertes directes occassionnés par la dévastation des cultures qui auraient pu être vendues et/ou consommées, il existe d'autres impacts tels que les pertes causées pa les moissons anticipées afin de préserver le reste des cultures et des impacts indirects, difficilement quantifiables.

Les impacts sociaux comprennent les pertes de temps dues à la néceessité pour les paysans de se faire disponible jour et nuit pour chasser les éléphants des champs. Les écoliers aussi peuvent s' absenter plusieurs jours lorsqu' ils doivent aller aux champs aider leur parents au gardiennage et au refoulement des éléphants.

Un autre impact se traduit par une migration des populations humaines locales. Des cas ont été rapportés où les familles se sont déplacées suite à l'arrivée des éléphants et aux dégâts répétés chaque année pour le même

Tableau 2. Répartition spatiale des dégâts et évolution des superficies endommagées (ha) de 1992/1993 â 1996/ 1997 par les éléphants de la plaine de Waza-Logone (DDAMK, 1993,1994, 1995 et 1996; DDAD, 1994 et 1995).

Dæpartment	Arrondissement ou District	92/93	93/94	94/95	95/96	96/97
Mayo-Kani	Kaélé	4513,25	1321,75	136,00	483,50	627,75
	Moutoutoua	363,00	731,86	0,00	55,00	213,00
	Mindif	193,00	50,05	56,65	450,50	233,50
	Guidiguis	20,00	103,35	0,00	0,00	0,00
	Moulvoudaye	0,00	43,50	13,05	0,00	7,00
Sous-total		**5089,25**	**2250,51**	**205,70**	**989,00**	**1081,25**
Diamaræ	Pétté	-	6,25	12,87	-	-
	Dargala	-	37,50	68,50	-	-
	Maoua	-	0,02	23,00	-	-
	Bogo	-	16,00	268,25	-	-
Sous-total		**-**	**59,77**	**372,62**	**-**	**-**
Total		**-**	**2310,28**	**578,32**	**-**	**-**

personnes (Lougouma, Zouang et Barazi dans 1'Arrondissement de Logone Birni, Gabon et Doyang dans l'Arrondissement de Kaélé).

En plus des impacts sociaux, on assiste aux impacts environnementaux tels que la formation de semelles de labour suite au piétinement du sol par les éléphants. Quelques fois, les éléphants consomment totalement l'eau des puits devant servir au repiquage du sorgho de saison sèche ou à 1'abreuvement du bétail.

Impact des hommes sur les éléphants

Influence des activites humaines sur les mouvements et les habitudes de recherche alimentaire

La dimunition de la surface et de la durée d'inondation des crues, suite à la construction du barrage de Maga, a réduit de façon significative la capacité de charge de la plaine (Van Oijen and Kemdo, 1986) et auraient eu pour conséquence que d'une part les éléphants quittent plus tôt le Parc National de Waza en saison sèche à la recherche de l'eau et de pàturages, et d'autre part qu'un nombre plus important d'éléphants quitte le Parc National de Waza pour le Parc National de Kalamaloué (Thouless *et al.*, 1995).

Avant 1980, les interactions homme-éléphant étaient limitées aux alentours des Parc Nationaux de Waza et Kalamaloué (Tchamba, 1996 2)). En 1980, le domaine vital d'une partie des éléphants de Waza va s'étendre au sud jusque dans la région de Mindif, et en 1994 il s'étendra au sud jusqu' à près de 100 km dans la région de Kaélé (Tchamba *et al* 1995 b). Suite à la pression humaine (principalement la demande accrue de terres pour agriculture et l'exploitation forestière pour le bois de chauffage) l'habitat naturel de l'éléphant a été considérablement réduit et par conséquent son domaine vital s'est élargi et les conflits qui les opposent aux humaines se sont accentués.

Contribution humaine à la mortalité des éléphants

Bien que le quota annuel pour la chasse sportive soit de 30 individus, le chasseurs n'ont abbutu qu'en moyenne 9 éléphants par an entre 1993 et 1996 (SPFAP, 1996. Lorsque ces animaux cuasent de sérieux dégâts sur les cultures ou quand ils occasionnent des pertes en vies humaines, les battues administratives sont organisées par le Service Provincial de la Faune. Dans ce genre d'opération, en moyenne 20 éléphants par an sont mort entre 1993 et 1997.

Entre 1993 et 1997, en moyenne 4 et 2 éléphants par an ont été braconnés au Parc National de Waza et au

Tableau 3. Evolution du nombre de victimes de dégâts d'éléphants de 1992/1993 à 1996/1996 dans la plaine de Waza-Logone (DDAMK, 1993, 1994,1995, et 1996; DDAD, 1994 et 1995).

Dæpartment	Arrondissement ou District	92/93	93/94	94/95	95/96	96/97
Mayo-Kani	Kaélé	1.578	1.817	150	663	1.045
	Moutoutoua	391	1.294	0	97	494
	Mindif	1.022	312	133	400	348
	Guidiguis	22	168	0	0	0
	Moulvoudaye	0	43	32	0	11
Sous-total		**3.011**	**3.634**	**315**	**1.160**	**1.898**
Diamaræ	Pétté	-	12	24	-	-
	Dargala	-	18	164	-	-
	Maoua	-	11	58	-	-
	Bogo	-	48	224	-	-
Sous-total		**-**	**89**	**470**	**-**	**-**
Total		**-**	**3.723**	**785**	**-**	**-**

Parc National de Kalamaloué respectivement (SPFAP, 1996). Ces estimations devraient être considérées comme grossières du fait que d'une part elles ne concernent que les éléphants trouvés danls les parcs alors que le braconnage s'opère également sur les éléphants qui migrent en dehors des parcs, et que d'autre part il n'est pas toujours possible de détecter tous les animaux braconnés dans les parcs.

Utilisation de l'éléphant par les hommes

Utilisaitons traditionnelles

La viande de l'éléphant est consommée uniquement par les populations non-musulmanes de la région et provient principalement des battues adminsitratives opérées dans le cadre de la protection des cultures.

L'artisanat d'art est une activité très importante dans le Nord du Cameroun, mais n'est qu'une activité marginale danls la plaine de Waza-Logone. Un seul artisan traville l'ivoire dans la région et n'aurait pas utilisé l'ivoire depuis 1990. Le passage de l'éléphant en classe I de la CITES aurait négativement affecté la fabrication et la commercialisation des objets en ivoire dans la région (Dublin *et al.*, 1995).

Au contraire de l'ivoire, les autres produits tels que 1' urine, le placenta, la peau, la moelle des os, et les crottins de l'éléphant jouent un grand rôle dans les utilisations traditionnelles de l'éléphant. L'urine aurait des propriétés curatives sur la rhumatisme, la jaurtisse, l'asthme et le mal de reins. Le placenta de l'éléphant guérirait la stérilité chez les femmes et empêcherait les avortements.

Le peau de l'éléphant est utilisés dans les massages, le traitement du mal d'oreilles, des plaies légères, du plaudisme de la rougeole et de la méningite. Enfin, elle empêcherait les avortements. L'huile extraite de la moelle des os de l'éléphant serait un élément exceptionnel dans les massages, principalement en cas de mal de dos ou de rhumatisme.

Les crottins de l'éléphant auraient des propriétés curatives sur plusieurs maladies à cause de la diversité végétale du régime alimentaire de l'éléphant. ils sont utilisés dans le traitement du mal d'oreilles, de la rougeole, de la varicelle, de toutes sortes d'infections de la peau, et de la tuberculose. Ils protégeraient également contre les mauvais esprits.

Tableau 4. Evaluation de la production moyenne perdue par culture au cours des cinq dernières années (1992/1993 à 1996/1997) (sur la base de statistiques des autorités locales) suite aux dégâts occassionnés par les éléphants, et estimations des pertes financières encourues par les peysans.

Cutlures	Superficies detruites (ha)	Rendement moyen (kg/ha)	Production perdue (tonne)	Prix moyen/kg (FCFA)	Valeur (FCFA)
Sorgho pluvial	1.280	784	1.003	70	70.210.000
Arachide	240	1.400	336	225	75.600.000
Coton	200	826	165	160	16.400.000
Sorgho de saison sæche	180	832	150	80	12.000.000
Niebæ	60	478	29	125	3.625.000
Mais	20	1.016	20	85	1.700.000
Mil penicillaire	20	802	16	90	1.440.000
Total	**2000**				**190.975.000**

Tourisme cynégétique et tourisme de vision

Entre 1981 et 1992, la chasse professionnelle à l'éléphant a généré annuellement environ US$14,000 (en moyenne sept éléphants abattus chaque année) Tchamba, 1996a).

Depuis 1994, en moyenne vingt chasseurs professionnels sont enregistrés chaque année et neuf éléphants sont abattus (SPFAP, 1996). La loi de finances 1996/1997 prévoit pour les touristes des droits de timbre de US$500 pour le permis de grande chasses, une taxe de chasse dans une zone cynégétique non affermée de US$60 par jour et une taxe d'abattage de US$2.000 par éléphant. La chasse professionnelle à l'éléphant dans la plaine de WazaLogone rapporte actuellement à l'Etat Cameronais environ US$29.000 par an.

Entre 1981 et 1992, le Parc National de Waza a eu une moyenne annuelle de 5.000 visiteurs et a généré annuellement US$41.000 par an (Tchamba, 1996a). Le tourisme de vision est très peu développé au Pare National de Kalamaloué et rapporte moins de US$ 250 par an (SPFAP, 1996).

Une enquête effectuée auprès de 1078 touristes en 1991 et 1992 au Parc National de Waza a revélé que pour 54% de touristes l'éléphant était l'espèce la plus attractive du parc et la présence de cette espèce justifierait leurs visites au parc (Tchamba, 1996a). L'éléphant serait done sur le plan du tourisme de vision l'espèce clé du Parc National de Waza.

Ces dernières années le nombre de visiteurs du Parc National de Waza a considérablement diminué (en moyenne 3.000 visiteurs par an) et les recettes moyennes annuelles avoisinent US$ 22.000 seulement (SPFAP, 1996). Cette régression est due en partie à l'inséeurité qui règne dans la région et à l'irrégularité des liaisons aériennes entre Douala, la principale port d'entrée du Cameroun, et Maroua, la vile la plus proche. Si l'on considère à la fois le tourisme cynégétique et le tourisme de vision, la valeur potentielle directe de l'éléphant comme ressource naturelle dans la plaine de Waza-Logone pourrait être estimée à près de US$51.000 par an. Un éléphant raporterait donc annuellement environ US$36 par an dans la région de Waza-Logone.

CONCLUSIONS ET RECOMMANDATIONS

Les interactions homme-éléphant sont localisés aux alentours du Parc National de Waza et sur les pistes des migrations des éléphants qui sont actuellement connues. La destruction des cultures est le fait le plus marquant de ces interactions. La situation est la plus alarmente dans le Mayo-Kani où les éléphants séjournent pendant la saison de pluie. Bien qu'au niveau de l'ensemble de la Province de l'Extrême-Nord les supeficies dévastées ne soient par eonsidérables, pour le Département du Mayo-Kani et pour les cultivateurs pris individuellement, ces dégâts sont très significatifs. Les facteurs de l'accroissement des ravages incluent: l'augmentation de la populations des éléphants dans le Parc National de Waza, la dimunition des ressources alimentaires (eau, Pâturages, et sels minéraux) dans le Parc National de Waza, et l'envahissement des zones de migrations par les cultures suite à l'expansion démographique. Les conséquences des dégâts occasionés par les éléphant sont multiples et incluent: une dimunition des production agricoles entraînant des pertes financières ou conduisant à la famine, et un sentiment d'insécurité.

Les recettes directs générées par l'éléphant à travers le tourisme de vision et le tourisme cynégétique dans la région de Waza-Logone ne dépasse pas US$51.000 par an, alors que les pertes encourues suite aux dégâts occasionnés par ces éléphants sur les cultures avoisinent US$ 206.000. Sur un plan purement éeonomique, la présence des éléphants dans la plaine de Waza-Logone coûte quatre fois plus chère que ce que les éléphants pourraient rapporter. II est donc urgent qu'une solution durable soit trouver à la divaguation des éléphants at aux conflits homme-éléphant qui en découlent.

Compte tenu des connaissances actuellement disponibles sur les différents aspects du conflit, des expériences acquises dans d'autres pays et du contexte socio-politique certaines mesures ne sont pas recommandées pour faire face au conflit homme-éléphants dans la région de Waza-Logone.

L'abattage de tous les éléphants qui maraudent dans les zones agricoles est moralement et écologiquement inacceptable. Cette approche est unjustifiée quand on sait qu'une menance sérieuse pèse sur les éléphants du Cameroun en général et ceux de fôret en particulier du fait d'un braconnage intensif. La "translocation" ou le trasfert des éléphants à problème n'est pas envisageable dans le contexte de la région de Waza-Logone à cause du coût élévé de l'opération au moins US$ 500.000 pour déplacer 100 éléphants), des difficultés logistique (manque de routes pour les camions spéciaux utilisés pour cette opèration), et de l'absence de destination finale appropriée pour les éléphants dans la région. Cette option pourrait simplement transférer le conflit à une autre région.

Les compensations financières pour les ravages des éléphants ne sont pas à encourager. D'une part, le mécanisme de compensation est difficile et coûteaux à administrer, susceptible de corruption, de détournements de fonds et de tricherie dans l'estimation des dégâts, et les fonds ne sont jamais suffisants. D'autre part, il est difficile de faire une évaluation quantitative claire et nette, et il existe des coûts d'opportunité difficilement quantifiables (Ngure, 1992).

Dans la région de Waza-Logone la combinaison des mesures intégrant des considérations écologiques, sociales, économiques, administratives et légales pourra conduire à une solution durable pour le problème d'éléphant. Toute stratégie utilisés pour atténeur les conflits homme-éléphant devra être financièrement et techniquement à la portée des populations locales pour êtres réalisable.

Dans le contexte des presisons sociales et politiques, les battues contrôlées s'avèrent la technique initiale de gestion, de préférence dans la région de Kaélé. Les tests effectués en 1997 indiquent que l'amélioration de l'intensité de l'efficacité des refoulements pourraient réduire la distance maximale parcourue par les éléphants, leur domaine vital au sud du Parc National de Waza, et la durée de séjour hors du parc.

Il est indispensable que soit mis en place un mécanisme d'estimation des ravages. Des rapport précis et détaillés concernant les estimation des ravages des cultures par les éléphants sont essentiels pour un contrôle effectif. Un formulaire standardisé (ainsi que des critères spècifiques et des méthods pour évaluer les dégâts causés par les éléphants, pourraient améliorer la capacité de contrôle, fournir des informations (da ns les domaines économiques et scientifique), et améliorer les niveaux professionnels des services locaux.

Afin de mieux comprendre la problématique du conflit hommes-éléphants et d'y faire face efficacement il faudrait améliorer les connaissances scientifiques sur les éléphants. En particulier, les recherehes se concentreront sur le régime alimentaire des éléphants. Ces études détermineront les relations entre la quantité et la qualité du fourrage disponiblee et les besoins des éléphants en alimentation et espace, et feront des recommandantions pour accroître la capacité du Parc National de Waza et ses environs à contenir les éléphants.

En fin de compte, une aide technique et fmancière est nécessaire pour renforcer les capacités et les compétences locales en gestion de la faune et en gestion des resources naturelles orientées sur les communautés locales. Pour réussir, les éléments proposés pour la gestion des conflits homme-éléphant doivent s'appuyer sur des structures institutionnelles solides. Les différentes formes d'asistance technique et financière dont auront besoin les autorités locales devront être assurées.

C'est dans notre grand espoir que la combinaison de ces mesures servira à trouver une (ou des) solution(s) à ces conflits homme-éléphants dans la région de Waza-Logone grâce à la collaboration de gestionnaires locaux de la faune, de populations locales, et de la communauté internationale de conservation.

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REFERENCES BIBLIOGRAPHIQUES

Barnes, R.F.W., Azika, S. & Asamoha-Boateng, B. (1995) Timber, cocoa, and crop-raiding elephants: a preliminay study from southern Ghana *Pachyderm* 19,33-38.

Bell, R.H.V. & McShane-Caluzi, E. (1984) The man-animal interface: an assessment of crop damage and wildlife control. *In Conservaiton and Wildlife management in Africa: Proceedings of a Peace Corps Workshop,* Malawi. (eds R.H.V. Bell & McShane-Caluzi). US Peace Corps, Washington DC.

DDAD (1994) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Diamaré pendant la campagne agricole 1993/1994. Délégation Départementale de l'Agriculture du Diamaré, Maroua, Cameroun.

DDAD (1995) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Diamaré pendant la campagne agricole 1994/1995. Délégation Departementale de l'Agriculture du Diamaré, Maroua, Cameroun.

DDAMK (1993) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Mayo-Kani pendant la eampagne agricole 1992/1993. Délégation Départementale de l'Agriculture du Mayo-Kani, Maroua, Cameroun.

DDAMK (1994) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Mayo-Kani pendant la campagne agricole 1993/1994. Délégation Départementale de l'Agriculture du Mayo=Kani, Maroua, Cameroun.

DDAMK (1995) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Mayo-Kani pendant la campagne agricole 1994/1995. Délégation Départementale de l'Agriculture du Mayo-Kani, Maroua, Cameroun.

DDAMK (1996) Situation des dégâts causés par les éléphants sur les cultures dans le Département du Mayo-Kani pendant la campagne agricole 1995/1996. Délégation Departementale de l'Agriculture du Mayo-Kani, Maroua, Cameroun.

Dublin, H.T., Milliken, T. & Bames, R.F.W. (1995) *Four years after the ban: Illegal killing of elephants, ivory trade and stockpiles.* IUCN/SSC African Elephant Specialist Group, Nairobi, Kenya.

Flizot, P. (1948) Les éléphants des régions du Nord Cameroun et de la Bénoué. *Mammalia* 4, 148-151.

Flizot, P (1969) Rapport d'activités 1968/1969. Inspection Nord des Chasses, Garoua, Cameroun.

Fry, C.H. (1970) Report to the International union for the Conservation of Nature and Natural Resources. Trans-African Hovercraft Expedition. Gland.

Lahm S.A. (1994) L'impact des éléphants et d'autres animaux sur l'agriculture au Gabon. Ministère de Eaux et Forêts et de l'Environnement, Libreville.

McNeely, J.A. (1995) *Expanding partnerships in conservation.* IUCN, Island Press, Washington D.C.

SPFAP (1996) Rapport Annuel 1995/1996. Service Provincial de la Faune et des Aires Protégées, Maroua, Cameroun.

SPSA (1996) Rapport Annuel 1995/1996. Service provincial des Statistiques Agricoles, Maroua, Cameroun.

Taylor, R.D. (1987) Les éléphants de Madarounfa: L'investigation d'une incursion d'elephants danls le sud du Niger. WWF, Gland.

Tchamba, M.N. (1993) Number and migration patterns of elephants in Northern Cameroon. *Pachyderm* 16, 66-71.

Tchamba, M.N. (1996a) Elephants and their interactions with people and vegetation in the Waza-Logone region, Cameroon. PhD.thesis. Utrecht University, Utrecht. The Netherlands.

Tchamba, M.N. (1996b) History and present status of the human-elephant conflict in the Waza-Logone Region, Cameroon. *Biol.Conserv.*75, 3541.

Tchamba, M.N. & Elkan, P (1995) Status and trends of some large mammals and ostriches in Waza National Park, Cameroon. *Afr J. Ecol.,* 33,366-376.

Tchamba, M.N. and Hatungimana, E. (1996) Analyse socio-Economique des Interactions Homme-Elephant dans la Région de Waza-Logone (Nord Cameroun). Rapport de Consultation.

Tchamba, M.N. Drijver, C.A. & Njiforti, H. (1995a) The impact of flood reduction in and around the Waza National Park, *Parks,* 5,6-14.

Tchamba, M.N. Bauer, H. & Iongh, H.H. (1995b) Application of VHF-radio and satellite telemetry on elephants in the Extreme North province of Cameroon. *Afr J. Ecol.,* 33, 335-346.

Tchamba, M.N., Bauer, H. Hubia, A., De Iongh, H.H. & Planton, H. (1994) some observations of the movements and home range of elephants in Waza National Park, Cameroon. *Mammalia* 58,527-533.

Tchamba, M.N. and Nshombo, I. (1996) Evaluation préliminaire du conflit homme-éléphants autour du Pare National de Kahuzi-Biega, Zaire. Projet IZCN/GTZ, Bukavu, Zaire.

Thouless, C.R., Allen, M., Coetzee, C., Dublin, H., Mahamat, H., Mohamadou, Njoh, A.D., Peters, H., Schoelte, P., and Tchamba, M.N. (1995) Management of conflict between humans and the migratory Waza elephants. Consultants' report. IUCN Waza-Logone Project, Maroua, Cameroun.

Van Oijen C.H.J. and Kemdo (1986) Les Yaérés Relevés une Description Phytosociologique de la Plaine d'Inondation du Logone. Nord Cameroun. Série Environnment et Développement au Nord Cameroun, CML, Universityé d Leiden, Pay-Bas.

White, G.C. and Garrott R.A. *(1990) Analysis of Wildlife Radio-Tracking Data.* Academic Press, New York.

VARIABILITY IN RANGING BEHAVIOUR OF ELEPHANTS IN NORTHERN KENYA

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ABSTRACT

The elephants of Laikipia and Samburu Districts in northern Kenya range over a huge variety of habitats and land uses, and there is great variability in home ranges within the population. The movements of these elephants were studied intensively in 1990 to 1992 and monitoring has continued for an additional five years. Elephants now resident in the well-protected private ranches of Laikipia District are believed to have moved south from Samburu District during the course of the 1970s and 1980s in response to intensive poaching. It was anticipated that, as a result of decreased elephant poaching during the 1990s elephants might spend more time in the northern part of their range, thus reducing the impact on vegetation and farms in the south. The monitoring programme has shown no consistent northwards shift in elephant ranges during 1993 to 1997, although the ranges of some individual matrilines have changed substantially during this time, possibly as a result of increasing levels of human disturbanoe. There is also much more overlap between different sub-populations and variability within sub-populations than previously suspected.

RESUME

Les éléphants des Districts de Laikipia et de Samburu au nord du Kenya abritent une zone à grande variété d'habitats et de formes d'utilisation des terres. Il y a une importante variabilité sur le terrain à l'intérieur de cette population d'éléphants dont les mouvements ont été étudiés de manière intensive entre 1990 et 1992 avec un suivi pendant les cinq années ayant succédé 1'étude. On pense que les éléphants qui résident maintenant dans un ranch privé bien protégé au niveau du District de Laikipia seraient venus du District de Samburu entre 1970 et 1980, à la suite d'un braconnage intense. Suite à la diminution du braconnage des éléphants pendant les années 1990, on espérait voir ces éléphants passer plus de temps dans la partie nord de leur zone de distribution avec pour conséquence ne diminution de leur impact sur la végétation et les champs dans la partie sud. Le programme de suivi n'a pas relevé un changement significatif au niveau de la distribution des éléphants dans la partie nord de 1993 à 1997, malgré les changements substantiels observés au niveau des répartitions de quelques individus matrimoniaux pendant cette période, probablement à cause de la croissance des pertubations occasionnées par l'homme. Il y a également beaucoup plus de chevauchement entre les différentes sous - populations et plus de variabilité à l'intérieur des sous - populations que préalablement suspecté.

INTRODUCTION

There are about 3,000 elephants living in Laikipia and Samburu Districts in Kenya The elephants move between private ranches in Laikipia and arid communal areas and montane forests in Samburu. As a result of their use of these differing areas, they present a variety of conservation problems. They come into conflict with small-scale farmers on the southern edge of their range (Thouless, 1994), have an impact on vegetation and fences in the ranches (Thouless and Sakwa, 1995) and are under pressure from heavily armed poachers in the north.

The movements of the Laikipia-Samburu elephants have been studied since 1990. An intensive study was carried out between May 1990 and December 1992, in which up to 20 radio-tagged elephants were located every 10-15 days. This study showed that there was enormous variation in home range size within the population, with minimum convex polygon home ranges sizes varying from less than 150km^2 to over 5,000km^2 (Thouless, 1996). The population included several overlapping sub-populations, showing distinct patterns of movements, and tending to avoid each other while in the same area (Figure 1) (Thouless, 1996). Elephants from the 'migrant' sub-population moved 80-120km in a north-easterly direction during the two rainy seasons, between ranches in Laikipia and arid low-lying communal grazing areas in Samburu district (Thouless, 1995). The 'resident' sub-population included animals with small home ranges based exclusively on the Laikipia ranches, while elephants from the 'Ewaso' sub-population had home ranges of intermediate sizes based on the ranches, but with some seasonal movements. The 'Mathews' sub-population had medium sized home ranges on the eastern side of the Mathews Range in Samburu, and never came south to Laikipia Another apparently distinct sub-population consisted of elephants with a dry season range around Lewa Downs ranch and the Ngare Ndare Forest Reserve in the eastern part of Laikipia. These elephants dispersed northwards into communal grazing lands during the wet season, but over a much shorter distance than did members of the 'migrant' sub-population.

Fifty years ago there were almost no elephants in L aikipia but large populations to the north in Samburu. so the substantial changes must have taken place within the lifespan of some elephants which are still alive. The new patterns of movement are probably a response to the increased bush cover and water availability in Laikipia, together with greater poaching pressure and conflict over water in Samburu.

Figure 1. Sub-populations of elephants from Laikipia and Samburu Districts, Kenya as described in Thouless (1996). Each grey polygon shows the outline of minimum polygon home ranges from a typical animal from each sub-population (name shown in uppercase italics). Protected areas shown with thick outlines. Scale along axes in kilometres.

Poaching has been greatly reduced since the formation of the Kenya Wildlife Service in 1990. It has been suggested that as a result of reduced poaching and

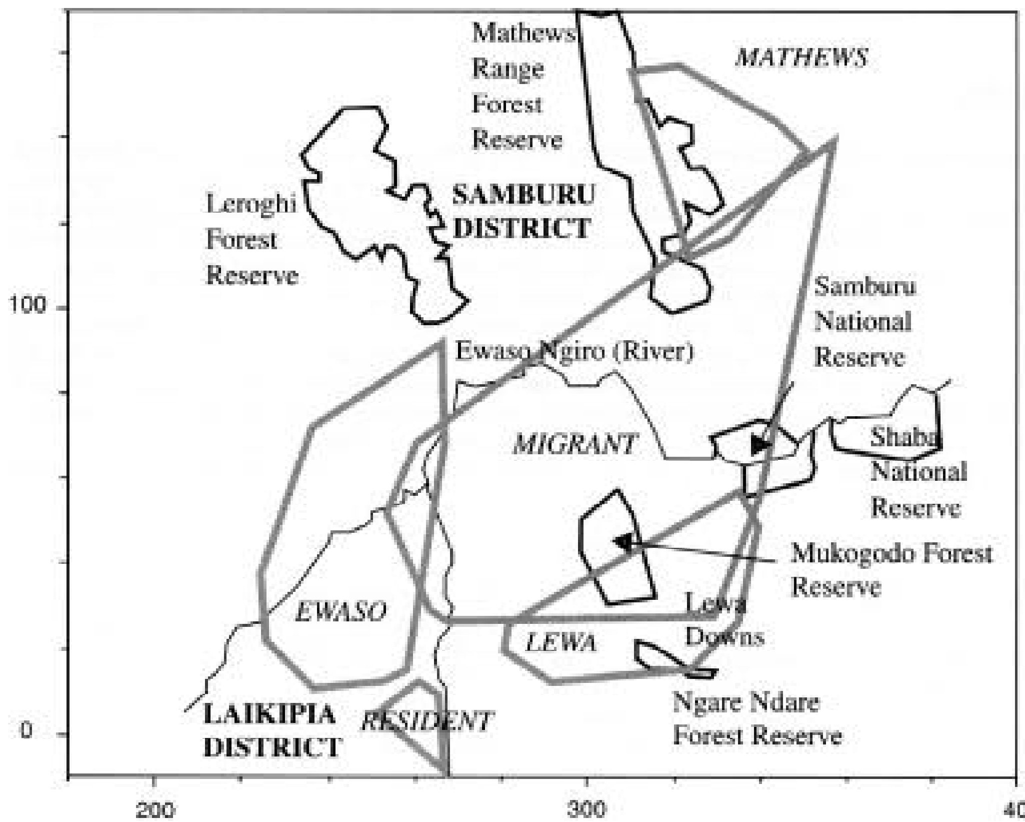

Figure 1. Sub-populations of elephants from Laikipia and Samburu Districts, Kenya as described in Thouless (1996). Each grey polygon shows the outline of minimum polygon home ranges from a typical animal from each sub-population (name shown in uppercase italics). Protected areas shown with thick outlines. Scale along axes in kilometers.

greater human tolerance, the elephants may return to their original range in the north. This would lead to a reduction of the ecological impact on the ranches and conflict in small-scale farming areas. The main reason for continuing the elephant movement study has been to find out whether movement patterns have changed as predicted, and **to** what extent conclusions about elephant movements based on a relatively short-term study are valid over a longer time period. If animals were returning to the north, one might expect that elephants from the 'migrant sub-population' would either shift their ranges further north, spend more time in Samburu, or even adopt home ranges similar to those of the 'Mathews' sub-population. Similarly one would expect elephants from the 'Ewaso' and 'Lewa' sub-populations to extend their ranges to the north, perhaps adopting movement patterns similar to those of the 'migrant' sub-population.

METHODS

Elephants were fitted with Telonics Inc. MOD-605 radio transmitters attached to machine belting neck collars as described in Thouless and Dyer (1992) and Thouless (1995). During the intensive phase of the study, collared elephants were located from the air at intervals of approximately seven to ten days. No tracking was carried out between January and August 1993. Thereafter elephants were located at intervals of one to two months. Some radio collars have been replaced on the same individuals or other members of the same families, and new elephants have been collared in areas where additional information is needed.

RESULTS

Continuity of monitoring

At the end of the intensive phase of the project, in December 1992, 18 collars were still operational out of the original 20. One collar had been removed, and one collared elephant killed as a 'problem animal'. It was decided to continue monitoring elephants only from the migrant', 'Lewa' and 'Ewaso' sub-populations (Figure 1), so transmitters on six elephants from the 'resident' and 'Mathews' sub-populations were allowed **to** run down without replacement Transmitters on four other elephants failed, or the collars broke, before it was possible to replace them. Monitoring has continued for the remaining eight families for six to seven years. Collars have been replaced on the same elephants, or new collars placed on other members of the same matriline.

Between 1993 and early 1997 an additional six elephants were collared. Three of these collars are still operational.

Longevity of collars

Two collars were known to have fallen off, after two-and a-half and two years respectively. Ten elephants were followed until the signals from their transmitters became weak as the batteries ran down. They all lasted for more than four years, with the majority continuing for about four-and-a-half years. One lasted for five-and-three quarter years.

Changes in range

Table l shows the 100% minimum convex polygon home range sizes calculated in 1992 and in 1997 for the eight families that have been tracked for six or more years. There was little change in the movement patterns of the elephants from the 'migratory population'. They continued to move between the Laikipia ranches in the dry season, and the communal grazing areas to the north and east during the rainy seasons. However, one of these families (66/17) was observed further north than before, in an area that was subjected to heavy poaching pressure in the 1980s, during the unusually wet rainy seasons of 1994/5 and 1997/8. 82/17 showed a very slight expansion in range to the north, while 52/25, the other 'migratory' elephant still collared, showed no evidence of a shift in ranging behaviour.

Elephants that were permanently resident on ranches close to the confluence of the Narok and Ngiro rivers (74/19 and 86/23) have shown no sign of a northwards shift in range. In both cases, a slight recorded increase in home ranges since 1992 has resulted from use of areas slightly to the south-east of the previous ranges.

One of the two 'Lewa' elephants - 42/46 - ranged over a much wider area in the wet seasons of 1993 to 1997 than previously. On two occasions she was even found in the Somali grazing area to the south of Shaba National Reserve, which is considered to be relatively unsafe for elephants. However, there was no northwards expansion in her range and she did not cross to the north of the Ewaso Ngiro river. The other Lewa elephant - 50/38 - had a much smaller range, which was slightly expanded to the eastin the 1993 to 1997 period.

Matriline 54b/c was considered, on the basis of its movements in 1992, to be part of the 'ranch resident' subpopulation, based on O1 Pejeta ranch and the area to the immediate north. However, its range shifted substantially. During 1993-4 the members of this matriline ranged widely between their former range and Lewa Downs ranchto the east, but from 1995 onwards, they were back in their original relatively small home range **to** the east of the Ewaso Ngiro river.

Table 1: Changes in home range size measured as minimum con vex polygons (MCP) between 1992 and 1997.

Ele ID	Sub-population	MCP (1990-1992)/ km²	N (1990-1992) km²	MCP (1990-1997)/	N (1990-7)	% increase in range
66/17	Migrant	5,206	84	6,079	108	16
52125	Migrant	3,656	86	3,707	118	1
82/13	Migrant	2,650	51	3,108	70	17
74/19	Ewaso	2,294	50	2,602	69	13
86/23	Ewaso	1,567	49	1,663	67	6
42/46 b	Lewa	1,439	74	2,610	106	81
50/38	Lewa	624	79	899	88	44
54 b/c	Resident	500	32	2,856	65	471

Changes in home ranges have been seen for elephants tracked over a shorter time period. Figure 2 shows observations for three elephants from the 'Lewa' subpopulation. For the first few months after she was collared in January 1991, 54a showed movement patterns similar to other 'Lewa' elephants, moving north from Lewa into the rangelands south of the Samburu National Reserve in the wet season. However, in May 1991, she moved 60km west, and remained in that area until she was shot dead by KWS rangers during a problem animal control operation in December 1991.

Elephant 96 was collared in the insecure Somali grazing lands **to** the north east of Isiolo town in January 1993. For two years, she remained in this area, but in June 1995, she appeared on Lewa Downs ranch, and thereafter adopted movement patterns similar **to** elephants from the 'Lewa' sub-population.

Number 21 was a young bull collared with a family group on Lewa Downs in January 1996. In June 1996 he was found in the Imenti forest, which is less than 30km from Lewa, but separated from it by a main road and intensive agriculture. The Imenti forest is a small patch of indigenous forest close to Merit town, and connected to the main Mt Kenya forests by a narrow forest corridor. Small farms surround **it,** and crop-raiding by elephants from the Imenti forest is a major problem. It had previously been supposed that these elephants originated from the Mt Kenya forests, but this result indicates that some at least come from lowland elephant populations.

Overlap between sub-populations

Collaring of additional elephants has shown that the divisions between sub-populations are not quite as simple as appeared after two years of study. The ranges of 'Lewa and 'Ewaso' elephants show considerable overlap, although they use very distinct dry season ranges, and there is also a greater variety of movement patterns than initial results indicated. The first three collared members of the Ewaso sub-population - which spends the dry season on Laikipia ranches **to** the south of the dry season range of 'migrant elephants-moved north in the wet season, largely remaining within the large scale ranches. However, additional elephants collared since 1992 have moved east during the wet season, with wet season ranges overlapping with those of the 'Lewa' elephants (Figure 3).

Movements of recently collared elephants of the 'Lewa sub-population are even more complex. While they all spend **at** least part of the dry season on Lewa or the neighbouring Ngare Ndare forest, wet season movements occur in all directions, and there is a great deal of overlap with members of the 'Ewaso' sub-population (Figure 4). This situation is further complicated by changes in home ranges of several of the elephants collared in the Lewa area.

DISCUSSION

Between 1990 and 1997 none of the collared elephants from the Laikipia-Samburu population shifted their range substantially to the north. It had been suggested that they might start to return to their original range in response to the greatly reduced level of poaching for ivory in the 1990s compared to the 1970s and 1980s. While there have been significant alterations in the range of individual matrilines in the Laikipia-Samburu population, these have not been in a consistently northwards direction. None of the groups which remained south of the Ewaso Ngiro river in 1990 to 1992 moved north of the river in later years. While at least one of the elephants already moving across the river ventured further north after 1992, this appeared to be in response to greater availability of ephemeral water supplies during two high rainfall years.

There is actually stronger evidence for a continued southwards expansion of elephant range in the eastern part of their range. The number of elephants using the area around Lewa Downs, which includes the Ngare Ndare forest and Borana ranch, has increased. Prior to 1991 they were almost never seen on Borana, while in the following years the area was heavily used by elephants. During this time elephant 96 has shifted her range from east of Isiolo to the Lewa area Somali pastoralists now heavily use the region in which she was first collared, and it is possible that she left as a result of increasing conflict.

It is also likely that one of the reasons why elephants are not returning to the north is because increasing human populations in these pastoralist areas have led to increased conflict over the limited number of permanent water sources, except immediately after the rains, when there is abundant ephemeral water.

The demonstration of linkages between elephant populations from Laikipia and Samburu has been an important impetus towards new conservation initiatives. Two of the most successful community conservation projects in northern Kenya, the II Ngwesi Group Ranch and the Namunyak Wildlife Conservation Trust, were established in the wet season range of the Laikipia-Samburu elephant population. These projects were initiated with support fiom land-owners from the ranching areas, who saw improvement in the situation to the north as a possible way forward to reducing their own elephant problems. It is now clear, however, that success depends not only on eliminating poaching, but finding ways to reduce conflict over access to water between elephants and pastoralists. Even if this is achieved, elephants may not become resident once again in the north, since access to abundant permanent water in the Laikipia

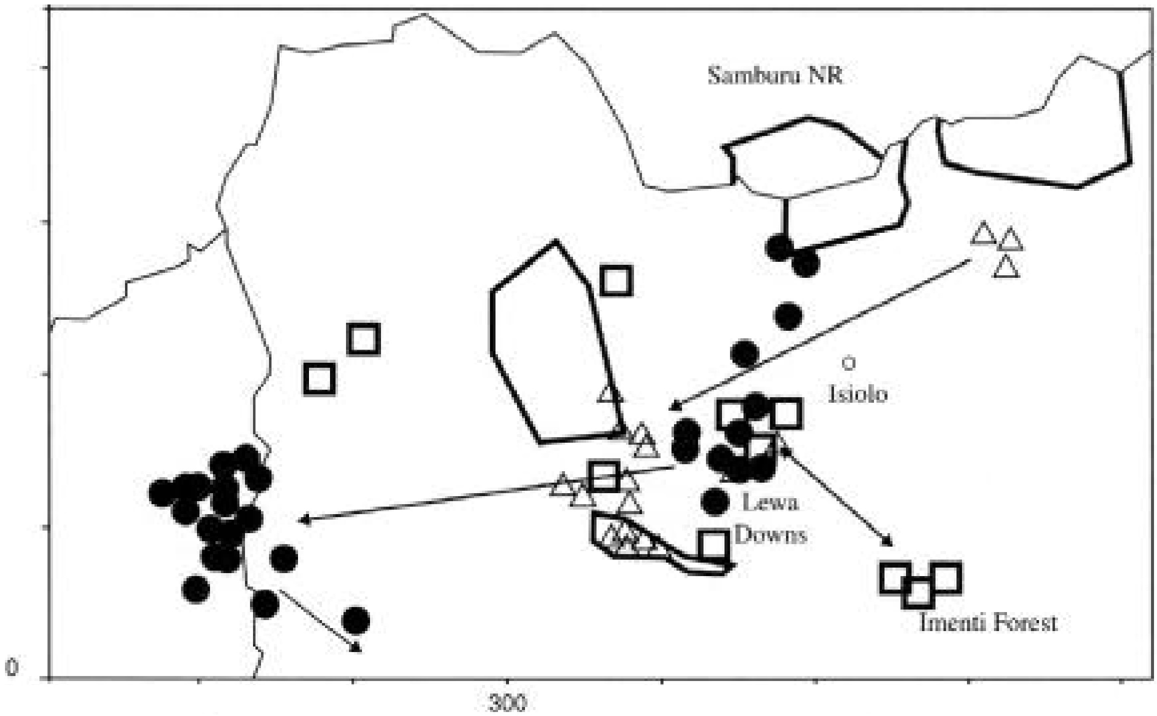

Figure 2. Observations of collared elephants from the 'Lewa' sub-population. 96- triangles; - 21 squares; 54a - circles. Arrows indicate shifts in range.

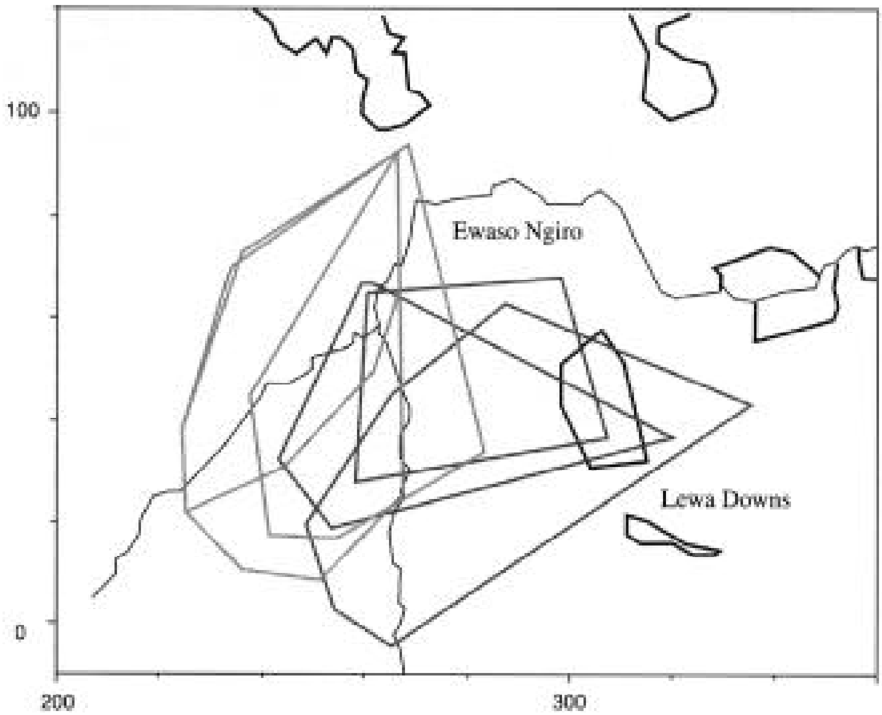

Figure 3. Minimum convex polygon home-range of 'Ewaso' elephants. Elephants remaining on ranches in the wet season shown in dark grey, elephants using pastoralist areas shown in pale grey.

ranches may still outweigh any advantages (probably involving food availability) of the northern areas.

A secondary conservation benefit of the monitoring programme has been its linkage with the Kenya Wildlife Service's anti-poaching operations. The fact that elephants have radio collars and are monitored regularly from the air is well known locally, and this has almost certainly had a deterrent effect on poachers. KWS security staff are informed when elephants move into areas where they are particularly vulnerable to poaching. Unseasonal elephant movements can be an indication that hitherto undetected poaching has occurred and lead to investigations.

While the southern part of the Laikipia-Samburu elephant range is well protected within the Laikipia ranches, and the northern part is becoming increasingly secure as a result of community wildlife programmes such as the Namunyak Trust, the intermediate area, which is used by elephants as a movement corridor, and as a feeding area towards the end of the wet season, is much less secure and less well-known. In order to get more detailed information on movement routes, it is planned to extend the monitoring programme by fitting GPS collars on elephants from the monitored family groups. These collars automatically give elephant locations at frequent intervals, and the data can later be downloaded through a remote modem link. With this information, i1 will be possible to pinpoint the most important intermediate areas, and to focus community conservation and conflict resolution efforts there.

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The African Elephant Specialist Group (AfESG) of IUCN (the World Conservation Union) has provided funding for the programme. This has covered the cost of aircraft fuel, collar refurbishment and additional darting costs. The Chairman of AfESG, Holly Dublin, and Executive Officers, Ruth Chunge and Greg Overton,

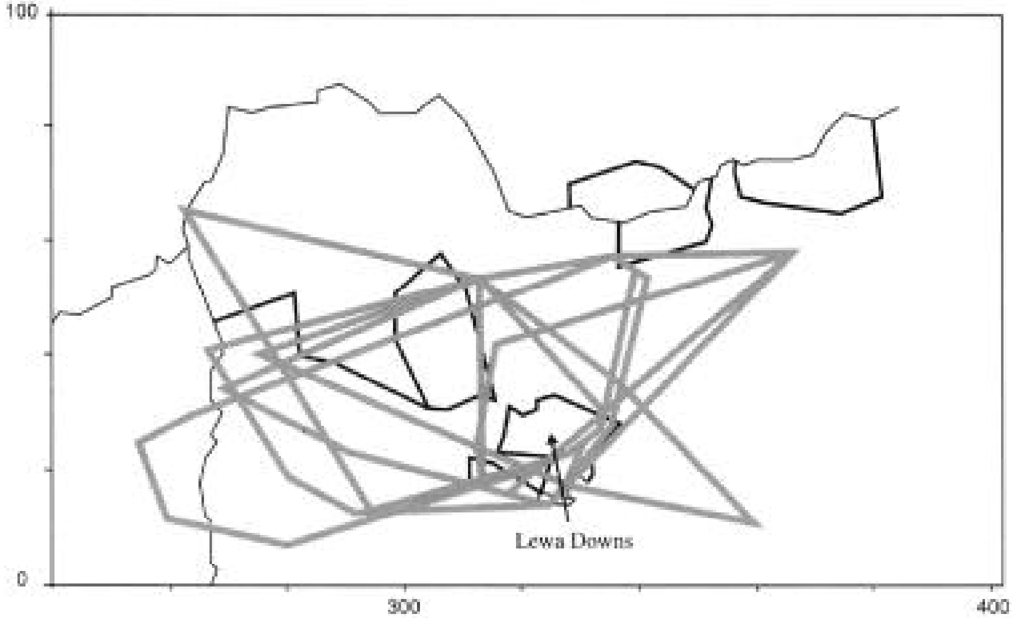

Figure 4. Minimum convex polygon home ranges of 'Lewa' elephants, showing common dry season range in vicinity of Lewa Downs ranch, but wet season dispersal to the west, north, and east.

have provided support and encouragement. George Small and the Dulverton Trust provided replacement collars.

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REFERENCES

Thouless, C. R. and Dyer, A. (1992) Radiotracking of elephants in Laikipia District, Kenya, *Pachyderm 15:* 34-39.

Thouless, C. R. (1995) Long distance movements of elephants in northern Kenya, Afr. *J. Ecol.* 33: 321-334.

Thouless, C. R. (1996) Home ranges and social organization of elephants in northern Kenya, Afr. *J. Ecol*. 34: 284-297.

ELEPHANT STATUS AND CONFLICT WITH HUMANS ON THE WESTERN BANK OF LIWONDE NATIONAL PARK, MALAWI

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ABSTRACT

The study was conducted to assess the status of elephants in a new range of the Liwonde National Park in Malawi and relate it to elephant-human conflict. Elephant numbers estimated from aerial counts and ground surveys were used to estimate herd sizes and sex ratios and assess movements. Elephant herds were identified as either male or female herds and their locations were noted. Outside the Park, sampling of crop damage by elephants was done in agricultural land and the elephants responsible were identified as far as possible. Overall, crop damage levels were 10-25% of the potential harvest despite the high potential for such conflict. This is attributed to the small number of adult bulls and the availability of sufficient natural forage elsewhere. The bulls frequented the crops 5.8 times more than the females.

RESUME

Cette étude a été menée pour évaluer le statut des éléphants qui ont traversé la rivière du Shire pour la premiére fois dans le Parc national de Liwonde et leur implication dans le conflit homme/éléphant. Les effectifs des éléphant ont été établis à partir des comptages aériens et des inventaires terrestres. Les troupeaux d'éléphants ont été identifiés et leurs emplacements repérés. A l'extérieur du Parc, un éehantillonnage régulier des dégâts des cultures a été effectué en 1996, et les éléphants responsables de ces dégâts ont été identifiés. En général, il y avait entre l992 et 1995, un seul troupeau à structure familiale et un troupeau composé de célibataires. Le niveau des dégâts se situait entre 10 - 25% malgré l'importance de tel conflit. Cela est lié au nombre réduit des éléphants mâles et à la disponibilité suffisante de forage dans la nouvelle zone de distribution. Les troupeaux de célibataires fréquentaient les culture 5 à 8 fois plus que les troupeaux familiaux.

INTRODUCTION

The western boundary of Liwonde National Park, Malawi runs parallel to, but approximately 1km away from, the Shire River for some 35km (Figure 1) and is commonly referred to as the Western Bank. In July 1992, elephants *(Loxodonta africana africana* Blumenbach) crossed the river to this area for the first time since the creation of the Park in 1972, and have not since left the area. In this area, 151 elephants were counted in one group in December 1995 (i.e. density 4.3 elephants/km^2).

Neighbouring the Western Bank, are high human densities with a mean of 302 persons/km^2 (Machinga Agricultural Development Division, 1996). The people are mostly subsistence farmers and their crop fields extend to the Park boundary. When elephants occur close to people, conflicts such as destruction of crops, damage to property and even loss of human life are bound to occur (e.g. Bell, 1984; Kiiru, 1995; Tchamba, 1995).

The elephants first crossed the Shire River during the worst drought in living memory in southern Africa (Magadza, 1994; Braack, 1995; Zambatis and Biggs, 1995). They were probably seeking better forage after the floodplain on the Eastern Bank was over utilised (Bhima and Dudley, 1997). This, together with the above factors, i.e. small area and high density of subsistence farmers, contribute to a high potential for elephant/human conflict (e.g. Sukumar, 1990; Kangwana, 1995; Kiiru, 1995). The objectives of this study were to assess the status of these elephants and relate this to human-elephant conflicts on the Western Bank. Many studies on human-elephant interactions pay little attention to ecological perspectives of the animals involved (Sukumar, l990). In this study ecological aspects which were assessed, such as the numbers, group size and density of the elephants, were related to the observed conflict pattern.

STUDY AREA

The Liwonde National Park (538km^2) is located in southern Malawi, between 14^0 36'-15^0 03'S and 35^0 26^0 E. The Park topography is flat with a mean elevation of 500m above sea level. The Shire River, the only outlet of Lake Malawi, is the most dominant physical feature in the Park and it flows southwards. The area has two marked climatic seasons: the dry season lasts from May to October, and the wet season from November to April. The mean annual rainfall for the period 1987/88 -1995/96 is 803.3 m. The temperature ranges from mean lows and highs of 12 and 28^{0}C in the early dry season and 20 and 41^{0}C in the late dry season.

The major vegetation type is dry, deciduous mopane woodland, which occupies 74% of the Park area. Other vegetation types are floodplains, grasslands, forest thickets and mixed woodlands, all occupying small areas. The Western Bank has four vegetation types (Figure 1). The floodplain covering about 12km^2 occurs along most of the riverbank. The major species are *Phragmites mauritianus*, *Cyperus papyrus* and *Typha domingensis*. The dry deciduous mopane woodland covering about 14km^2 occurs in the south and central areas. *The Acacia xanthophloea* woodland covering about 7km^2 is the major woodland of its type in the Park. Finally, there is a dense mixed woodland/thicket of under 2km^2 and with trees of about 25m tall which includes species such as *Borassus* palms, *Terminalia sericea*, *Acacia* spp *and Diospyros* spp.

The area outside the Park, where human-elephant conflict was studied, lies in the Machinga Agricultural Development Division (MADD) and in the Ulongwe Planning Area of the Balaka Rural Development Project. The people have a small land holding of some 0.7ha per family (Table 1). The major agricultural crop is maize with some sorghum and cotton. The production of maize in this area was the lowest of all three Rural Development Projects in the MADD.

METHODS

Elephant movements and density on the Western Bank

Since the elephants crossed to the Western Bank, aerial total counts were conducted in the Park in the late dry season of 1992, 1993, 1994 and 1995. The locations of elephant herds were plotted on a map. In 1994, a GPS was attached to the aircraft to obtain more exact locations. Surveys were also done on the ground, recording the date, number of elephants seen, their location and the vegetation type occupied. A hand-held GPS was used to determine their exact ground locations. For groups seen at close range, sex was also recorded. Additional information on elephant locations was obtained from game scouts' reports and from safari boat operators who were requested to identify locations by using identifiable physical features such as the confluence of smaller rivers with the Shire River and the names of known places. The Wilcoxon-Mann-Whitney Test (Siegal and Castellan, 1988) was used to compare seasonal differences of male, female and overall herd sizes.

Dry and wet season elephant density distribution was determined for male groups and female herds. A map of

Table 1. Details of the Ulongwe Extension Planning Area in Malawi.

General statistics:	
Surface area (km^2)	397.40
Human density (no. per km^2)	302
Number of farming families	22,431
• No. male-headed	11,375
• No. female-headed	11,056
Total arable land (ha)	18,699
Cultivated area (ha)	30,000
Mean crop field size per family (ha)	0.70
Crop production estimates (kg/ha):	
Local maize	650
Hybrid maize	1,057
Sorghum	843
Cotton	1,000

Source: Machinga Agricultural Development Division (1996).

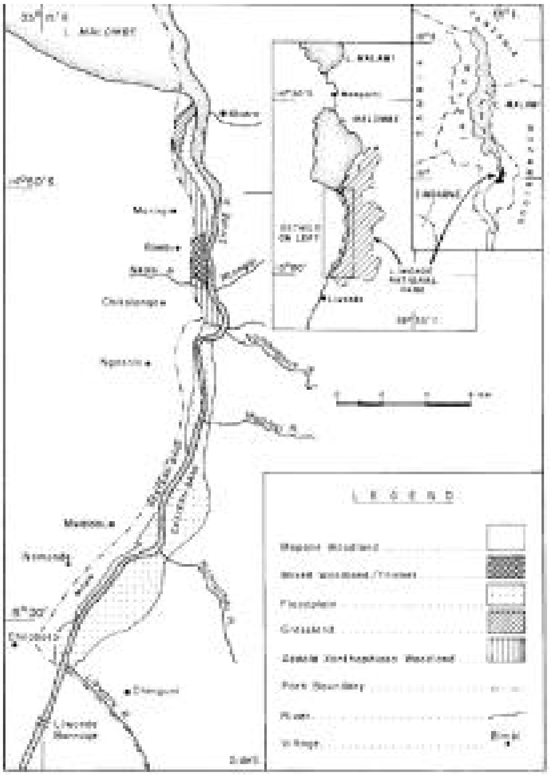

Figure 1. The Western bank of the Shire River showing the Liwonde National Park's Western Bank area, its vegetation and the villages adjacent to it.

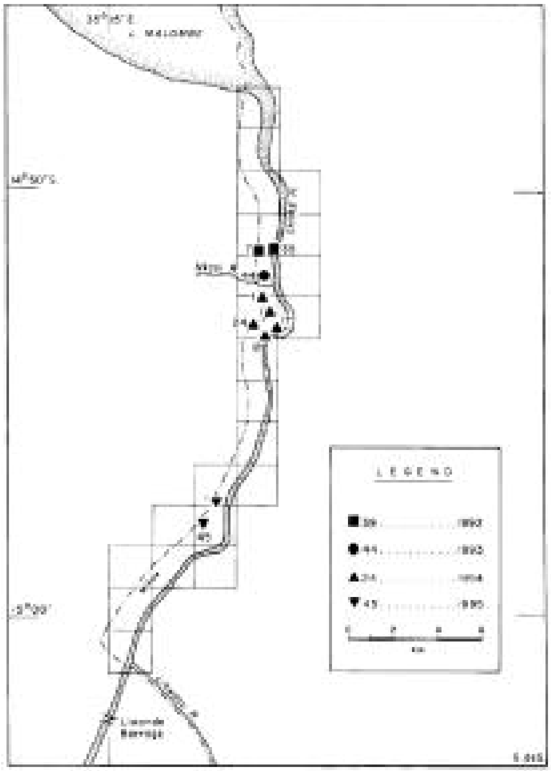

Figure 2. Group numbers and location of elephants seen on the Western Bank

the study area was divided into l x 1km grids based upon the Universal Transverse Mercator (UTM) Projection. For each grid square, a density value of elephants was estimated by dividing the total number of elephants observed in each cell by the total number of times they were observed in the dry season and in the wet season.

Assessment of conflict

Human-elephant conflict was assessed during the crop season of November 1995 to April 1996. In all villages along the western Park boundary, reports of elephants raiding the villages were investigated. For each crop field assessed, the following information was recorded: the surface area of the field, type of crop(s) grown, the location of the field using the GPS, and an estimate of the shortest distance of the field to the Park boundary. Information on crop damage included the date of the damage, the surface area of the field damaged, the surface area damaged, the number of elephants involved, the date of previous damage in the field and where possible, the number of elephants involved in the previous two incidents. Other conflict, such as damage to property and loss of human life were recorded as they occurred.

For each village, the mean crop field size and area damaged were calculated. For raiding sorties by female and male herds, the frequency, mean size of the elephant group, area damaged per crop field, and the mean distance traveled by the elephants from the Park boundary were estimated and were compared statistically.

RESULTS

Elephant numbers and density distribution

Forty-four elephants were counted during the aerial count on the Western Bank in 1992. In 1993 it was 46, in 1994 it was 67 and in l995 it was 51 (Figure2). From 1992 to 1994, all the herds were found in the mixed woodland/ thicket. In 1995 the herds moved south. These herds were suspected to be the same ones that had first crossed to the Western Bank in July 1992.

There were no differences between the dry and wet seasons for the mean female herd size ($z = 1.225$; $P > 0.05$) and for the male herds ($z = -0.77$; $P > 0.05$) (Table 2). The overall mean herd size for the wet season was significantly higher than that for the dry season (z=-12.015; $P<0.001$). A sex ratio of 0.68 males per female was observed.

Elephant density distributions for the female herds was more widespread in the dry season than in the wet season with a density in the dry season of three to seven elephants per km^2 in an area of about $7km^2$ near the northern end of the study area and one of just over $1km^2$ in the southern part (Figure 3). The same distribution pattern was observed for male herds, but at a lower density of 0.7 elephants per km^2 (Figure 4). The high-density area included the mixed woodland/thicket, the floodplain and the scrub mopane. The wet season distribution was reduced. This resulted in higher elephant densities of less than seven elephants/ km^2 for family herds in the core area which was almost entirely in the mixed woodland/thicket.

Conflict with humans

Villages affected by elephant crop raiding on the Western Bank were within 0.5 km of the Park boundary and were near the high elephant density. areas (Figure 1). The mean crop field size was 1.14 ha and mean area damaged per four consecutive nights in one area. Crop raiding began in February after the maize crop had attained maximum height of some 2m. Most raids (30%) occurred in April and May when the crops were mature.

Female herds which raided crops were reported on three occasions in 1995 and five in 1996. Thirty-nine elephants walked out from the southern main elephant area in April 1996. This herd went 8km away from the Park boundary and killed five people, injured two people and killed two goats. Smaller herds followed the same route in May and August 1996. In the latter excursion, a male and a female elephant broke away and walked to the lower Shire Valley, some 200km away. All eight incidents were reported to the Parks and Wildlife Officer. It is unlikely that any other raids by these large family herds went unnoticed. We surveyed 11 crop fields raided by the herd of 39 in one night and nine fields raided by another herd, also in one night. The Wilcoxon-Mann-Whitney test shows that the family herds traveled significantly further away from the Park boundary than the bachelor herds ($W_x = 32; P < 0.05$). The mean area per field damaged by female herds, however, was not different from that damaged by male field was 0.l0ha (0.09% of each field was damaged) (Table 3). In other areas, however, the degree of damage varied from 2.3 to 22.3%. The villages of Maninji, Bimbi and Chikolongo were adjacent to the high elephant density area near the northern end. Damage in this region ranged from 0.04 to 0.08 ha per field and was mostly caused by male herds. Chiloboto village is adjacent to the high elephant density area in the south and was most affected by female herd raids. In these villages, the major crop was maize.

Table 2. The mean herd size of female and male herds separately and of the total elephant population (± sd) on the Western Bank in Liwonde National Park in the 1995/96 wet and dry seasons. Statistical data for the Wilcoxon-Mann-Whitney test are also given to show a significant difference for the total population between the seasons but no difference for the family and bachelor herds.

Herd size	Wet season	Dry season	z-value	Significance **level**
Female herds	56.94 (± 30.67) n = 16	48.79 (± 25.18) n = 22	1.225	>0.05
Male herds	3.69 (±2.16) n = 12	4.21 (± 2.55) n = 19	-0.77	>0.05
Total population	33.07 (± 34.96) n = 28	22.87 (± 27.15) n = 41	-12.015	<0.001

Male elephants (Table 4) did most crop raiding. These elephants were either individuals, or small herds of up to six. These male herds accounted for 85% of crop raiding nights recorded. One herd raided up to three crop fields at most in a single night doing so for as many as three to herds ($W_x = 22; P = 0.05$).

DISCUSSION

In all the aerial counts the elephants were in areas of about $1km^2$, and apart from the 1992 count, the elephants were found virtually in the same area. These similarities suggest that all the elephants on the Western Bank were from one family herd. This family herd is probably the one that initially crossed in 1992. Herds crossing later soon returned to the Eastern Bank.

The mapping of elephant distribution in this small area of the Park can be considered to be reliable because reasonable proportions of the area were covered, even during casual

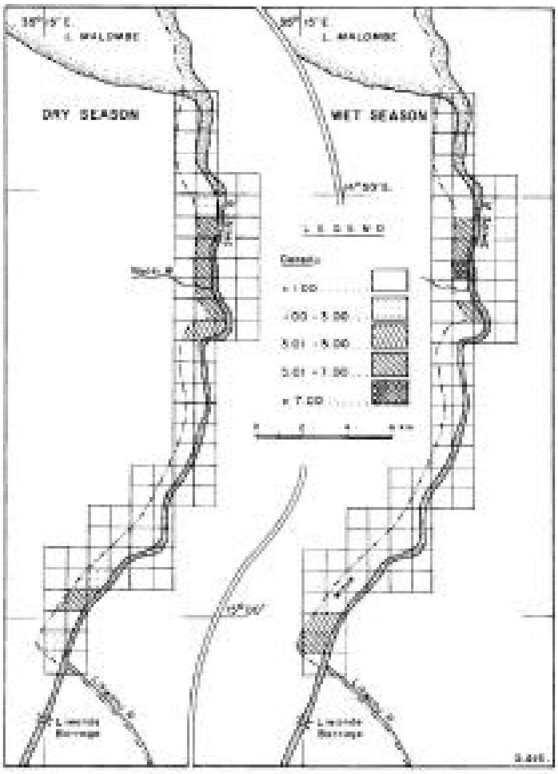

Figure 3. Density (per km²) distribution of family herds of elephants on the Western Bank of the Liwonde National Park, Malawi for the dry season.

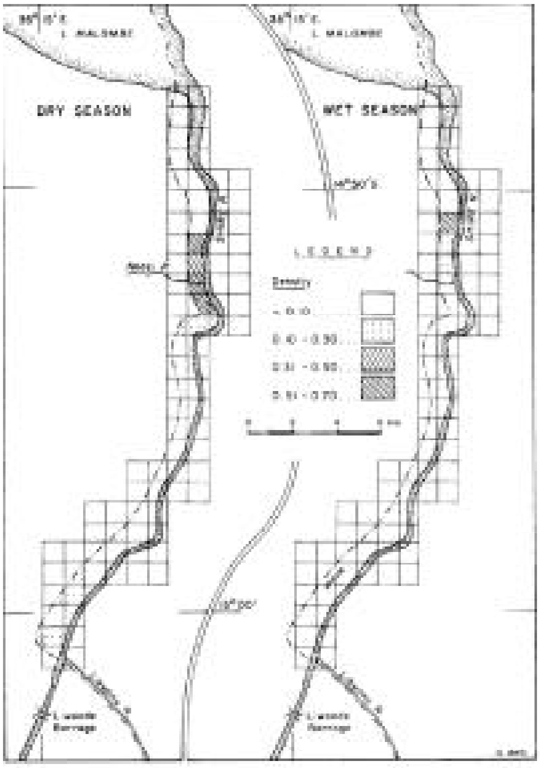

Figure 4. Density (per km2) distribution of bachelor herds of elephants on the Western Bank of the Liwonde National Park, Malawi for the dry and wet season.

forays of a few hours. The dense woodland/ thicket where the elephants concentrated is similar to the "drought deciduous forest" on the eastern side of the Park. The latter is the richest vegetation of the Park in terms of species numbers (Dudley, 1994). On the Western Bank, this vegetation was not utilised by elephants for many years prior to 1992 and consequently it had both good quality and large quantities of forage. Reduced use of the floodplain by the elephants in the wet season is similar to that observed on the east of the Shire River *(Bhima, pers. obs).*

From the human population statistics of the Ulongwe Extension Planning Area (Table I), it is estimated that there are 70 farming families per km^2 in that area If a high conflict zone were defined as the 1km wide strip along the 35km western boundary of the Park, then there were potentially 2,500 families at risk. With a mean field size of l.l4ha per family, and maize production of 2,057kg per ha, the potential crop loss is 515 tonnes (10%) for the whole area. Using Bell's (1984) rating of crop damage by elephants, this level of crop damage is in category two, which is a moderate loss, despite the potential for a high level of elephant-human conflict. This was because the small number of male herds present caused most of the crop damage. Of the 51 elephants counted in the aerial count in 1995, only one herd of six bulls was seen. In addition, although crop damage is done by male herds as elsewhere (e.g. Bell, 1984; Sukumar and Gadgil, 1988), some of them may not have participated in regular crop raids. Sukumar (1995), for example, found that only two bulls in one herd were responsible for 40% of all crop damage done by bulls in a much larger herd of Asian elephants.

Another reason for the moderate damage could be because the male herd often stayed near the female herd. This may mean that the males on the Western Bank are pubertal to young adult bulls *circa* 12 to 25 years old which return to the family herd from time to time (Croze, 1976). Consequently they usually raid the closest crop fields, returning quickly to the family herd in the Park.

The mean herd size of 33.07 elephants in the Park for the wet season is within the observed range of 28 to 42 elephants that crop raided. This implies that the whole female herd of the Western Bank went out of the Park to raid the crops when this happened, and not just some individuals. As for male herds, crop raiding seems to be

Table 3. Mean (± sd) of crop field sizes and areas damaged by elephants on the periphery of the western boundary of Liwonde National Park, Malawi during the 1995/96 crop season.

Village	Number of fields sampled	Mean field size (ha)	Mean area damaged per field (ha)	Mean area damaged per field (%)
Namonde	10	0.60 (±0.43)	0.14 (±0.20)	22.3
Ngasale	9	1.01 (±0.64)	0.06 (±0.11)	5.9
Bimbi	9	0.90 (±0.56)	0.04 (±0.05)	4.4
Maninji	8	3.45 (±3.18)	0.08 (±0.05)	2.3
Chiloboto	13	0.82 (±0.51)	0.18 (±0.10)	22.0
Mwalabu	9	0.47 (±0.40)	0.04 (±0.02)	8.5
Chikolongo	9	0.81 (±0.73)	0.07 (±0.20)	8.6
Total	67	1.14 (±1.55)	0.1 (±0.13)	8.8

Table 4. Comparison of crop raiding patterns on the Western Bank of Liwonde National Park, Malawi by elephant male and female herds of different sizes, including frequency of raiding, area damaged and maximum distance traveled from the Park.

Number of elephants	Number of nights raided	Number of fields raided raided	Total area damaged (ha)	Mean area damaged per field (ha)	Maximum distance traveled (km) from Park
Male herds					
I	6	8	0.22	0.027	0.1
2	9	15	0.66	0.044	0.6
3	2	5	0.26	0.051	0.3
4	2	3	0.03	0.009	0.4
5	6	9	2.08	0.231	0.7
6	4	3	0.08	0.024	0.4
Female herds					
28	2	10	0.79	0.079	8.0
29	I	I	0.04	0.042	4.0
39	I	11	2.16	0.196	3.0
42	I	I	0.15	0.148	0.5

part of their daily individual activities. They therefore could go on crop raids in any numbers, from one to six.

Because the main elephant areas on the Western Bank are adjacent to maize fields, it could be expected that this would lead to the total destruction of the crops. The female herds were, however, involved in crop raiding on only eight nights during two crop seasons. The presence of adequate forage on the Western Bank, particularly in the dense woodland/thicket may have kept them inside the Park as was observed by Dudley *et al.* (1992) in southern Ghana and by Smith *et al.* (1995) in Garamba National Park, Zaire. When these habitats become over utilised crop raiding could become a big problem.

CONCLUSION AND MANAGEMENT RECOMMENDATIONS

The proximity of human settlements and their crop fields to the Park on the Western Bank makes this area prone to conflict with elephants. Despite this, elephant damage to crops in the 1995/96 crop season was moderate. This can possibly be attributed to the small number of adult males present on the Western Bank, and the availability of suitable forage in the Park may have kept the elephants away from the crops. The incidence of crop raiding may, however, increase in future as the elephant population grows and the suitable habitats in the Park become overutilised. Currently the same bulls are causing most of the conflict. Killing some of these would cause a temporary reprieve to the problem. Another possibility would be trophy hunting, with some of the income earned accruing to the local people. However, this can only be possible if trophy hunting is legalised in the country. Construction of an elephant-proof boundary fence would also reduce elephant-human contact, if constructed and maintained properly by sensitising the local people to its advantages, and involving them in its maintenance. In this way, the fence ultimately will become the responsibility of the people most at risk to crop raids by these elephants.

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REFERENCES

Bell, R.H.V. (1984) The man-animal interface: an assessment of crop damage and wildlife control In: *Conservation and wildlife management in Africa - The proceedings of a workshop organised by US Peace Corps at Kasungu National Park Malawi,* Ed. R.H.V. Bell & E. McShane-Caluzi.

Bhima, R. *(1996) Estimation of elephant numbers in some protected areas in Malawi.* Report to the ELESMAP Project, Dept. of National Parks and Wildlife, Lilongwe, Malawi, l6pp.

Braack, L.E.O. (1995) Seasonal activity of savanna termites during and after severe drought. *Koedoe* 38(1): 73-82.

Croze, E. (1974) The Seronera bull problem, *East African Wildlife Journal* 12:1-27.

Dudley, C.O. (1994) The flora of Liwonde National Park, Malawi. In: *Proceedings of XIIth Plenary Meeting of AETFAT, Malawi. 2,* Ed. J.H. Seyani and A.C. Chikuni.

Dudley, J.P., Mensah-Ntiamoah, A.J. and Kpelle, D.G. (1992) Forest elephants in a rain forest fragment: preliminary findings from a wildlife conservation project in southern Ghana, *African Journal of Ecology* 30:116-126.

Kiiru, W. (1995) The current status of human-elephant conflict in Kenya, Pachyderm 19:15-19.

Kangwana, K. (1995) Human-elephant conflict: the challenge ahead. *Pachyderm* 19: l 1-14.

Machinga Agricultural Development Division (1996) *Annual Work Plan for Balaka Rural Development Project - 1996/1997,* Machinga, Malawi, 3lpp.

Magadza, C.H.D. (1994). Climate change: some likely multiple impacts in southern Africa, *Food Policy* 19(2);165-191.

Siegal, S. and Castellan Jr., N.J. (1988). *Nonparametric Statistics for the Behavioral Sciences,* McGraw-Hill, New York.

Smith, A.K.K.H., Merode, E. DE, Nicholas, A Buls, B. Ndey, A. (1995) Factors affecting elephant distribution at Garamba National Park and Surrounding reserves, Zaire, with a focus on human-elephant conflict, *Pachyderm* 19:39-48.

Sukumar, R. (1990) Ecology of the Asian elephant in southern India,Il. Feeding habits and crop raiding patterns, *Journal of Tropical Ecology* 6:33-53.

Sukumar, R. (1995) Elephant raiders and rogues, *Natural History* 7: 52-60.

Sukumar, R. and Gadgil, M. (1988) Male-female differences in foraging on crops by Asian elephants, *Animal Behaviour 36:* 1233-1255.

Tchamba, M.N. (1995) The problem elephants of Kaele: a challenge for elephant conservation in northern Cameroon, *Pachyderm* 19:26-32.

Zambatis, N. and Biggs, H.C. (1995) Rainfall and temperature during the 1991/1992 drought in the Kruger National Park, *Koedoe* 38(1); 1-16.

TRACKING AFRICAN ELEPHANTS WITH A GLOBAL POSITIONING SYSTEM (GPS) RADIO COLLAR

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ABSTRACT

Conventional radio-tracking defines a wide range of elephant home ranges in Africa, but only one record can be made per elephant per tracking session and cost factors limit the frequency of locations. Satellite tracking using the ARGOS system allows more frequent data acquisition but gives a proportion of inaccurate fixes and is also expensive. Global Positioning System (GPS) technology, however, promises improved radio tracking with frequent and accurate fixes. A prototype GPS collar weighing 12kg was tested in July 1995 and worked for ten days giving two fixes per 24 hours. An improved collar, designed by Lotek Engineering was tested from December 1996 to May 1997, in and around Amboseli National Park, on two bulls.

The GPS instrument and VHF modem package were attached to the top of the collar, counter weighted by a battery pack at the bottom. The whole unit weighed 4.5kg. Data were stored cumulatively in a dedicated bank of non-volatile random access memory (RAM). Sensors in the collar also recorded motion and temperature. The frequency of acquiring fixes, the times at which the collar was open for communication, a back-up radio beacon, the sensors and functions of power consumption were remotely controlled. Position records and data from the sensors were downloaded remotely though a VHF modem linked to a control unit and a laptop computer. Downloading sessions were conducted from a light aircraft, which first located the elephants using the back-up radio beacon on the collar.

One of the GPS collars was tested in a fixed position and gave a mean position error of 43.6m (95%CL±4.3m, n=281). The collars on the two bulls were monitored for 134 days and 168 days. Readings were made either 24 or eight times per day in different periods. On average each elephant was located 20 times per day and downloadings were made every two weeks. One collar gave a total of 3,136 readings of which 2,966(94.6%) gave successful position records, the other made 2,734 readings of which 2,638 (96.5%) were successful. Failure to log a position peaked just before dawn with a subsidiary mode one hour after midday. It is thought that these failures were caused mainly from elephants tending to lie down at these times of day, which placed the GPS antenna at an unfavourable angle. Tracking was terminated in each case when the collars dropped off. A weak point was discovered where the collars passed under a sharp metal clamp. The collars have since been redesigned to correct this error in a new strengthened version.

The results were converted to spreadsheets (MS Excel) from which maps were created using MapInfo software. The mean daily movements of the two elephants were 10.3km (± 0.8km, 95% CL) and 8.6km (±.6km, 95% CL). Average movements for each hour over the entire period were also calculated. The greatest movements occurred between dawn and midday and from sunset to midnight, with the elephants tending to travel most in the first part of the night. The periods of least movement occurred in the three hours before dawn and from 11:00am to 15:00pm. The motion detector recorded a similar activity pattern.

Both bulls were darted in the national park but spent most of the period outside. One occupied a range of 210km^2 that extended from the park to the West and across the border into the West Kilimanjaro area in Tanzania, and the other a range of 140km^2 mainly in the East in the Kimana area close to human settlement. The western bull spent 92% of his time in the Longido Conservation Area in Tanzania, and the eastern bull 99% of his time in the Kimana Group Ranch area The bulls spent 7% and 1% of their time respectively in the national park, but this was covered on a fraction of the years and may not be representative. The nocturnal crop raiding forays of the eastern bull were plotted and timed precisely.

The trials demonstrate that GPS radio tracking of elephants is feasible and generates large amounts of high quality data 24 hours per day, and under all weather conditions. The chip in the GPS can store up to 3,640 waypoints so even recording at a frequency of 24 times per day would necessitate downloading only once every five months.

The minimal human intervention eliminates most human errors. Although the initial cost of $6,800 per collar is high the cost per location will be low relative to conventional or ARGOS radio tracking as hundreds of records can be collected per animal per flight. Although longevity was not tested the manufacturer claims that the 700gm battery pack provided with the elephant collar may give two years of operation at eight fixes per day.

In conclusion GPS animal tracking systems are set to establish a new standard for studies of daily movement patterns and ranges of large mammals over the next five to ten years.

RESUME

Le système de suivi conventionnel par radio permet de déterminer les grandes aires de distribution des éléphants en Afrique, mais ce suivi ne peut se faire que de manière individuel sur un éléphant. Aussi, son coût relativement élevé limite son utilisation. Le système de suivi par satellite à base du système d’ARGO, permet d’obtenir régulièrement des informations, mais donne également une proportion de repèrcs inexactes et coûte aussi cher. Cependant, le système de positionnement global (GPS) peut améliorer le système de suivi par satellite en fournissant régulièrement des repères exactes. Un prototype de GPS sous forme de collier de 12kg testé en Juillet 1995 et utilisé pendant 10 jours a donné deux positions toutes les 24 heures. Un collier amélioré et mis en place par Lotek Engineering a été testé de Décembre 1996 à Mai 1997 sur deux éléphants mâles dams les environs du Parc National d’Amboseli.

L’instrument GPS et le modem FHF ont été attachés au sommet du collier et alimentés par une batterie au-dcssous, le tout pesant au total 4,5kg. Les informations étaient cumulativement stockées dans une mémoire vive non volatile (RAM). Les détectives dans le collier enregistraient aussi le mouvement et la température. La fréquence des positions, les moments où le collier cst disponible pour la communication, le témoin de fonctionnalité de la radio, les détectives et les fonctions de la batteries sont contrôlés à distance. Les enregistrements de la position et les données des détectives sont transférès à distance à travers le modem VHF relié à une unité de contrôle et à un ordinateur portatif. Les opérations de transféré se font à partir d’un avion ultra léger, qui repère la position des éléphants grâce au témoins de fonctionnalité fixé sur le collier.

Un des colliers GPS testé dans une position repérée, a donné une erreur de 43,6m (95% LC ± 4,3m, n=281). Les colliers sur les deux éléphants mâles ont été suivi pendant 134 à 168 jours. Les lectures étaient faites entre 8 et 24 fois par jour en différentes périodes. En moyenne, chaque éléphant est localisé 20 fois par jour et les enregistrements étaient faites toutes les deux semaines. Un collier a donné un total de 3.136 lectures dont 2.966(94%) ont eu du succès au niveau des enregistrements de la position, l’autre a fourni 2.734 lectures dont 2.638 (96%) réussies. Les faillites sur l’enregistrement dc la position sont beaucoup plus fréquents au lever du jour et dams les environs d’une heure de l’après midi. On pense que les faillites proviennent du fait que les éléphants à ces heures de la journée tendent à se coucher et placent l’antenne du GPS dams un angle qui n’est pas favorable. Dans chaque cas, le suivi est terminé quand les colliers deviennent défectueux. Nous avons découvert sur le collier, des endroits où le métal avait légèrement été frotté. Les colliers ont été refaits pour corriger ces erreurs en vue de les améliorer. Les résultats ont été convertis dans un logiciel (MS Excel) dans lequel des canes ont été insérées en utilisant le sosft Info Map. Les principaux mouvements des deux éléphants étaient de 10,3km(±8km, 95% CL) et 8,6km(±0,6km,95%aCL). En moyenne, les mouvements pour chaque éléphant ont été calculés pendant toute la période. Les plus grands déplacements ont été enregistrés entre le lever du soleil et midi, et également entre le coucher du soleil et minuit, avec une tendance des éléphant à se déplacer beaucoup plus dams la première partie de la nuit. Les périodes de moindre mouvement ont été enregistrées pendant les trois dernières heures avant le lever, et aussi entre 11heures et 15heures. Le détecteur de mouvements a enregistré la même activité.

Les deux éléphants mâles ont été fléchés à l’intérieur du Parc, mais passent la majeur partie de leur temps au dehors. L’un utilise une superficie de 210km^2 qui s’étend à l’Ouest du Parc et traverse jusqu’au niveau de la zone du Kilimanjaro en Tanzanie. L’autre évolue dans une zone de 140km^2 principalement à 1’Est dans la zone de Kimana, fermée par les installations humaines. Le mâle se trouvant à l’Ouest passe 92% de son temps dans la zone de conservation de Longido en Tanzanie, et celui de l’Est 99% de son temps dans la zone du Ranch de Kimana. Les éléphants mâles passent respectivement 7% et 1% de leur temps dans le Parc national, mais cela n’a été étudié que pour quelques années, et n’est peut être pas représentatif. Les dommages nocturnes occasionnés par le mâle de l’Est, ont été recensés avec précision dams le temps.

Les essaies ont démontré que le suivi des éléphants par satellite est faisable et procure des données de qualité 24heures par jour sous toutes les conditions du temps. L'appareil du GPS peut stocker jusqu'à 3640 positions différentes si bien qu'un enregistrement de 24 fois par jour nécessiterait un transfere une fois tous les cinq mois. Une intervention minimale de l'homme peut éliminer les erreurs potentielles de manipulation. Même si le coût initial de 6800 $ par collier est élevé, il est relativement bas par rapport au suivi par ARGOS car des centaines d'enregistrements peuvent être effectués sur chaque animal durant le vol. Bien que la longévité n'ait pas été testée, le constructeur estime que les 700mg de paquet de batterie fourni avec le collier d'éléphant pent être opérationnel pendant 2 ans en raison de 8 repérages par jour.

En conclusion, les systèmes de suivi par GPS ont été établis pour les études standards des mouvements journaliers et de distribution des grands mammifères pendants des périodes allant de 5 à 10 ans.

INTRODUCTION

African elephants have been tracked by conventional radio beacons since the late sixties and the technique has defined home ranges of individuals in many different parts of Africa. The method has been an effective way of monitoring movements when animals disappear into inaccessible terrain. However, its limitation is that only one record can be made per elephant per tracking session (usually from an aeroplane) and each session is costly (Whyte, 1996). Fixes may be acquired as frequently as twice daily (Douglas-Hamilton, 1971), but more usually are recorded weekly, monthly or at longer intervals. In one of the most detailed studies 20 collared elephants in Laikipia were located on average once every two weeks for a period of two years, then at approximately once a month for another five years (Thouless and Dyer, 1992; Thouless, 1996a and 1998). Where the elephants went in between the fixes could not be determined.

Satellite radio tracking using the ARGOS system allows more frequent data acquisition, but gives a proportion of inaccurate fixes that can be as much as 10km out. In this method the collar transmits a signal to a receiving satellite within the ARGOS system that measures the Doppler effect between the transmitter and the receiver and calculates a position. The results are transmitted down to an earth station. Theoretically this can give four to six fixes a day, but in one of the more successful elephant studies in Namibia, position fixes were acquired only once every three to four days (Lindeque and Lindeque, 1991). The method is once again costly and ARGOS readings are less accurate than fixes made with visual sightings from an aeroplane. Erroneous points may cause inaccurate calculations of range. It is suitable for very far ranging elephants where such errors would not make a big proportional difference to calculations of home range. Both methods have been extensively reviewed by Thouless (1996b), but neither measure fine scale movements of animals on an hourly basis.

A Global Positioning System (GPS) has the potential for improving radio tracking with more frequent and more accurate fixes. The GPS is a satellite based navigation system providing accurate position data in real time. Receivers are commercially available that detect and analyse signals from the Global Navstar constellation of 26 satellites installed in high earth orbits (about 20,000km) by the US military. These devices receive coded signals that allow the precise time at which the signal left the satellite to be calculated. By knowing the positions of the satellites and the speed at which the radio waves travel, the distance of the receiver from the satellite can be accurately measured. A minium of four satellites is needed to provide a 3D triangulation, but commonly receivers monitor six or more channels, which improves accuracy. Typically locations can be made within 30 to 40 metres. Measurements would be even more accurate but for a deliberate downgrading of the signal available to civilian users known as selective availability. GPS tracking was first used in Kenya in the Tsavo Elephant Counts from 1991 to 1994. GPS units were fitted to aircraft and were progammed to store co—ordinates every few seconds, in order to plot out exact flight paths (Douglas-Hamilton, 1996). From tracking aircraft it was a small conceptual step to the idea of tracking elephants, and this led to the present study. However, the high power consumption of GPS units had to be overcome if a realistic battery life was to be obtained. In addition, elephants pose a special challenge, as the GPS units would need to withstand several tonnes of pressure every day, exposure to the elements and total immersion in water.

There were three possible ways of collecting GPS information from an animal's movements. The first and simplest is to create a data logger that would accumulate fixes, but which had no capacity for remote downloading. The units would have to be recovered from animals before data could be read. Such units could be lightweight, but the disadvantage was that there was no way of knowing if the system was working *in situ*. The second possibility is to download data via a satellite, or to fixed ground receivers. However, the technology had not yet been developed. A third method is to download a GPS unit by means of a VHF modem communicating with a receiver and control unit mounted in an aeroplane. This last method was adopted in the present study. A prototype GPS elephant collar weighing 8kg, made by OHB Systems (a German aerospace company), was tested in July 1995 in Amboseli. The collar worked continuously for ten days giving four fixes per 24 hours. It then failed, probably due to premature passivation of the NiCad batteries, and could not be resuscitated. The results however seemed promising. An improved design was then tested in this study, modified from a moose collar that had already been extensively deployed in North America (Moen et al., 1995; Rodgers *et al.*, 1996). Lotek Engineering manufactured the collar. This paper reports the testing of two prototypes, the sort of data produced, and how it may lead to new analyses.

THE GPS TRACKING SYSTEM

In the Lotek GPS tracking system the GPS and modem aerials are enclosed in a tough plastic housing attached to the top of the collar, and counterweighted by the electronics housing and battery pack at the bottom. The two components are connected by power and antennae cables that weave between double layers of belting separated by spacers and fastened by rivets, stitching and glue. The battery can be replaced by undoing six screws. Data are stored cumulatively in a dedicated bank of nonvolatile random access memory (RAM). Sensors in the collar also record motion and temperature. The frequency of acquiring fixes, the times at which the collar is open for communication, a back-up radio beacon, the sensors, and functions of power consumption are remotely controlled. Position records and data from the sensors are downloaded remotely through a VHF modem liked to a control unit and a laptop computer. Downloading sessions in this study were conducted from

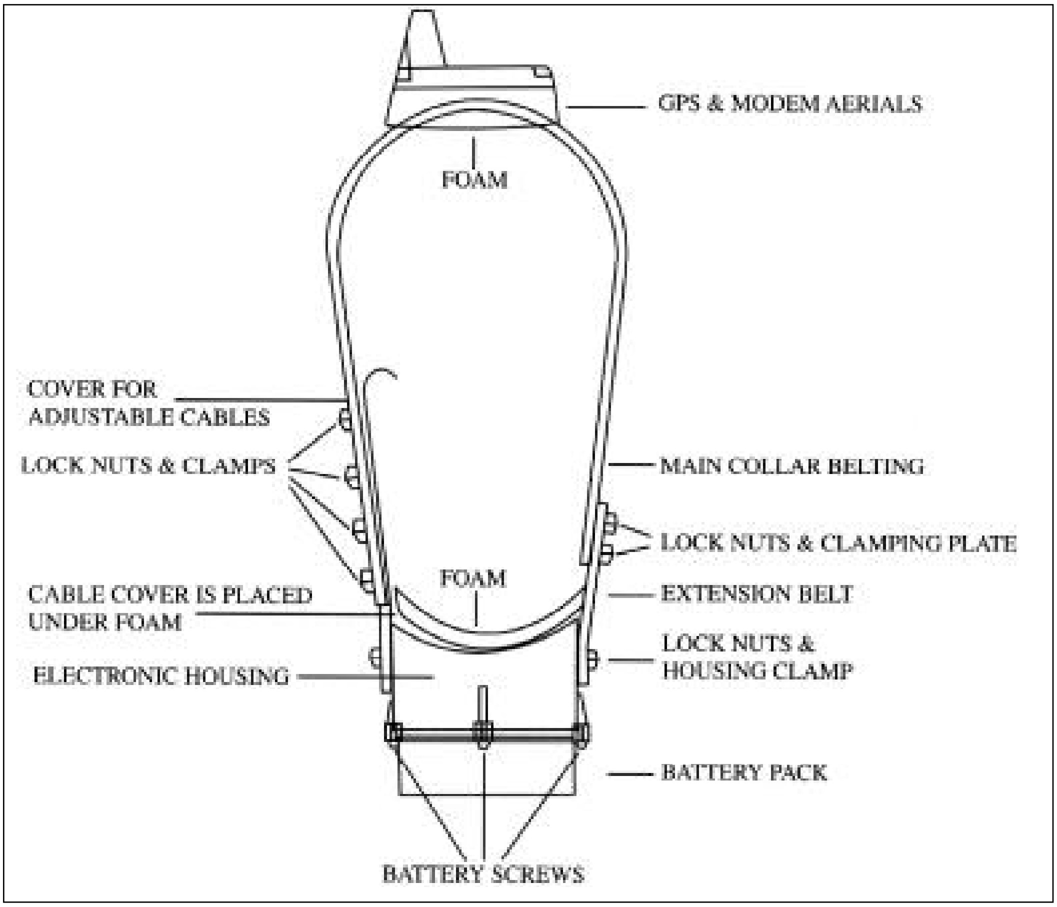

Figure 1. Lotek GPS Elephant collar. Belting is adjustable on both sides.

a light aircraft, which first located the elephants using the back-up radio beacon on the collar. The results were converted to spreadsheets (MS Excel) from which maps were created using Maplnfo software. Each record contained the coordinates and the status of the fix, whether it was 2D, 3D or a failure. The chip in the GPS can store up to 3,640 waypoints, so even recording at a frequency of 24 times per day necessitates downloading only once every five months. A further refinement in the system is the ability to alter the schedule of fixes, to turn the radio beacon and modem on and off and to set the period over which the motion detector is activated. These parameters can be adjusted to prolong battery life.

Field trials of the prototype Lotek GPS elephant collars began on two bulls in Amboseli in Kenya in early December 1996. Each of the collars eventually broke at a point where the collar was attached to the electronics housing by a sharp metal clamp. The double belting was rolled on both collars, but the rivets had kept the two edges together and the cables intact. The plastic housings and the battery box were scored, but the electronic components were fully functional. Some strong force must have caused the break, perhaps a log wedged between the neck and the belting, or a tussle with another bull with a tusk giving a huge tug. Since then the collar design has been improved (see Figure 1). The metal clamp is now rounded and the belting made of a heavier, industrial material. The two layers are separated by a spacer with a hollow in the middle, down which the antenna and power cables run coiled in such a way as to be extensible allowing 96cm of adjustment. Where the cables emerge from the two layers they are protected by an adjustable cover. Each collar weighs 4.2kg.

RESU LTS

Static testing

One of the prototype collars was tested off an elephant by setting it in a fixed position with an open view of the sky. 281 readings were taken at one-hour intervals. An average centre point was calculated from all the readings and taken to be the true position. From this point the deviation of each data point was calculated. The mean deviation was 43.6m, the maximum 196m, and 95% of the points lay between 27 and 48 metres of the centre point. This level of accuracy is greater than other radio-tracking systems. However, Lotek collars may also be ordered in a configuration that permits differential correction of the GPS results, which will increase accuracy down to the level of five to ten metres (Moen et al., 1995).

Field trials on elephants

The trials were conducted in and around the Amboseli national park in collaboration with the Kenya Wildlife Service and the Amboseli Elephant Research Project Two bulls were selected with the help of the Amboseli Elephant Research Project and both were known to disappear for prolonged periods from the park, the extent of their range being unknown. M86 was a bull of about 38 years, believed to cross the border into Tanzania to the West, and M169 a bull, of about 33 years, thought to be a crop raider in the Kimana area to the East. KWS veterinarians carried out immobilisation of these elephants on 5 and 6 December 1996. A GPS collar was fastened around the neck of each elephant, bolts tightened up, and antidote administered. In the course of the next few months downloading was made from a Cessna 185. First the elephant was tracked by its radio beacon using directional H antennae mounted on the wing struts. Once a strong beacon signal was obtained, a “Whose There” signal was sent out by the software through the control unit, which would initiate a link, followed by downloading of the data through the VHF modem.

The electronics of both collars worked satisfactorily. M86 was tracked for 134 days and M169 for 168 days before the collars dropped off. Readings were made either 24 or eight times per day in different periods. On average each elephant was located 20 times per day and date were downloaded every two weeks. The collars were successful in obtaining fixes in 94.6% and 96.5% out of 3,136 and 2,734 attempts as in the table below. The relatively low number of failures to acquire a fix were related to time of day and peaked at 05.00 to 06.00hrs with a subsidiary mode at 13.00 to 14.00hrs (Figure 2). These are times when elephants have a higher probability of lying down or standing under the shade of trees. Either of these activities would tend to interfere with GPS reception.

Table 1. Number of GPS fixes acquired by two GPS elephant collars.

	M86 Fixes	%	M169 Fixes	%
Total Days	168		134	
3D readings	1,124	36%	1,630	60%
2D readings	1,842	59%	1,008	37%
Failures	170	5.4%	96	3.5%
Successes	2,966	94.6%	2,638	96.5%
Total	3,136		2,734	

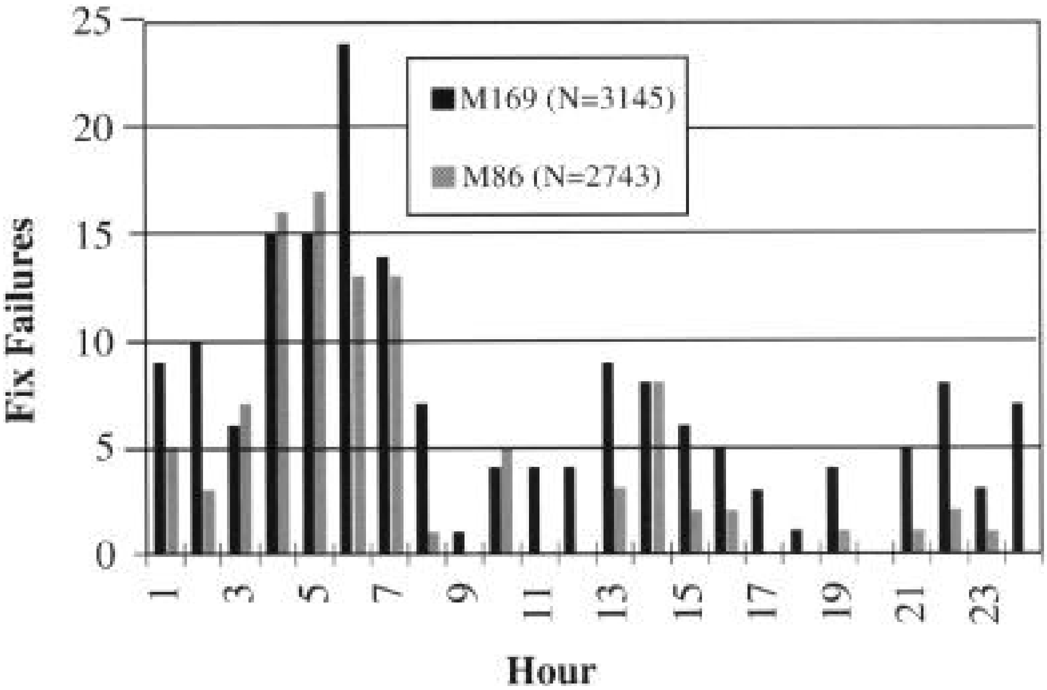

Figure 2. Fix failures at times when elephants were lying down or in the shade.

Daily movements

Daily movements were totaled for each elephant by cumulating the distances between fixes over a 24-hour period from midnight to midnight Figure 3 presents daily movements, as five-day running averages, over the 168-day study period. The frequency distribution of daily distances traveled is shown in Figure 4 and Table 2.

M86 over the whole period averaged 10.3km per day. When first darted he was in musth and covered between 15 and 29 kilometres a day. Much of this was spent in patrolling areas of the national park, apparently searching for females in oestrous. Later he crossed the international border into Tanzania and made an up and down movement, covering ten to 15 kilometres in 24 hours on a straight line, then returning in the opposite direction on the same axis in the next 24 hours, probably still patrolling. Later his movements became more rambling and it appeared that he had come out of musth and was now engaged in feeding in a well wooded area within the Longido Game Controlled Area in Tanzania.

M169, the smaller of the two bulls, was not in musth and did not travel such great distances, except when he moved from one distinct locality to another. He was darted in the east end of the Amboseli National Park. After lingering for one day he made a fast night time march to the Kimana swamps in the east covering 20km in 12 hours of darkness. Thereafter his usual days' travel averaged 8.6km, as he moved from the safety of the forest, and on frequent nights he raided the crops of the Kimana villagers.

Table 2. Daily Movement Statistics.

Movements in kilometres	M86	M169
Mean	10.3	8.6
Standard Error	0.4	0.3
Confidence Level(95.0%)	0.8	0.6
Median	9.5	8.0
Minimum	2.7	2.6
Maximum	29.4	27.3

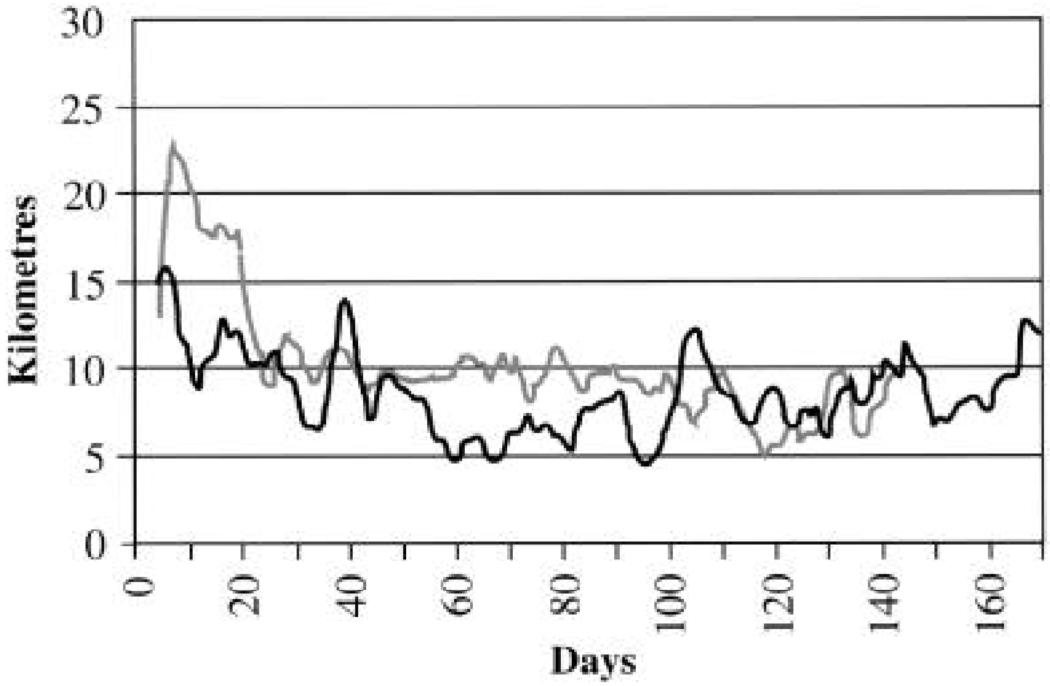

Figure 3. Dally distances (five day running averages) traveled by two bulls, M86 and M169, over the 168 day study period.

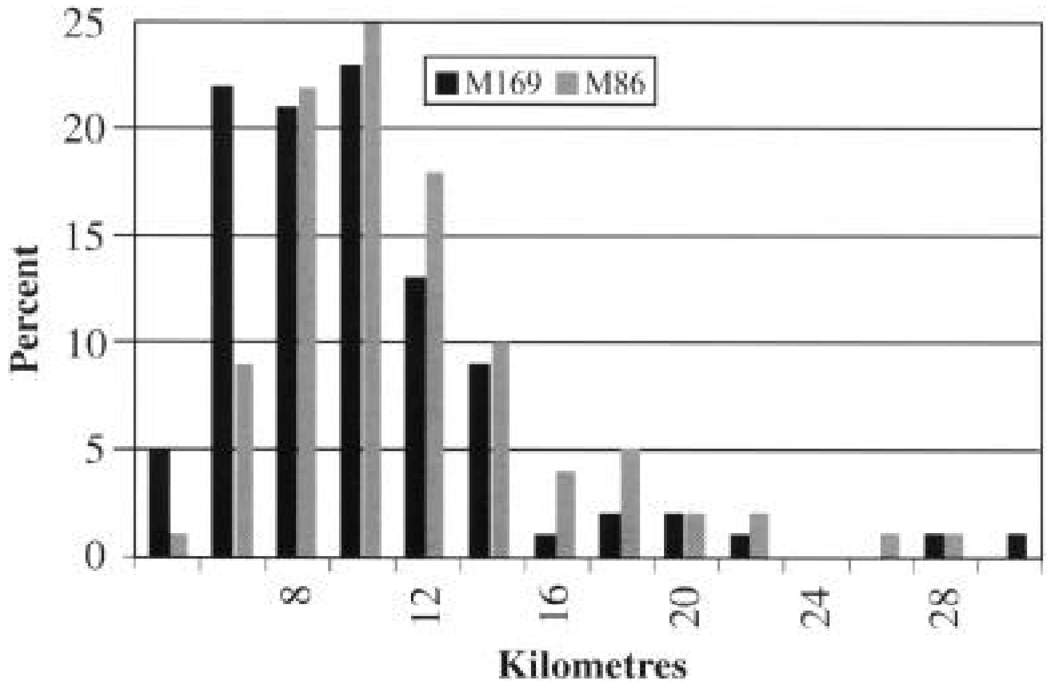

Figure 4. Frequency distribution of dally distances traveled by two bulls M86 and M169.

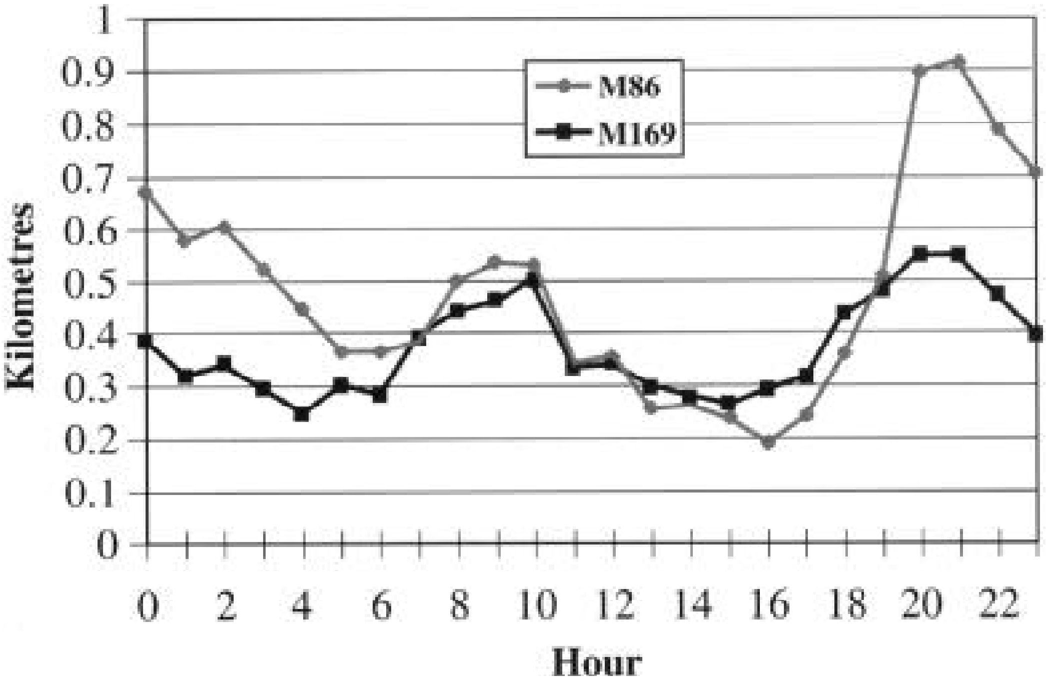

Figure 5. Average distances traveled per hour by the two bulls, M86 and M169. Movements peak mid morning and in the first half of night.

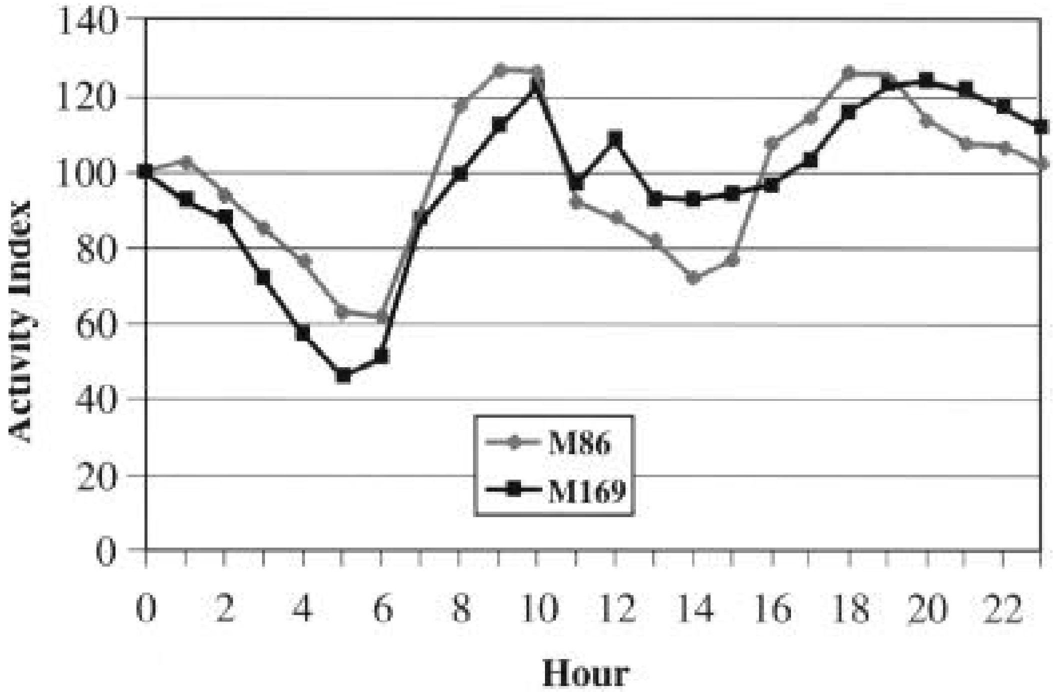

Figure 6. Average activity per hour recorded by motion detectors, for the two bulls M86 and M169, showing a similar pattern to distance traveled.

Hourly movements and activity

Hourly movements were calculated as the distances between hourly fixes. The motion detector also gave hourly readings, which could be caused by any movement. Averages were then calculated both for hourly movement and for hourly activity (Figure 5 and 6), and both bulls showed similar patterns. Movement and activity on average shared the same peaks and troughs. Movement of both elephants was lowest in the pre-dawn hours and then rapidly increased in the early morning to reach a maximum at 09:00 and 10:00, which then dropped off rapidly as the day warmed to reach another minimum from l5:00 to 16:00. In the late afternoon and early night movements increased rapidly. M86 tended to walk throughout the night until about 04:00, covering more distance than he did by day, while M169's night time movements were similar to his morning schedule.

Activity (i.e. unspecified motion) was very similar to movements except that the pre-dawn trough was more marked. At this time motion records tended to sink to zero and both elephants were presumed to be asleep. The possibility that they were lying down is reinforced by the distribution of GPS fix failures, which peak simultaneously at these hours (Figure 2). This could be because when the body is recumbent it obscures the GPS antenna on the top of the collar from part of the sky.

Home ranges

Although both the bulls were immobilised within the Amboseli National Park they spent little time there. M86 spent 92% of his time in the Longido Game Controlled Area in Tanzania, and M 169 spent 99% time in the Kimana Group Ranch area to the East of the park (Table 3). The time they spend outside of the park shows how important these external areas are to the elephants.

Table 3. Proportion of fixes in different localities.

Location	Time Spent in National Park			
	M169		M86	
	Fixes	Percent	Fixes	Percent
In Amboseli NP	180	7%	17	1%
In Kenya outside Park	29	1%	3,119	99%
In Tanzania	2,525	92%	0	0%
Total	2,734		3,136	

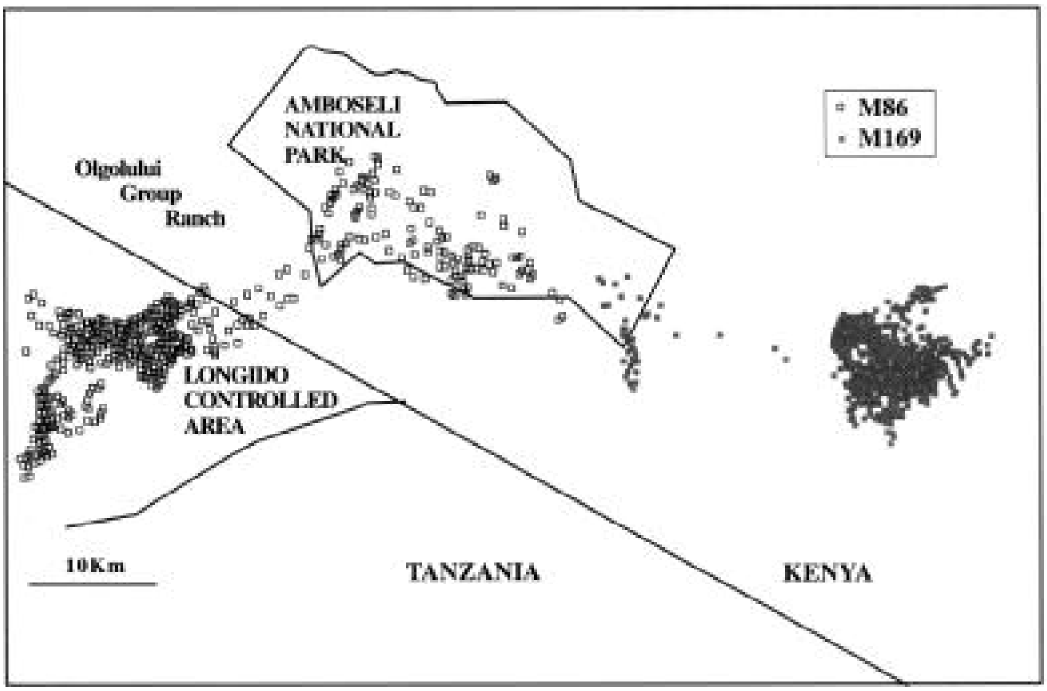

Figure 7. Fixes plotted for the two bulls M86 and M169 in the Amboseli National Park, Olgolului and Kimana group ranches, in Kenya and in the Longido Game Controlled Area in Tanzania.

For the time the collars lasted home ranges could be defined as the actual area occupied by the fixes plotted on a map. M86 occupied a range of 210km^2 that extended from the south central portion of Amboseli National Park to the West into Tanzania as far as the Seven Sisters Hills in the Longido Game Controlled Area (Figure 7). In December1996 when this elephant was in musth he spent most of his time in the Park in company with female groups, but in January he moved to Tanzania and stayed there for four months. It is likely that he came out of musth at the same time that his movements slowed down. He was observed mainly associating with bulls and never came into the Park. His collar dropped off on 22 April, after which he was observed back in the park in May, in full musth once again and in company with females. The problem of large bulls leaving Amboseli National Park and entering the Longido Game Controlled Area in Tanzania is highlighted by this data on one bull. It supports the decision of the Tanzanian Government to close elephant hunting in this area as an activity incompatible with the objectives of the neighbouring Amboseli National Park.

M169 occupied a range of 140km^2. He spen tthe first few days after immobilisation in the eastern portion of Amboseli National Park. Then he walked to Kimana area, which contains an *Acacia xanthophloea* woodland of mixed age stands with some dense regeneration. This woodland is heavily browsed by elephants on the edge of a swamp filled with nutritious swamp grasses. Villagers have expanded cultivation over the last 30 years into the heart of the elephant range. Elephants are therefore surrounded by people at Kimana and spend much of the day hidden in the dense vegetation. The GPS tacking allowed the precise logging of movements into areas of cultivation. M l96's excursions into the Kimana shambas were done

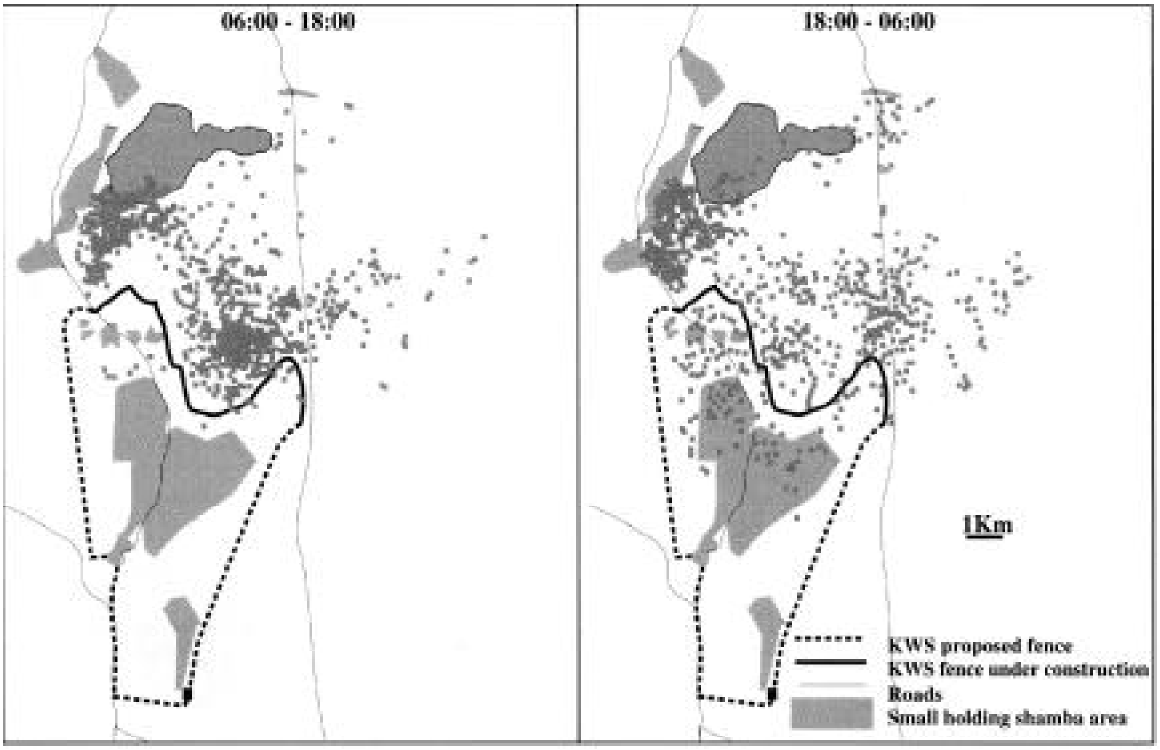

Figure 8. Day and night fixes for Kimana Area in relation to shambas and the elephant fence under construction by KWS.

exclusively at night. In relation to the KWS fence under construction the data show that the fence will exclude this elephant from its nightly crop raiding, but the daytime range will remain almost unaffected (Figure 8).

The fence line will protect people and still allow the elephants access to the Kimana Wildlife Sanctuary which provides a corridor to the Amboseli elephants for their dispersal to the East and into the Chyulu Hills.

CONCLUSIONS

These trials demonstrate that GPS radio tracking of elephants is feasible and generates large amounts of high quality data 24 hours per day, and under all weather conditions. The technique minimises human error in recording positions and allows detailed mapping of elephant movements. Software is being developed to display these movements in animated form on maps which will help to explain how elephants move in relation to food and water availability, relative protection and each other. Although longevity was not tested the manufacturer claims that the 700gm-battery pack provided with the elephant collar should give a life of 575 days at six locations per day; assuming that the tracking window is open in "power save" mode for eight hours per day and five days per week.

Although the initial cost of US$6,800 per collar is high the cost per location is low relative to conventional or ARGOS radio tracking as hundreds of records can be collected per animal per flight. However I should point out that to embark on GPS elephant tracking involves a great commitment in money and energy. Although software problems were not experienced in the trials here, there have been some bugs subsequently and these can prove costly to the researcher. However, the software is continuously evolving and improving.

A number of plans exist to use these GPS collars more widely in Africa. Promising tests have been made of the performance of GPS elephant collars under rain forest canopy in Congo Republic and it is planned to deploy them on elephants in the near future (Blake, pers.comm.). Lotek GPS elephant collars are currently deployed in Samburu National Reserve, Laikipia District, Meru National Park and in the Shimba Hills area in Kenya by Save the Elephants and in Tarangire National Park in Tanzania (Rossi and Foley, pers. comm.). In the Kruger National Park they will soon be deployed in connection with elephant birth control research (Whyte, pers.comm.) and in the Timbavati Private Nature Reserve in South Africa in connection with "Green Hunting" (Douglas-Hamilton, 1997).

In future simultaneous point sampling of behaviour, including feeding behaviour, social behaviour, and reactions to human factors would enhance the value of recording detailed movements with this technique. The presence or absence of other elephants, the availability and condition of browse, grazing and water and some quantitative measure of danger from human predators would help interpret movements. It will be a potent tool for understanding elephant social behaviour, especially if deployed with known animals and accompanied by studies of spatial and social interactions at different levels of elephant society.

The technique will show how elephants raid crops. Such knowledge can be used to reduce conflict between people and elephants by the designation of elephant corridors or by designing fences tailored to protect human interests while disrupting elephant needs as little as possible. The technique will map fine scale movements in relation to detailed vegetation and habitat, or in relation to land-use; protected areas, fence-lines, crops or topographical features. This is important in view of large-scale changes in habitats induced by human beings and the threat this now poses for elephant populations. It will also provide unparalleled insights into how elephants use their environment and into what they need in order to survive.

ACKNOWLEDGEMENTS

The first prototype GPS collar was funded by Discovery Communications through Save the Elephants and made by OHB systems, Germany. The Lotek collars were provided by Save the Elephants, funded by HRH Prince Bernhard of the Netherlands and the Columbus Zoological Society in Ohio. Trials of this equipment were made within the framework of the Kenya Wildlife Service's elephant programme and in collaboration with African Wildlife Foundation's Amboseli Elephant Research Project. KWS provided logistical support, and Dr David Western and Dr John Waithaka gave moral support. Dr Thomas Manyibe carried out the immobilisations. Advice on selection of elephants was given by members the Amboseli Elephant Research Project including Cynthia Moss, Soila and Katito Sayialel, and Nora Njirani. Alex Clydesdale, Saba and Dudu Douglas-Hamilton and Simon Dugdale assisted Field operations. GIS maps and diagrams were prepared by Clair Geddes and Hilde Van Leeuwe. Katy Catapano GPS logged and mapped the exact position of shambas and the proposed KWS fence line in the Kimana area.

REFERENCES

Douglas-Hamilton, I. (1971) Radio-tracking of elephants, In: *Symposium of Biotelemetry,* CSIR, Pretoria

Douglas-Hamilton, I. (1996) Counting elephants from the air — total counts, In *Studying Elephants* (ed) Kangwana, K. African Wildlife Foundation Technical Handbook Series 7: 28-37.

Douglas-Hamilton, I. (1997) Proposal for "Green Hunting" of elephants as an alternative to lethal sport hunting, *Pachyderm* 24:30-32.

Lindeque, M. and Lindeque, PM. (1991) Satellite tracking of elephants in north-western Namibia, *African Journal of Ecology* 29:196-206.

Moen, R., Pastor, J., Cohen, Y, Schwartz, C.C. (1995) Effects of moose movement and habitat use on GPS collar performance, *J. Wildl. Mgmt.,* 60(3): 659-668.

Poole, J., and Reuling, M. (1997) A survey of elephants and other wildlife of the West Kilimanjaro Basin, Tanzania, Afiican Elephant Specialist Group, Typescript Report 1-66.

Rodgers, A.R., Rempel, R.S., and Abraham, K.F. (1996) AGPS-based telemetry system, *Wildlife Society Bulletin* 24(3):559-566.

Thouless, C. and Dyer, A. (1992) Radio-tracking of elephants in Laikipia District, Kenya, *Pachyderm* 15:34-39.

Thouless, C. (1996a) Home ranges and social organisation of female elephants in northern Kenya, Afr *J. Ecol.* 34:284-297.

Thouless, C. (1996b) Satellite tracking of elephants, In *Studying Elephants* (ed) Kangwana, K, African Wildlife Foundation Technical Handbook Series 7: 120-125.

Lotek Engineering, Inc. (1994) The GPS animal location system, *User 's Manual,* Lotek, Inc, Newmarket, Ontario, Canada.

Whyte, I.J. (1996) Studying elephant movements, In *Studying Elephants* (ed) Kangwana, K. AWF Technical Handbook Series 7.

SESSION TITLE: AFRICAN ELEPHANT DATABASE AND DATA RELATED ISSUES

Chair: I Whyte

Rapporteurs: K Lindsay, D Balfour, G Overton

PRESENTATION: PROPOSAL FOR INCORPORATION OF GRID-BASED DATA INTO THE AFRICAN ELEPHANT DATABASE

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INTRODUCTION

Data on estimates of elephant numbers within the African Elephant Database is now well documented, and the quality of the data is described in the database. However, the quality of information on elephant range is much poorer and is inadequately documented. To some extent these problems will be resolved by ensuring that the source of range maps will be referenced in future versions of the database. However, there are still major problems with the process of drawing range maps.

New range maps tend to be based on changes from existing versions. Where the person who is drawing the map has inadequate personal knowledge of the entire elephant range within his/her country, he/she is likely to perpetuate inaccuracies or previous guesses that were based on inadequate information. Because range is simply displayed as polygons with no indication of quality, such information appears to be as authoritative as that from countries with very good data.

A second problem is with defining the edge of the elephant range. There is seldom a 'hard edge' such as a fence precisely to circumscribe range. Where range is limited by a rainfall gradient, the range may change from year to year, depending on the rainfall in more arid areas. Where elephant populations are being disturbed, there may also be animals wandering around in unusual areas.

In order to deal with these problems and to have range information in the database that is objective and gives some indication of data quality, it is proposed to include grid-based distributional information within the database. As with bird atlases, it is proposed that this should be based on a quarter degree geographic grid system (although this needs to be considered further, and it may be necessary to adopt a half-degree grid).

WHAT SORT OF DATA CAN GO IN A GRID-BASED SYSTEM?

Information on elephant distribution varies greatly in quality. It is important to use a system that does not degrade the quality of the best data, but does not reject less good information. It is also important to have a system that allows negative data to be entered.

The best quality data is from aerial surveys, and includes density data and negative information. Intensity of survey will have an effect on the data, since low intensity surveys will tend to give more empty grid cells, and higher density estimates in cells where elephants are observed. Where there are repeated low intensity surveys, it is best not to rely on the most recent data, but to pool surveys, perhaps using a five-year cut-off. To avoid the problem of bias with density estimates, density data should be excluded if it comes from surveys lower than a particular intensity. Consideration could also be given to the use of smoothing functions. There may be significant differences between wet and dry season surveys, and these should be kept separate.

The next best data will come from people who have detailed knowledge of a particular area. They are likely to be able to indicate whether elephants or their signs have been observed in a particular grid square, and also to indicate areas which are never used by elephants to be able to indicate whether elephants or their signs have been observed in a particular grid square, and also to indicate areas which are never used by elephants.

The poorest kind of information will come from people who have traveled through an area once, and have some definite information on where elephants or their signs have been seen, but cannot provide convincing negative information. This will particularly be the case where observers are traveling by road. Although the quality of this information may be poor, it may be all that we can get for many counties, and should not be rejected.

STRUCTURE OF THE DATABASE

It is proposed that data for each grid cell be categorised into five types, as follows:

1. Density estimate
2. Elephants or sign observed - give date and type of observation
3. Not elephant range
4. No elephants recorded
5. No information

Data of a higher category will automatically replace previous data in a lower category.

The database will consist of three tables:

1. The first table consists of the basic information from data forms. Each row is a single grid cell. Columns are for county, grid cell boundaries, type of category, date (or year in the case of 'not elephant range'), type of observation (direct, dung, feeding signs, informant), observations made on foot, from vehicle or aircraft.
2. This will link to another table which summarises the above data by year and season, with a separate row for each cell in each year and season. Where there is multiple data for single cells in a particular year and season, ie a definite sign of elephants from one record, and negative data from another, the definite information will take precedence.
3. Information from Table 2 will be summarised in further tables which will be linked to maps. For an update there will be two tables, one for wet season and one for dry season (in counties where this is relevant, or where there is good enough data to make it worthwhile). This will summarise all the information over the previous five years from Table 2, giving positive values for all cells with any positive records over this time, and taking the averages of density estimates where there have been repeated surveys. For counties with poor quality information, it may be necessary to degrade the resolution from quarter degree grids to half degree or even one degree at this stage.

CONCLUSION

The update and improvement of the AED is a constant process, and one which the DRTF is continually striving to effect. By instituting this new system of data collection for distributional data into the AED, it is hoped that objectivity and an indication of data quality for elephant distribution can be introduced into the database. With more accurrate range information, the quantitative analyses which can be done can be increased, improving the accuracy and usability of outputs for users.

PRESENTATION: PREDICTING HUMAN-ELEPHANT CONFLICT

Chris Thouless

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INTRODUCTION

At its meeting in April 1997, the AfESG Data Review Task Force agreed that the African Elephant Database is ready to be used for analytical purposes, and that it should be applied to particular problems of elephant conservation. It has been suggested that the database, together with other data layers, may be used to predict where human-elephant conflict is most severe, and where it is likely to become a problem in the future.

At the Inaugural Meeting of the AfESG Human-Elephant Conflict Task Force (HETF) on 27-28 January 1997, it was agreed that one of the objectives of the HETF should be to identify existing human-elephant conflict sites. Following this meeting the database manager generated a preliminary model of conflict based on overlap between elephant range, arable farmland, and areas with a high human population density. Preliminary assessment during the AED Task Force meeting indicated that this approach might be useful, but that it would be necessary to refine the measures used to produce maps that closely reflected the situation on the ground. In particular it appeared that the base map for arable farmland was out of date, which is a problem, because it is often in recently settled farmland that conflict is most severe. It was suggested that just using overlap between elephant range (excluding protected areas) and high densities of human population would be more useful.

OBJECTIVES

The objective of this study is to develop a descriptive GIS model of human-elephant conflict, and to use it to predict areas where conflict is likely to become more severe in the future.

DISCUSSION

A serious problem with attempting to predict areas of human-elephant conflict is that some level of conflict occurs in almost all areas where elephant range overlaps with human settlement. Even if there is no agriculture, there is likely to be some conflict over resources such as water. At present we have no standard measures of the intensity of conflict, and very little quantitative data on conflict at all, we will not be able to take a rigorous approach, and the model will have to be for illustrative purposes only.

The general approach to be used will be to vary the parameters used to predict areas of conflict in countries for which there is good information, until there is a good match with the known situation on the ground. These parameters will then be applied to countries for which there is less information, and can be commented on by representatives of these countries at the next AfESG meeting. As a result of this either modifications may be made to the range maps, or to the parameters in the model. Once we have agreed on the parameters, then we can repeat the process, using human population projections based on known rates of increase to predict areas where conflict is likely to get worse.

The other approach that we should be taking is to look for good, simple measures of intensity of conflict. At a district! provincial level we are not going to be able to get direct measures, such as total economic cost, or the proportion of total crops destroyed by elephants, but data on human deaths due to elephants may be more reliably recorded and may be related to other indices of conflict. lf there are enough data available, we might be able to do a multiple regression of human deaths caused by elephants (per thousand people per year) against human population and elephant population on a district/province basis. If there is a relationship, then one could use this to predict death rates and hence intensity of conflict. One problem with this approach is whether to include elephants within protected areas. If they are not included, the model may generate some odd results if deaths are caused by animals which spend the daylight hours (when they are counted) inside protected areas (PAs), but on the other hand, the majority of elephants inside PAs will not be involved in conflict. There will also be problems in administrative regions with a gradient in human population density, and with elephants only in part of the area, as well as where the input zones for elephant densities are different from the administrative units used for human deaths and human population density.

At this stage of development, the Task Force can do no more than see how much data there are, and decide what to do next.

DISCUSSION OF DRTF TERMS OF REFERENCE AND MEMBERSHIP

The Data Review Task Force (DRTF) is concerned with all issues relating to the management of data on elephant populations and numbers collected by, stored by, managed by, or disseminated by the African Elephant Specialist Group (AfESG). In particular, it oversees the African Elephant Database (AED) on behalf of the members of the AfESG.

As agreed to by the Group, the DRTF members are suggested by the AfESG Chair and presented to the members of the Specialist Group for approval each triennium or meeting. All DRTF members must have appropriate technical expertise in survey work and/or GIS technology. lf the need arises, the Chair can appoint an acting DRTF member until the time arises when the acting member’s services are no longer required. While there is no formal Chair for the DRTF, the AfESG Secretariat is responsible for organising and co-ordinating all meetings and communications for the Task Force, and the AfESG Programme Officer is specifically charged with serving as the Secretary to the Task Force.

The membership of the Task Force is as follows:

Richard Barnes
Colin Craig
Holly Dublin
Chris Thouless
Greg Overton - Secretary

DISCUSSION OF THE DATA DISSEMINATION POLICY

From the inception of the African Elephant Database, there has been discussion amongst members of the Group as to who should have access to the raw or digital data from the AED. Due to the sensitive nature of the data contained in the AED, and the fear among some countries that their data may be manipulated incorrectly and used against them, the DRTF drafted a policy to determine to whom and how data from the AED can be disseminated in digital form This draft policy was presented to the membership of the AfESG, discussed and approved. This policy will now guide all requests for dissemination of digital versions of the AED and can be obtained from the AfESG Secretariat on request for the AED data.

SESSION TITLE: AFESG TERMS OF REFERENCE

Chair: H Dublin

Rapporteurs: S Seydou, L Sebogo

The period from 1997 to 2000 is a new triennium for the SSC, and for which the AfESG membership was reappointed. Due to the new membership, discussions of the mission, objectives and Terms of Reference for the Group took place. The Group agreed on the following:

Mission:To promote the long-term conservation of Africa's elephants throughout their range.

Objectives

1. To compile and synthesise information on the conservation and status of the African elephant across its range.
2. To provide and improve technical information and advice on the conservation of Africa's elephants to the following:

a) Range State government agencies
b) non-governmental organsations, including both international and African-based organisations
c) inter-governmental organisations
d) non-Range State governments

Special effort will be made to target outputs in a manner that meets the needs of the above.

3. To promote and catalyse conservation activities on behalf of Africa's elephants to be carried out by the above.
4. To build capacity through the exchange of ideas, information and technical expertise among the members of the Group.

Activities

1. To review the status of elephant populations in Africa
2. To maintain, update and improve the African Elephant Database and, ideally, to publish a report every three years.
3. To undertake analyses of relevant data to assess conservation priorities.
4. To provide technical information to assessments of the impact of human activities (including legal and illegal off-take, changing land use patterns, and changes in relevant national and international policies and legislation) on Africa's elephants.
5. To contribute technical information to evaluations of the effectiveness of different management actions.
6. To advise governments on options for conservation action through interactions on both national and regional bases.
7. To improve technical support for the development, promotion and implementation of conservation strategies.
8. To facilitate co-ordination and co-operation in conservation-related research on Africa's elephants to ensure that lessons learned can be disseminated and applied as widely as possible.
9. To produce a peer-reviewed journal, *Pachyderm*, publishing articles on elephants and rhinoceroses.
10. if funding allows, holding a meeting of members every two years to facilitate information exchange and collaboration between members.
11. To form Task Forces, as required, to examine technical issues in detail.
12. In order to serve the public demand for information on Africa's elephants, to liaise with the IUCN/SSC to ensure that the information on the Specialist Group web site is accurate.
13. To liaise as closely as possible with the IUCN/SSC Asian Elephant Specialist Group.

SESSION TITLE: IMPLEMENTATION OF CITES DECISION REGARDING MONITORING OF ILLEGAL KILLING OF ELEPHANTS AND TRADE IN IVORY

Chair: H Dublin

Rapporteurs: R Bhima, S Kasiki

Forest Working Group
Chair: A. Ekobo
Rapporteurs: R. Barnes, S. Lahm

Savannah Working Group
Chair: R. Masogo-Mojaphoko
Rapporteurs: N. Leader-Williams, R. Bhima

West Africa Working Group
Chair: S. Sagnah
Rapporteurs: K. Koanate, D. Kouame

East Africa Working Group
Chair: I. Douglas-Hamilton
Rapporteurs: M. Maige, S. Kasiki

Central Africa Working Group
Chair: M. Tchamba
Rapporteurs: A. Nchanji, S. Lahm

Southern Africa Working Group
Chair: M. Lindeque
Rapporteurs: M. Garai, R. Hoare

TRAFFIC and IUCN/SSC were called upon by the Parties to CITES to recommend monitoring systems for trade in elephant products and illegal killing of elephants that include determinations of the effect of CITES Decisions and Resolutions on wild elephant populations. TRAFFIC and IUCN/SSC organised a workshop in Nairobi in December 1997 to provide advice and recommendations with regard to development and implementation of these systems. The AfESG was asked to comment on the recommendations from the workshop and to provide advice on the sites to be included in the system.

The first session was to discuss data needs and collection protocols as outlined in the workshop report. The AfESG members attending the meeting were divided into savanna and forest ecosystem working groups, which were to: provide recommendations on the data to be collected; recommend additional needs, or suggest variables which could be removed from the list; provide comments on the data collection protocol; recommend possible options on how to go about designing a collection sheet if necessary.

The working groups decided that only two additional categories needed to be added to the data collected in the monitoring system, and these are:

- external factors - drought
- enforcement - degree of training (as a measure of enforcement)

In the afternoon session, there were four working groups based on the four sub-regions in Africa, to discuss the site selection for the monitoring system. The working groups were to: familiarise members with the site selection criteria produced during the monitoring workshop; provide recommendations on the site selection criteria; recommend additional criteria, or suggest criteria which could be removed from the list; based on these criteria and using the list of selected sites from the workshop as a guide, fill in the data sheets with sites and the appropriate corresponding data; every county in the sub-region should be examined for possible sites; for each Range State select up to a maximum of3 sites and complete the site selection worksheet for each; prioritise the sites within a country and across the sub-region if necessary.

It is important to note that the sites selected below are those the Group chose to be chosen from, for the monitoring system. Not every site can be used, as this would be far too costly for implementation. The sites selected are as follows:

CENTRAL AFRICA

Chad
1. Zakouma

Congo-Kinshasa
1. Ituri
2. Garamba NP
3. Kahuzi-Biega NP

Cameroon
1. Nki-Boumba Bek-Lobeke
2. Banyang-Mbo
3. Waza NP

CAR
1. Dzanga-Sangha
2. Sangba
3. Bangassou

Congo-Brazzaville
1. Noubale-Ndoki
2. Conkouati
3. Odzala

Equatoria1 Guinea
Not represented

Gabon
1. Complexe Gamba
2. Reserve a Lope
3. Minkebe Reserve

Rwanda
Not represented

EASTERN AFRICA

Eritrea
1. Gash Setit

Ethiopia
Not represented

Kenya
1. Tsavo NP
2. Elgon NP
3. Samburu District

Somalia
Not represented

Sudan
1. Bentin

Tanzania
1 Selous GR
2 Ruaha NP
3 Katavi NP

Uganda
1 Murchison NP
2 Queen Elizabeth NP
3 Kidepo NP

SOUTHERN AFRICA

Botswana
1. Chobe Enclave
2. Moremi
3. Tuli

Ma1awi
1. Kasungu
2. Liwonde
3. Vwaza Marsh

Mozambique
1. Niassa
2. Cahorra Bassa

Namibia
1. Etosha NP
2. A Conservancy (to be selected at a later date)

South Africa
1. Kruger NP
2. Tembe

Swaziland
Not represented

Zambia
1. Luangwa
2. Lower Zambezi
3. Mumbwa

Zimbabwe
1. Hwange
2. Chewore/Mana
3. Nyaminyami District

WESTERN AFRICA

Burkina Faso
1. Ranch de Gilieu du Gingou
2. Ranch de Nazinga
3. Parc du W

Benin
1. Parc National du W
2. Pare National du Pendjau
3. Zone Cynegetique de la Djona

Cote d'Ivoire
1. Parc National Tai
2. Parc National de la Comoé
3. Parc National de Allaihoué

Ghana
1. Mole NP
2. Red Volta
3. Kakum NP

Guinée
1. Massif forestirer de Ziama
2. Ouré-Kaba
3. Sansalé

Guineé Bissau
Not represented

Liberia
1. Sopa NP

Mali
1. Reserve des Elephants de Gourma

Nigeria
1. Yankari NP
2. Sambisa GR
3. Cross River NP

Niger
1. Pare National du W
2. Baban Rafi

Senegal
Not represented

Sierra Leone
Not represented

Togo
1. Parc National de la Kéran
2. Parc National de Fazao/ Nalfakassa
3. Pare National de la Fossa-aux Lions

Those countries with no sites listed did not have members from their countries present at the meeting, and members present did not feel comfortable prioritising sites for them. Hence, there is no information for those countries. However, those countries with members have been sent the same form which was filled out at the meeting and they have been asked to carry out the same exercise which was done at the meeting. These sites will be added as responses are received.

SESSION TITLE: HUMAN-ELEPHANT CONFLICT TASK FORCE (HETF)

Chair: K Okoumassou

Rapporteurs: J Ononanga, E Bossou

PRESENTATION: HUMAN - ELEPHANT CONFLICT BIBLIOGRAPHY

The HETF has put together a bibliography of material on all aspects of human-elephant conflict. This bibliography is available from the AfESG Secretariat on demand.

DISCUSSION OF HETF TERMS OF REFERENCE

The Human-Elephant Conflict Task Force (HETF) is concerned with all issues surrounding the collection and analyses of data, and research related to human-elephant conflict carried out by the African Elephant Specialist Group (AfESG).

As agreed to by the Group, the HETF members are suggested by the AfESG Chair and presented to the members of the Specialist Group for approval each triennium or meeting. lf the need arises, the Chair can appoint an acting HETF member until the time arises when the acting member's services are no longer required. The Chair of the Task Force is appointed from within.

All members of the HETF must be actively involved in human-elephant conflict work.

The members of the Task Force are as follows:

Richard Hoare, Chair
Sam Kasiki
Sally Lahm
Moses Kofi Sam
Martin Tchamba
Greg Overton, Secretary

SESSION TITLE: CAPTIVE BREEDING OF ELEPHANTS

Chair: J Waithaka

Rapporteurs: L Osborne, L Saiwana

With increasing frequency, zoos/captive breeding facilities are arguing that their maintenance of African elephants is primarily for elephant conservation reasons and not primarily to generate viewing revenues. Therefore the AfESG is being asked more and more to make technical statements/judgements as to their worth. A number of members expressed discomfort with this. Therefore we solicited American Zoos Association for their view. A paper from Michael Hutchins was written for the Group on the subject which was discussed at the meeting.

The AfESG membership debated the role played by captive facilities in the conservation of the African elephant The Group agreed on the following points which it asked the Chair to present formally to the American Zoos Association:

- AfESG recognises there is some role for captive facilities in the conservation of African elephants, through the fields of public education, scientific research, development of technologies, professional training and direct support to the oonservation of the species in the field.

- AfESG also recognises the role that zoos and zoological societies play in mobilising public support for funding of these activities.

- However, the AfESG is concerned by the poor breeding success and low life expectancy of captive African elephants and does not see any contribution to the effective conservation of the species through captive breeding per se.

- Where African elephants are held in captivity, the AfESG believes that special care should be accorded to their physical and psychological well being.

- AfESG encourages captive facilities to maintain and expand field programmes directed to African elephant populations in African Range States, but wishes to point out that the holding of African elephants by a captive facility is not a necessary precursor for involvement in *in situ* African elephant conservation.

SESSION TITLE: A REVISIT TO THE IUCN RED LISTING OF THE AFRICAN ELEPHANT

Chair: N Leader-Williams

Rapporteurs: S Mainka, M K Sam

The Group agreed in 1996 that the African elephant should be listed as Endangered under the new IUCN Red Listing criteria. This listing was subsequently published by IUCN in Baillie and Groombridge (1996). However, a petition was received from Jon Hutton of the Africa Resources Trust that this listing was not appropriate, particularly for southern Africa, where many elephant populations were increasing and/or were strictly managed. Under procedures currently being developed by IUCN for appealing against listings, the first step in the process is for the listing authority, in this case the Group, to consider the merits of the petitioner's case, and determine if the listing should be revised.

Through debate, the only realistic alternative listing for the African elephant was in the category of Data Deficient This was discussed at great length because, in the case of the African elephant, the current Red List criteria require that the population trend should be examined over 60 years, whereas the first continental estimate dates back only to 1979. Discussions centred on whether the moving window approach was valid for looking at these data.

Further discussions examined whether the taxonomy of the African elephant might be revised into two species, and therefore in future be listed separately. This was dismissed as a current consideration, as review of the data regarding genetic differences between the forest and savanna elephant is still ongoing.

After considerable debate, the Group decided by simple majority that the African elephant should remain listed as Endangered. This decision was reached for the following reasons:

- the new criteria for listing all species are currently under a process of further review by IUCN;
- under these criteria, most difficulty has been encountered in listing long-lived or widely distributed, but differentially impacted species, for which there is no clear evidence of declines over three generation lengths;
- the present criteria do not allow for national and regional listing; and,
- the various continental elephant estimates from 1979

to 1995 may not be strictly comparable.

However, the Group noted the following caveats:

- it would wish to re-examine the continental listing of the African elephant after the new listing criteria have been approved;
- furthermore, it would hope to evaluate the listing at regional and/or national levels, once appropriate criteria had been developed;
- in addition, there is need to re-evaluate the population trends of the African elephants, by applying the same categorisation process that had been adopted by the African Elephant Database (AED) for the 1995 continental estimate, to those estimates available from 1979.

SESSION TITLE: MINUTED MEETING

Chair: H Dublin

Rapporteurs: L Sebogo, G Overton

The final half-day of the meeting was dedicated to a closed, minuted session. At this session, the members reviewed the decisions and findings of the week, and officially agreed to all resolutions.

The Group agreed upon decisions for:

- Recommendations from the data needs and site selection working groups
- DRTF members and Terms of Reference
- Data dissemination policy
- HETF members and Terms of Reference
- AfESG mission, objectives and activities
- Captive breeding of Elephants
- Current IUCN/SSC Listing of the African elephant

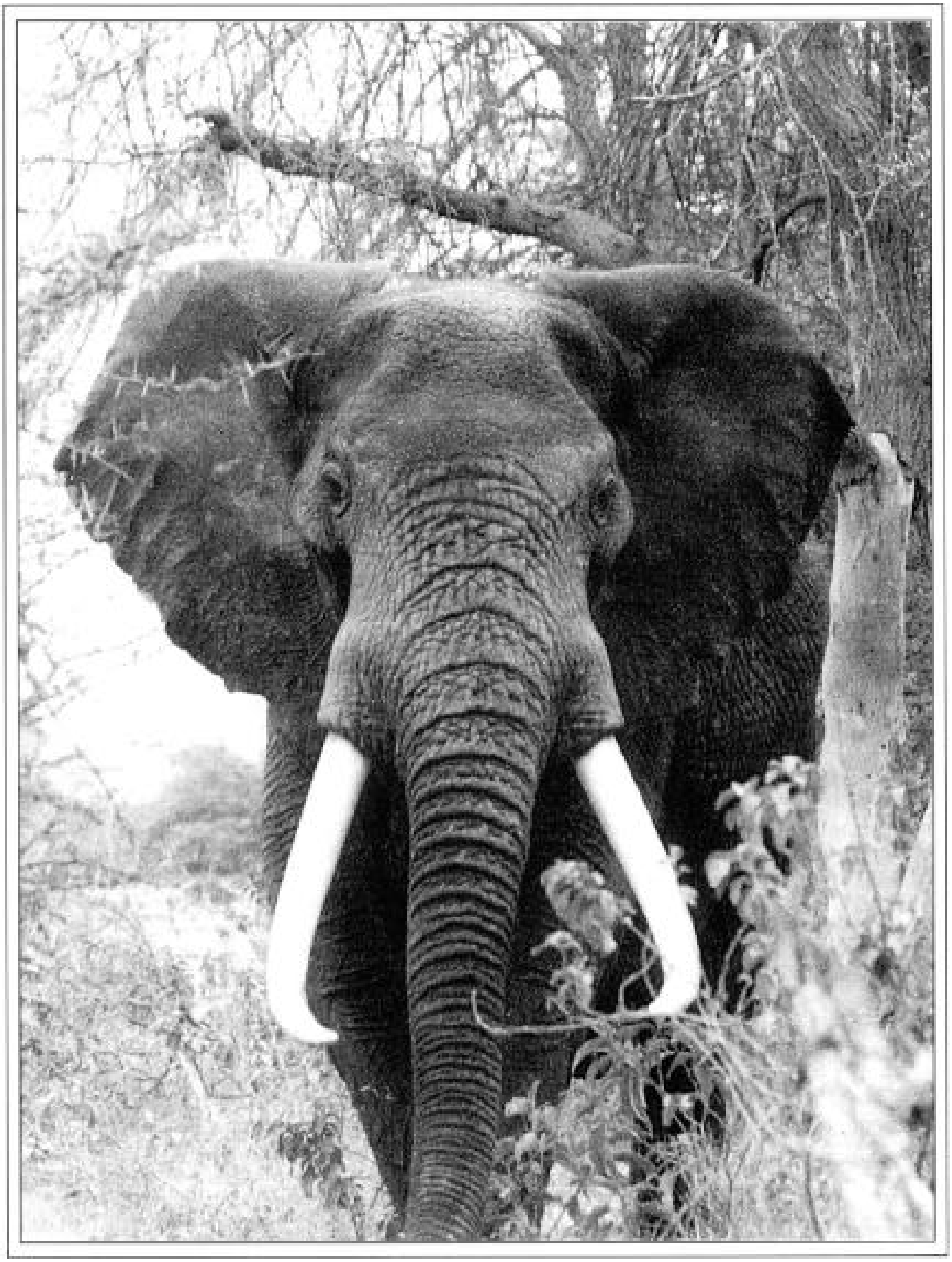
SESSION TITLE: AOB AND CLOSE OF MEETING

The participants from West and Central Africa thanked the Chair and for all the efforts to integrate the two sub-regions into the activities of the Group. They noted that the efforts are very important to allow the effective contribution of the two sub-regions into the workings of the Group.

A member expressed his gratitude to the US Fish and Wildlife Service for sponsoring all the members of the AfESG to attend the meeting and he also appreciated, on behalf of the Group, their efforts not only for this meeting, but all their efforts to assist Africa in the conservation of the elephant.

Notes from the Field

Photo Credit: Joyce Poole



THE CURRENT STATUS OF THE NORTHERN WHITE RHINO IN GARAMBA

Despite the upheaval Garamba National Park in the newly formed Democratic Republic of Congo (formerly Zaire) has recently been through, the northern white rhino populations are doing well, although most other large mammal species have suffered from poaching.

Between October 1996 and April 1997, what was previously Zaire was overtaken by civil war, which created the Democratic Republic of the Congo. Garamba National Park, in the north-east of the country, was on the route for fleeing Force Arm Zaroise, and by January 1997 was being used as a base by mercenaries fighting for ex-President Mobutu. The Liberation forces arrived at Garamba in mid-February 1997 and initially disarmed the park guards. During these upheavals, 90% of the park's equipment for the law enforcement activities was lost or destroyed. Although joint anti-poaching and monitoring efforts gradually resumed from March 1997 onwards, the anti-poaching effort between March and June was a fraction of what it was for the same period in 1996.

The war of liberation followed several years of heavy meat poaching, which law enforcement monitoring efforts showed was largely perpetrated by Sudanese with some Zairois/Congolese, and was associated with the military and arms presence across the border in Sudan, which was (and still is) experiencing civil war. Due to financial restrictions resulting from the socio-economic crisis in the country under Mobutu and limited donor funds, the joint efforts of park officials and the WWF Garamba project personnel were insufficient to adequately combat the poaching. By 1995, buffalo numbers had been halved from 53,312±16,960 in 1983 to 25,242+16,920 although elephant and rhino numbers had increased, with elephants increasing to 11,117 ±3,660. However, the annual poaching distribution maps demonstrated that poaching was moving south through the park towards the rhino sector. The breakdown of law and order in the country, and the resultant reduction in anti-poaching effort gave the poachers an advantage.

By June 1997 it was possible to carry out an intensive aerial survey of the southern sector of the park, which is the main rhino and elephant area. Eighteen different individual rhinos were found, while the estimated maximum number of rhinos which could be counted, based on the proportional returns from previous surveys of this type, was estimated at 24. Additionally, poaching activities were quite evident, with 49 new/recent poaching camps seen, mostly on the edge of the rhino sector, and ten groups of poachers were seen. All carcasses counted (29 elephant, 24 buffalo, 16 hippo, one giraffe, and one waterbuck) were fresh (Smith and Smith, 1997; Evaluation of the status of Garamba National Park in June 1997 following events associated with the Liberation War, Paper presented at Ministry of Environment Conservation Round Table meeting, Kinshasa July 1997).

Combating the poaching problem with extra support, and being able to obtain and safely bring in required equipment, involved working closely with the new government. An excellent working relationship was developed with the newly restructured Ministry of Environment and the Institute Congolese pour le Conservation de la Nature (ICCN), which led to a direct audience with the President.

On going ground and occasional aerial monitoring activities confirmed that two rhinos, a young adult male (Channel 2) and an adult female (F4) were poached in March and November 1997 respectively, and that three rhino calves were born between August 1997 and February 1998. The first of these was named *Congo* and was broadcast on national television.

In March and April 1998 it was possible to bring in the first shipment of equipment and fuel, and to carry out an intensive survey of the southern sector of the Park (Hillman Smith *et al.*, 1998 - Evaluation of the status of Garamba NP in April 1998, following the civil war and associated events). Twenty-four different individual rhinos were found, including another calf which was born in March, bringing the total births to four since the end of the civil war. Rhino distribution was closely associated with long grass mosaic patches that had been maintained during the burning regime as a protective management tool during the war. There was widespread evidence of old poaching, but no new signs, which correlates with information gained through law enforcement monitoring, which shows that there poaching levels reduced during the latter part of 1997. This may be partly due to the efforts of the park guards, partly to the support of the President's forces deployed in the hunting areas around the Park, and partly due to the re-distribution of Sudanese military in Sudan, where the current focus of combat has moved to the eastern Sudan.

A Comparison of poaching indicators June 1997 and April 1998.

Date	Elephant carcass, fresh	Elephant carcass, old	Buffalo carcass, fresh	Buffalo carcass, old	Hippo carcass, fresh	Hippo carcass, old	Poaching Camp, occasional	Poaching Camp, fresh	Poaching Camp, old
June97	29	1	24	0	16	0	10	49	3
April98	2	101	0	102	0	19	0	0	15

In May 1998 an independent rhino survey was carried out using a WWF consultant, independent observers, ICCN staff in addition to the Garamba project personnel. Twenty-two individuals were seen, including one new individual not seen in the April survey. In additional, a known group of three rhinos not seen in the May survey were observed in June.

These results are far better than had been hoped, and the lull in poaching gives time for a build-up of support for Garamba. However, as a word of caution, the results of the all species systematic aerial survey shows a massive reduction in elephants, buffaloes and hippos (seethe table below) though no significant reduction in other species is seen, and distribution is limited almost entirely to the southern sector.

Survey numbers of elephant, hippo and buffalo.

Species	1995 Pop est.	SE	1998 Pop est.	SE
Elephant	11,175	3,679	5,487	1,339
Buffalo	25,242	8,299	7,901	2,062
Hippo	3,601	1,294	786	

There is much to do to counteract the crisis and rehabilitate the park. The lessons of the last few years indicate that a greater level of support, more people and a collaborative effort with more partners and innovative, sustainable funding mechanisms are necessary for the long-term future of Garamba and the rhinos. A strategic planning workshop is to be held in August 1998 to address some of these issues for the way forward. In the context of new opportunities in a new nation, the substantial population of rhinos remaining gives cause for optimism.

Source: A K Kes Hillman Smith, Monitoring and Research, GNP, c/o PO Box 21285, Nairobi, Kenya

A SIMPLE METHOD FOR THE ANALYSIS OF STRATIFIED AERIAL SAMPLE COUNTS

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

Several researchers have developed computer programmes to calculate the Jolly's II population estimate and map distributions (Burl and Douglas-Hamilton 1984; Campbell, 1993; and Western, 1976). However, these prograrnmmes have often been tailored for individual areas, or are not widely available and cannot be easily adjusted to other count zones.

We have developed a method which utilises available spreadsheet programmes to provide:

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

This method of data analysis is of value to researchers undertaking the analysis of sample count data who would like to improve on the accuracy of the population estimate and produce basic figures representative of the distribution of wildlife surveyed without the need for Geographic Information Systems. Other programmes do exist for both of these aspects, but this method makes use of commonly available software (Fox, 1998) and does not require the most up-to-date computer hardware to undertake more elaborate analysis.
The method is based on the use of QuattroPro 4.1 (Borland, 1992), but the approach can be used in all other similar spread sheet programmes eg. Microsoft Excel and Lotus 1-2-3. In other spreadsheet programmes most of the commands will be identical or require only limited changes.

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

Anyone wishing for more information regarding this method can contact the Editor of Pachyderm for a copy of the manual which describes this method in detail.

REFERENCES

Borland (1992) QuattroPro 4.1, *Borland International,* USA.

Burril, A. and Douglas-Hamilton, I. (1984) *Aerocount, a computer programme for analysis of aerial census data,* Typescript.

Campbell, K. (1993) *SRF; Systematic reconnaissance flight software for aerial survey analysis,* Unpublished computer software.

Fox, B. (1998) Keep it simple, keep it safe, *New Scientist*, No. 2119, p.46.

Hilliman-Smith, A.K.K., Myayma, A., Likango, M., Smith, F., Ndey, A. and Panziama, G. (1995a) *Parc National de la Garamba et Domains de Chasse, General aerial count 1995 and evaluation of the status and trends of the ecosystem.* GNPP Report.

HilIman-Smith, A.K.K., Watkin, J.R., de Merode, E. & Smith, F. (1995b) *Parc National de la Garamba et Domaines de Chasse, General Aerial Counts, manual of methods and analysis,* GNPP Report.

Jolly, G.M. (1969) Sampling methods for aerial censuses of wildlife populations, *East African Agriculture and Forestry Journal,* 34: 46-49.

Mbugua, S. (1996) Counting elephants from the air - sample counts, In: Kangwana K. (Ed.) (1996) *Studying elephants,* African Wildlife Foundation, Nairobi, Kenya.

Norton-Griffiths, M.(1978) Counting Animals, Handbook No. 1 in a series of Handbooks on techniques currently used in African Wildlife ecology (Ed. J.J. Grimsadell), AWLF, Nairobi.

Smith, A.K.K., Smith, F., Mbayma, A., Monungu, L.,Watkin, J.R ,de Merode, E., Amube, N. and Eza, K. (1993) *Garamba National Park General Aerial Count 1993,* WWF/FZS/IZCN/IUCN/UNESCO Report.

Western, D. (1976) *An aerial method of monitoring large mammals and their environment, with a description of a computer programme for survey analysis,* Project Working Document 9, UNDP/FAO Kenya Wildlife Management Project (KEN/71/526), Nairobi.

Sources: John R. Watkin, c/o African Conservation Centre, PO Box 62844, Nairobi, Kenya and A.K.K. Hillman-Smith, Parc National de la Garamba, Nagero, DRC c/o MAF, P0 Box 21285, Nairobi, Kenya

NEPAL DESTROYS LARGE STOCKS OF WILDLIFE PRODUCTS

For many years the Nepalese authorities have been collecting wildlife trophies from animals which have died in and around royal Chitwan National Park. Those products found outside the Park are stored in the Forest Department's rooms at Tikauli (Chitwan District) which come under the jurisdiction of the District Forest Officer at Bharatpur; those products found inside the Park are deposited at the headquarters of the Park at Kasara.

Until the early 1990s some of the rhino products such as the horns and nails were sent regularly to the Royal Palace in Kathmandu. With the advent of multi-party democracy and the subsequent decline in the power of the King, the horns and nails have remained in the stores at Tikauli and Kasara.

Table. Wildlife trophies recorded in government storerooms in Tikauli arid Kasara, Nepal, as of 9 November 1998.

Product	Tikauli	Kasara	Total
Rhino skin pieces	994 (3,475kg)	207 (869.5kg)	1,201 (4,344.5kg)
Rhino horns	32(23.11kg)	51(35.33kg)	83(58.44kg)
Rhino nails	498	865	1,363
Rhino teeth	0	2	2
Rhino skulls	3	6	9
Fake rhino skin pieces	2	7	9
Tiger and leopard bones	144kg	99.4kg	243.4kg
Tiger skin pieces	9	4	13
Fake tiger skin pieces	10	0	10
Elephant tusks	1 (5.7kg)	63 (66.38kg)	64 (72.08kg)

* Most of these ivory tusks are derived from domesticated elephants owned by the Department of National Parks and Wildlife Conservation; they are cut to reduce the chances of people being injured.

Source: Gopal Prasad Upadhyap, Chief Warden, Royal Chitwan National Park, unpublished statistics.

By late 1997 the stockpile of wild animal products had reached significant amounts (see Table) with the world's largest collection of skins and nails from the greater one-horned rhino. A debate raged in Nepal amongst conservationists on what to do with these items.

Some officials believed that it was becoming too much of *a* security risk and too expensive to look after these products and therefore they should be destroyed. Others thought that some of these items such as rhino skin should be sold to the local people who use it for religious purposes, earning money to help conserve endangered species in Nepal. Still other conservationists commented that many of these trophies ought to be distributed to museums and schools to educate the general public on wildlife matters.

Finally, on 22 March 1998 at Tikauli, the Nepal government authorities burnt most of these trophies, but not the potentially very valuable horns.

Photot: Esmond Martin

The former Assistant Warden of Chitwan National Park in Nepal examines various rhinoceros products at the Parks' Headquarters at Kasara.

Source: Esmond Bradley Martin, c/o WWF PO Box 62440, Nairobi, Kenya

POURQUOI UNE STRATEGIE DE GESTION POUR LES ELEPHANTS D'AFRIQUE DE L'OUEST?

Les plus importantes populations d'éléphants en Afrique de l'ouest partagent des habitats situés à la lisière des limites des frontières des Etats de l'aire de répartition. Dans ce contexte, aucun Etat ne dispose de sa propre population d'éléphants si on tient compte des mouvements transfrontaliers des pachydermes. De même, aucun Etat ne peut individuellement asseoir une politique efficace de gestion à long terme de ses éléphants et parvenir à des résultats escomptés sans associer l'engagement manifeste et la dérermination de ses voisins. Les éléphants évoluant à l'intérieur des frontières d'un pays peuvent éventuellement bénéfcier d'une protection suffisamment efficace, mais lorsqu'ils franchissent les limites territororiales de ce pays, cette protection devient caduque. Ceci compte tenu de la diversité des textes réglemenraires en la rnatière, de leur degré d'application, des différences d'approches de gestion auxquels s'ajoute la culture des peuples. Certains pensent qu'il suffit d'une protection et d'un aménagement appropriés pour immobiliser les éléphants dans une aire donnée. Cet approche peut paraître réaliste, mais elle n'est pas suffisante car de nombreux autres facteurs influent sur le mouvement des éléphants. C'est pourquoi, le contexte de l'Afrique de l'Ouest nécessite une approche globale de gestion des éléphants à l'échelle sous - régionale, approche qui ne peur être développée qu'à travers un concept de base comme la strarégie de gestion. Un tel concept, élargi à la gestion des resources naturelles à l'échelle des pays de la Communauté Economique des Etats de l'Afrique de l'Ouest, pourrair avoir des effets bénéfiques.

Source: Lamine Sébogo, GSEAf Yaoundé, BP 5506, Cameroun

TSAVO -THE LEGACY

The Tsavo controversy, it seems, will never die. Thirty years on and we see it surface yet again (Waithaka, 1997). In one review of *Elephants* (Spinage, 1994), I was criticised for nor including the politics of the Tsavo controversy in a text which was essentially biological (Woodroffe, *1995).* Unfortunately, the controversy has been misrepresented from the beginning, and Woodroffe was seemingly as ignorant of the real facts as other commentators have been. Laws (1969) divided the Tsavo ecosystem into ten apparently more or less discrete elephant ranges, which he thought might constitute clans of more or less distinct sub-populations. The proposal was then formulated to take a sample of 300 elephants from eight of these areas, making a total sample of 2,400, or roughly ten percent of the estimated total population. The sub-samples would then be compared to determine which areas, in terms of health, rate of growth, and reproductive fitness of the elephants, represented the optimum stocking density. In those areas where the sub-populations exceeded the proposed density, the recommendation would be to reduce the sub-populations to the perceived optimum density. Thus, no target had been set indicating the number of elephants which might be necessary to cull to reduce the population. After taking samples of 300 each in the Tsavo Park north of the Galana River, and in the Mkomazi Game Reserve in Tanzania, which is within the Tsavo ecosystem, further scientific sampling, nor population culling, was halted. Whether the plan would have had the desired effect had it been implemented in its entirety is a moot point. The elephant is a spatially mobile animal if the need arises and would probably have continued to clump in preferred areas, thus reducing densities which were considered optimum elsewhere; or might have left the disturbed areas where culling was instituted, elevating densities elsewhere. To be successful, Law's proposal required that a clan system did indeed operate. Subsequent study, such as that of Leuthold and Sale (1973) on the movement of elephants within Tsavo, did not disprove Law's hypothesis, as the area had been affected by a catastrophic drought. As one observer put it, studying the elephants after the drought was like studying the movement of people in London after the World War II blitz, and then claiming this to be the normal pattern.

Waithaka (1997) quotes Botkin in his list of references but does nor refer to him in the text. Botkin was quoted as an authority on the Tsavo elephant problem elsewhere (Pimbert and Pretty, 1997). Supporting management intervention, Botkin made but *a* short visit to the areas and referred only to the popular book *The Tsavo Story* (Sheldrick, 1973), which he highlighted as an example of an outdated belief in the organisation of the natural world based upon mythical premises (Botkin, 1990). Botkin's views apart and as informative as Sheldrick's book is, it is misleading to suggest that the policy of management adopted by the warden of Tsavo East National Park was one of non-interference. On the contrary, it was interference on a massive scale, which probably contributed to the elephant problem in the first place. This interference was the construction of the Aruba dam in 1953, which provided a large, permanent water source in an area otherwise subject to seasonal and periodic aridity, sucking in elephants as permanent, year-round residents.

Further interference in another sense, which ended catastrophically, was an attempt to excavate the seasonal water hole at Mudanda Rock to provide another permanent water source. This was frustrated by the plug being removed from the waterhole, which then failed to hold any water at all. It is clear that there was *a* deliberate attempt to manipulate nature in Tsavo from the outset.

But, whereas drought and poachers removed the perceived threat to the stability of the Tsavo ecosystem caused by an overpopulation of elephants, the damage caused by the controversy following the decision by the authorities to halt research and abandon management initiatives, has proved lasting, discrediting the science of wildlife management in Kenya. In opting for a policy of "letting Nature rake her course", the authorities made clear they had no faith in scientific method or professional management. There were those in the 18th century, and later, who promoted the same lack of faith in medical science. We are fortunate indeed that their view did not prevail. In any manner in which the killing of elephants is viewed, the rejection of scientific management in Kenya has bedevilled wildlife management in Africa ever since. Not in Kenya alone, but continent-wide. That is the legacy of Tsavo.

REFERENCES

Botkin, D.B. (1990) *Discordant Harmonies, A New Ecology for* the *Twenty-first Century,* New York, Oxford University Press.

Laws, R.M. (1969) The Tsavo research project, *J. Reproduc. Fert. Suppl,* No.6:495-531.

Leuthold, W and Sale, J.B. (1973) Movements and patterns of habitat utilization of elephants in Tsavo National Park, *Kenya E.Afr.Wild.J.,* 111: 369-384.

Pimbert, M.P. and Pretty, J.N. (1997), Parks, people and professionals: putting 'participation' into protected-area management, In: *Social* Change & *Conservation,* Eds. K.B. Ghimire and M.P. Pimbert, London: Earthscan, 297-330.

Sheldrick, D. (1973) *The Tsavo Story,* London: Collins and Harvill Press.

Spinage, C.A. (1994) *Elephants,* London T & AD Poyser Natural History.

Waithaka, J. (1997) Management of elephant populations in Kenya - What have we learnt so far? *Pachyderm* 24: 33-35.

Woodroffe, G. (1995) Reviews, *Mammal News,* (100): 14-15.

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Pachyderm

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