A neighbour's perspective on the new management policy of the Kruger National Park

Michelle D. Henley (michelephant@worldonline.co.za)

Save the Elephants, Elephant Research Programme, Associated Private Nature Reserves, Hoedspruit, South Africa.

This report is based primarily on research conducted within the Associated Private Nature Reserves (APNR) on the western border of the Kruger National Park (KNP). The APNR covers an area of approximately 1800 km^2 which is open to the KNP which itself has recently become part of an even larger Transfrontier Conservation Area (Braack 2000). The fences were removed between the APNR and the KNP in 1993/1994, to create a greater KNP conservation area (Joubert 1996). In the sections that follow I will highlight some of the results of these studies under specific headings which are relevant to this debate and also draw on studies conducted elsewhere.

Factors affecting an elephant management policy

Carrying capacity: a popular misconception

Historically the objective of elephant culling in the Kruger National Park was to maintain a stable population density of one elephant per square mile (0.4 elephants/km^2). This was the prevailing policy between 1967 and 1994 (Whyte 2001). While the concept of a static carrying capacity within a dynamic environment no longer has scientific validity (Macnab 1985, McLeod 1997), regrettably the idea that KNP can only support a population of 7 000 elephants has become so deeply entrenched within the minds of the general public that the current population of 11 454 (I.J. Whyte pers. comm.) is unquestionably viewed by some as an overpopulation and in itself the primary reason to control elephant numbers. The revised KNP elephant management policy of the (Whyte *et al.* 1999) has moved beyond absolute numbers and rather focuses on attempting to maintain the processes that uphold ecosystems. It is important that this refinement to the policy be conveyed clearly to the broader public so that the current situation, and projections into the future, may be evaluated rationally. A meaningful debate cannot take place when the objectives of the elephant management policy are clouded.

Ecosystem resources influencing elephant populations

Dispersal and colonisation

A current study of elephant movements within the APNR, using GPS-satellite telemetry indicates that bulls do colonise new areas. A mature large tusked bull, Mac includes in his range both the KNP and APNR and the (Henley & Henley 2004). This option has only been available to him over the past 10 years; since the fence that separated the two areas was dropped. Anecdotal reports from land owners and rangers who were familiar with the area over this period suggest that he expanded his range from within the KNP to incorporate the APNR. Furthermore, having survived a period of hunting large-tusked bulls within the APNR would serve to corroborate the idea that Mac moved from the KNP into the APNR, rather than visa versa.

The increase in the APNR elephant population based on annual aerial surveys has been greater than predicted from the natural growth rate of elephants found elsewhere (de Villiers 2004). These results indicate an influx of elephants from the KNP since the removal of the boundary fence separating the reserves. The potential therefore exists for dispersal of elephants from the Kruger into surrounding areas, for example into Mozambique's Limpopo National Park. Under natural circumstances, local over-utilisation of woody vegetation by elephants within the KNP could be prevented by dispersal. Bulls are generally the first to colonise new areas (Hall-Martin 1992, Whyte 2001). Cows have the added burden of ensuring the safety of younger family members within the herd and consequently they may tend to take fewer risks than bulls (Sukumar 1991).

The colonisation of new areas by bulls could be of particular importance as bull groups have been found to have a heavier impact on the vegetation than family units (Greyling 2004) and all possible attempts should be made to encourage dispersal of particularly bulls as a natural population regulatory process. Furthermore, dispersal could be driven by a build up of densities of animals and pre-emptive culling could further disrupt this process if source areas are prevented from reaching high densities of elephants.

Mac's home range exceeds an area of 5 000 km^2 and spans both the proposed high density and low density management zones within the KNP (Henley & Henley 2004). The fact that an elephant's home range may be greater than the proposed management zones implies these zones do not contain separate elephant subpopulations that can be treated as discrete source and sink populations. This has implications for the effectiveness of the proposed zonation strategy in that many elephants may rearrange their pattern of range use to occupy preferentially the safe, high density zones.

At a fundamental level, any evaluation of elephant numbers should take into consideration the differences in foraging strategies between adult males and breeding herds. My research within the APNR (Greyling 2004) serves to corroborate the findings of Stokke & du Toit (2000) who, in the Chobe National Park, Botswana found that bull elephants not only ate different plant species when compared to family units but also utilised different plant parts (Stokke & du Toit 2000). Within the APNR, although bull groups and family fed on similar species, their diets differed in the plant parts ingested.

These results indicate that ecologically we cannot treat all elephants as a single unit when considering the factors that govern their movements and their consequent impact upon the vegetation. Different patterns of dispersal and resource partitioning between the sexes could be one way of meeting the nutritional requirements of the population during periods of resource limitation. It is apparent that an understanding of the patterns of movement of elephants the east and west of the KNP are of significance to all the above.

While elephants should disperse once their resource base becomes heavily utilised, an extensive network of artificial water points may interfere with this process. Elephants may remain in the proximity of the many water sources during the dry season instead of seeking out areas offering them more suitable food resources. In the dry season elephants tend to congregate near perennial rivers and more persistent water sources, thereby localising/diminishing their impact at a landscape scale. In the wet season when water is freely available, their impact will be more evenly spread across the landscape. The overall impact of elephants on the woody vegetation should also be lower in the wet season because woody species don't constitute such a large proportion of their diet. A dry season dietary shift to browse was confirmed within the APNR by carbon isotope analysis of faecal samples where a diet dominated by woody browse in the dry season (80%), reached near equal proportions of grass:browse by the wet season (Greyling 2004). Furthermore, impacted woody species would be most likely to recover in the growing season as well as during the coming dry season when elephants would, under natural circumstances, tend to move away from these impacted areas in search of water. Artificial water points thus potentially decrease both spatial and temporal heterogeneity (Walker & Goodman 1983). The KNP is currently decreasing the number of artificial water points (Whyte 2001), and this practise should be continued as far as possible and the public informed accordingly.

Climatic influence

While elephants may be more resistant to short-term climatic variability than other animals, this should not detract from the fact that they still are sensitive to them. The occurrence of oestrus in elephant cows could directly be related to short term rainfall cycles with their consequential increase in grass greenness indices (I. Douglas-Hamilton pers. comm.). Within the APNR the relative abundance of musth bulls is correlated with the mean monthly rainfall. The proportion of musth bulls peaks from March through to May. This is the most suitable time for bulls to come into musth. Cows that conceive during these months will give birth 22 months later from January through to March, the second half of the peak rainfall period. By implication, these cows would have access to the most nutritious food resources when their physiological needs are greatest, *i.e.* during late pregnancy and early lactation (Henley & Henley 2004). Whyte (2001) also recorded an increase in breeding activity in cows in response to rainfall but also after a two month time-lag. Moss (1988) mentioned that within Amboseli National Park breeding females stopped reproductive activity for two years after a severe drought. These findings serve to highlight the fact that elephant reproductive physiology is tied to prevailing environmental conditions and that elephants are not immune to climatic variability.

Principal woody forage species

Contrary to popular opinion, elephants do not feed on all available forage. Various studies have concluded that a small number of woody species contribute a large proportion to the overall diet of elephants (De Villiers 1994). During the dry season elephants, within the APNR typically ate a narrow range of woody species (6-8 spp.). *Grewia* species were the principal food to both family units and bull groups. Results indicate that up to 38% of bull groups and 41% of family unit's diet consisted of *Grewia* spp. *Grewia* has been described as a multistemmed shrub widespread throughout the KNP, especially on basaltic soils in knobthorn veld (Van Wyk 1988). This woody species is abundant within this area, and is frequently being cleared in sections of the APNR to prevent bush encroachment.

Favoured woody species

When considering which plant species are favoured by elephants, one has to also take their availability and not only their acceptability into account. Within the APNR, five woody plants - the common false thorn (*Albizia harveyi*), mopane (*Colophospermum mopane*), zebrawood (*Dalbergia melanoxylon*), sickle bush (*Dichrostachys cinerea*) and false marula (*Lannea schwienfurthii*) were identified as plants favoured by both bulls and breeding herds. In addition, bull groups favoured marulas (*Sclerocarya birrea)*. These six woody species together with *Grewia* spp. were utilized during 72% and 70% of all feeding events by bull groups and family units respectively (Greyling 2004).

To briefly focus on elephant impact on marulas: previous work conducted within the APNR (Haig 1999) has indicated that although elephants are impacting on the mature marula trees, regeneration of this species is being prevented by herbivory from smaller ungulates. The impala (*Aepyceros melampus*) population has increased substantially in the area and this species was found to be the main agent responsible for the lack of regeneration of marula trees. Impalas were also found to be the responsible for the lack of regeneration of *Acacias* in Lake Manyara National Park, northern Tanzania (Prins & Ven der Jeugd 1993) and for restricting the regeneration of the riparian woodland in Chobe National Park (Sharpe *et al*. 2004). Marula trees in the Kruger Park appear to be affected by fire as smaller trees are kept trapped in the grass layer by repeated burning and remain potentially non-reproductive individuals in the population. A change in the burning regime could potentially “release” these trees from a “fire trap” and allow recruitment into the population. Elephants are utilizing the mature/ adult marula trees, but very few trees are directly killed by elephants. A combination of elephant damage by bark stripping, burning of the exposed main trunk and high winds blowing weaken trees over a number of years and is affecting the larger trees in the population (Hofmeyr 2003).

The roan enclosure, in the northern basaltic region of the KNP, has been used retrospectively as an exclusion plot to measure the effect of elephant impact and other herbivores on marulas (Jacobs & Biggs 2002). Other than roan (*Hippotragus equines*), a few grey duiker (Sylvicapra grimmia) and steenbok (*Raphicus campestris*) large herbivores, including elephants have been excluded from the enclosure. The enclosure was erected in 1967; the same year the culling programme was implemented in the KNP. Results show that within this enclosure high densities of marulas including mature trees occur while no mature trees are found within the surrounding landscape. The results therefore verify that elephants do have an impact on the mature canopy of specific tree species within particular vegetation types. However, an important point has been overlooked. The culling programme did not prevent the disappearance of mature marula trees from this landscape.

Owen-Smith (1988) makes the observation that elephants will still have an impact on their favoured plant species, even at low densities. Pellew (1983) found that mature umbrella thorns (*Acacia tortilis*) were being lost at a rate of 6% per annum despite an elephant density of 0.2 elephants/km^2. Trollope *et al.* (1998) also concludes that culling has not prevented a change in the structural diversity of the woody vegetation in the KNP. Culling can therefore not be seen as a way of preventing elephants selecting for favoured species but merely an attempt to slow the process down. The question remains how did elephants co-exist with these tree species historically, and what has changed in the process of adult tree mortality and regeneration?

The importance of historical perspectives

In many African parks the recent vegetation structure and composition developed in the absence of elephants over a 70-100 year period (Sharpe *et al.* 2004), largely as a consequence of excessive hunting in the 1800's and early 1900's. Elephant populations within most protected areas are still recovering from low densities caused by intensive ivory hunting at the turn of the previous century. Although the vegetation is being modified by increasing elephant numbers, we are still unsure whether long term food production for elephants is being increased or decreased or whether the vegetation is not merely reverting to a historic state reminiscent of times when elephants were unaffected by hunting (Owen-Smith 1988). If the vegetation is reverting back to a previous state or in the process of establishing a new stable state, then we may be attempting the impossible task of sustaining high elephant densities whilst seeking to maintain the characteristics of the vegetation that would only have persisted if no or few elephants were present (Gillson & Lindsay 2003).

Final recommendations

When considering changes in the vegetation due to impact by elephants the most important step would be to determine the percentage of trees killed per annum and whether recruitment by surviving saplings and seedlings can maintain the tree population (Owen-Smith 1988). If this is monitored over a sufficiently long period, KNP could potentially predict changes in species composition and structure over time. The condition of the system can thus be assessed although this gives little or no insight into the numerous underlying processes that affect the status of the components (mature trees and elephants) in an ecosystem (Caughley 1983, Sinclair 1983, Owen-Smith 1988). If continuity of a mature canopy is desired, then recruitment is essential (Pellew 1983b).

Wildlife management policies should not be based primarily on subjective interpretations of the current state of an ecosystem. Rational strategies require appropriate ongoing monitoring to specifically test cause-effect relationships (Joubert 1983). To achieve this, a monitoring programme will need to be put into place that would not merely track changes but also look at causal effects by creating control areas which separate the effects of elephants from those of climatic variability, fire and other herbivores. An effective way in which these objectives can be met is by exclusion experiments (Sinclair 1983, Mallan 1992). It would be important to ensure that exclusion plots are erected in each of the management zones proposed by the new KNP management policy.

To briefly summarise the points discussed above and conclude:

1) The idea that the KNP has a static elephant carrying capacity is acknowledged by wildlife ecologists and managers to be an inappropriate basis for population control. However the concept persists and is still frequently invoked as the most pressing reason for culling. Before there can be an informed debate there needs to be a widespread understanding of the objectives of the elephant management policy.

2) New areas were recently made available for elephants to colonise in the expanded Limpopo conservation area. This may be driven by nutritional, social and safety issues within the new habitats.
3) Elephants exhibit measurable sex-related differences in forage use and this should be born in mind when evaluating the potential impact of a population on resources.
4) Elephants are influenced by short-term climatic cycles, although to a lesser extent than many other large herbivore species.
5) Staple food species do not include woody plants of conservation concern.
6) Concerns about the impact of elephants on aesthetically appealing mature trees may not be addressed through culling alone or at all. Factors influencing the patterns of tree regeneration need to be evaluated to understand and manage the process.
7) Historic elephant population densities in the KNP area need to be thoroughly investigated as the concept of biodiversity includes both temporal and spatial variability.
8) Exclusion plots in the evaluating the effects of elephants, other herbivores, fire, and climate on the woody vegetation dynamic should be an integral element of an adaptive management strategy.

References

BRAACK, L.E.O. 2000. Proposals for a Gaza/Kruger/Gonarezhou Trans-frontier Conservation Area. South African National Parks, Skukuza.

CAUGHLEY, G. 1983. Dynamics of large mammals and their relevance to culling. In *Management of Large Mammals in African Conservation Areas*, ed. R.N. Owen-Smith, pp. 115-126. Pretoria: Haum.

DE VILLIERS, P.A. 1994. Aspects of the behaviour and ecology of elephant (*Loxodonta africana* Blumenbach, 1797) in the Eastern Transvaal Lowveld with special reference to environmental interactions. P.hD. thesis, University of the Orange Free State, Bloemfontein.

DE VILLIERS, P.A. and P.J. Funston. 2004. Report on trophy and sport hunting of buffalo, elephant, impala and lion in the Association of Private Nature Reserves. Unpublished report to the Associated Private Nature Reserves. (109 pp).

GILLSON, L. and K. LINDSAY. 2003. Ivory and ecology-changing perspectives on elephant management and the international trade in ivory. *Environ. Sci. & Pol.* 6: 411-419.

GREYLING, M.D. 2004. Sex and age related distinctions in the feeding ecology of the African elephants, *Loxodonta africana.* PhD thesis, University of the Witwatersrand, Johannesburg.

HAIG, A.W. 1999. The impact of impala and elephant on demography and dynamics of *Sclerocarya birrea* subsp. *caffra* (marula) in the eastern lowveld of South Africa. B.Sc. (Hons.) dissertation. University of Pietermaritzburg, University of Natal, Pietermaritzburg.

HALL-MARTIN A.J. 1992. Distribution and status of the African elephant Loxodonta africana in South Africa, 1652-1992. *Koedoe* **35**: 65-88.

HENLEY, M.D. and S.R. HENLEY 2004. Population dynamics and elephant movements within the Associated Private Nature Reserves (APNR) adjoining the Kruger National Park. Unpublished November progress report to the Associated Private Nature Reserves. (20 pp.).

HOFMEYR, M. 2003. The spatial demography of elephant impacts on selected tree species in the Kruger National Park. Unpublished report to the US Fish and Wildlife. Skukuza. 43pp

JACOBS, O.S. and R. BIGGS. 2002. The status and population structure of the marula in the Kruger National Park. *S. Afr. J.l of Wildl. Res.* 32: 1-12.

JOUBERT, S.C.J. 1983. A monitoring programme for an extensive national park. In *Management of Large Mammals in African Conservation Areas*, ed. R.N. Owen-Smith, pp. 201-212. Pretoria: Haum.

JOUBERT, S.C.J. 1996. *Master plan for the Management of the Associated Private Nature Reserves*. 206pp.

MACNAB, J. 1985. Carrying capacity and related slippery shibboleths. *Wildl Soc. Bull.* **13**: 403-410.

MALAN, J.W. 1992. The relationship between elephants and the riverine tree communities of the Northern Tuli Game Reserve, Botswana. M.Sc. thesis, University of Pretoria, Pretoria.

MCLEOD, S.R. 1997. Is the concept of carrying capacity useful in variable environments? *Oikos* **79**: 529-542.

MOSS, C.J. 1989. Portraits in the wild: animal behaviour in East Africa. Elm Tree Books, London.

OWEN-SMITH, R.N. 1988. *Megaherbivores-The influence of very large body size on ecology.* Cambridge University Press, Cambridge.

PELLEW, R.A. 1983a. The impacts of elephant, giraffe and fire upon *Acacia tortillas* woodlands in the Serengeti. *Afr. J. Ecol.* 21: 41-74.

PELLEW, R.A. 1983b. Modelling and the systems approach to management problems: the *Acacia*/elephant problem in the Serengeti. In *Management of Large Mammals in African Conservation Areas*, ed. R.N. Owen-Smith, pp. 93-114. Pretoria: Haum.

PRINS, H.H.T. and H.P. VAN DER JEUGD. 1993. Herbivore population crashes and woodland structure in East Africa. *J. Ecol.* 81: 305-314.

SHARPE, C., P.A. AARRESTAD, H.P. ANDREASSEN, S.S. DHILLION, T. DIMAKATSO, J.T. DU TOIT, D.J. HALLEY, H. HYTTEBORN, S. MAKHABU, M. MARI, W. MAROKANE, G. MASUNGA, D. MODISE, S.R.MOE, R. MOJAPHOKO, D. MOSUGELO, S. MOTSUMI, G. NEO-MAHUPELENG, M. RAMOTADIMA, L. RUTINA, L. SECHELE, T.B.SEJOE, S. STOKKE, J.E. SWENSON, C. TAOLO, M. VANDEWALLE and P. WEGGE. 2004. The return of the giants: ecological effects of an increasing elephant population. *Ambio* 33: 276-282.

SINCLAIR, A.R.E. 1983. Management of conservation areas as ecological baseline controls. In *Management of Large Mammals in African Conservation Areas*, ed. R.N. Owen-Smith, pp. 13-22. Pretoria: Haum.

STOKKE, S. & DU TOIT, J.T. 2000. Sex and age related differences in the dry season feeding patterns of elephants in Chobe National Park, Botswana. *Ecography* **23**: 70-80.

SUKUMAR, R. 1991. The management of large mammals in relation to male strategies and conflict with people. *Biol. Cons.* 55: 93-102.

TROLLOPE, W.S.W., L.A. TROLLOPE, H.C. BIGGS, D.PIENAAR and A.L.F. POTGIETER. 1998. Long-term changes in the woody vegetation of the Kruger National Park with special reference to the effects of elephants and fire. *Koedoe* 41: 103-112.

VAN WYK, P. 1988. Field guide to the trees of the Kruger National Park. Struik Publishers, Cape Town.

WALKER, B.H. and P.S. GOODMAN 1983. Some implications of ecosystem properties for wildlife management. In *Management of Large Mammals in African Conservation Areas*, ed. R.N. Owen-Smith, pp. 79-92. Pretoria: Haum.

WHYTE, I.J. 2001. Conservation management of the Kruger National Park elephant population. P.hD thesis, University of Pretoria, Pretoria.

WHYTE, I.J., H.C. BIGGS, A.GAYLARD and & L.E.O. BRAACK. 1999. A new policy for the management of the Kruger National Park's elephant population. *Koedoe* **42**: 111-132.