Elephants and their Woodland Habitats in Northern Botswana

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CURRENT STATUS

The elephant population in northern Botswana is considered the largest remaining herd in Africa. According to official estimates, some 80,000 elephants currently dwell in the region (DWNP, unpubl.) Furthermore it appears that the elephant population maintains a steady increasing trend that has prevailed for over two decades (Calef 1988, Melton 1985).

An adult elephant consumes above 150 kg of vegetation material per day. Although the annual composition of an elephant's diet consists of at least 60% grass species, the bulk of the remaining portion is comprised of woody plant species. Some of the woody plant material consumed originates from tall trees that form mature woodlands. Thus, the combination of high consumption rates per animal, multiplied by the estimated elephant numbers, is suggestive of the prominent role that elephants have in the regulation of ecological processes within the local ecosystem and the profound influence of elephants on their habitats in northern Botswana.

High elephant densities may bring about considerable changes in the vegetation structure and composition, particularly in habitats where woody plants dominate the cover abundance of the vegetation. Already, a considerable number of reports has cautioned against the eminent destruction of habitats in northern Botswana, particularly along the northern Chobe and Linyanti rivers (Child, 1968; Sommerlatte, unpubl.). Although a detailed survey has not been conducted, it appears that mature stands of Ana trees *(Acacia albida)* that dominated the eastern part of the Chobe river front were destroyed as a result of elephant activity (Simpson, 1974). Furthermore, the indigenous Chobe bushbuck *(Tragelaphus scriptus ornatus)* was feared of becoming extinct as a result of elephants alternating the vegetation structure along the Chobe river.

In this paper, the role of elephants as agents of habitat change within the northern Botswana ecosystem will be put into perspective on the basis of eight years' research work. This synopsis will demonstrate that while elephants have a significant role in the regulation of the natural processes in the ecosystem, it is unlikely that a future increase in elephant densities will induce irreversible changes in habitats. On the basis of findings I will propose optional management strategies aimed to retain the viability of the northern Botswana ecosystem under the influence of an even more prolific elephant population.

THE REQUIREMENTS OF ELEPHANTS

Effective management policies for the ecological control of any elephant population should relate to parameters that describe the status of the vegetation at various habitat types. Thus, understanding the ecological scales of ecosystem dynamics in conservation areas is fundamental for the conception of appropriate policies (Waithaka, 1997).

Elephants can be found throughout northern Botswana, including the large islands within the permanent swamps of the Okavango Delta. Elephants maintain seasonal movements and congregate in the northern rivers and parts of the Okavango Delta during the dry season, only to disperse at the onset of the rains. Early research indicated that elephants return and occupy the same home range each year, covering a distance of up to 200 km between the wet and dry season home ranges (Calef, unpubl.). Typically, by the end of October, elephants amass in the vicinity of the Linyanti river, reaching considerable densities of between 4-10 elephants/km2 (Craig, 1990). Therefore, the availability of surface water in this semi-arid environment is a prime fac-

tor that regulates the abundance of elephants and restricts their movements, particularly toward the end of the dry season. Subsequently, the spatial patterns of vegetation utilization are influenced by the extent of local elephant aggregations.

The proximity of water sources is probably the best factor that predicts the extent of utilization rates of woody plant species by elephants in northern Botswana. Nonetheless, high variations in utilization rate, particularly at the watercourse fronts, renders this factor inappropriate to explain elephant induced damage to plants throughout the region. I found that elephant damage to woody plants, which includes trampling of seedlings and scratching against the bark of mature trees, was confined to a distance of several hundred metres from the water sources examined (Ben-Shahar, 1993). Hence, the resulting elephant impact to plants is unlikely to prevent the formation of woodlands beyond the close proximity to the water source.

I consolidated the findings on the damage to woody plants through the provision of a classification of plant communities in northern Botswana with respect to elephant utilization rates of plants and other types of damage that I observed. The classification segregated between three key plant communities dominated by mopane *(Colophospermum mopane)*, Rhodesian teak *(Baikiaea plurijuga)* and camel thorn acacia *(Acacia erioloba)*. These woodland habitats not only differed in plant species composition, but also with respect to prevailing elephant utilization rates, the occurrence of fire and the effects of other large herbivorous species as well as the effects of flooding on plants. Elephants range within each of these habitat types and reach considerable densities in some. However, other than in mopane woodlands, there were no indications that elephants exert considerable influence on woody plants in other habitat types.

ELEPHANTS ARE ONE ECOLOGICAL FACTOR

While elephants have a principal role in the regulation of the northern Botswana ecosystem and probably reduce the standing biomass far more by comparison to other herbivorous species, the role of other factors cannot be ignored. Fire has profound effects on the structure of woodlands and the survival rates of woody plants, particularly in areas where burning is frequent. In East Africa for example, the effect of fire and elephants is synergetic and exacerbate the damage to existing woodlands (Dublin et al., 1990). In northern Botswana, although fire and elephants may jointly affect the vegetation at some habitat types, the synergetic influence of both factors was found to be relatively light (Ben-Shahar, 1998). However, it seems that frequent annual fires, particularly the runaway fires that invade the northern parts of Chobe National Park, accelerate tree mortality in woodland habitats. Other habitats, such as those dominated by mopane and camel thorn, may also endure annual burning. Nonetheless, the heat loads, burning frequency and extent of burnt areas are much reduced because of the generally sparse grass cover. Subsequently, the detrimental effects of fire are less apparent.

SOME MANAGEMENT OPTIONS

The case of elephants in northern Botswana is unique in southern Africa because of the large size and openness of the national parks to even larger buffer zones designated as hunting areas and forest reserves. In spite of the huge range available for elephants the question pertains, how many elephants can northern Botswana sustain? Through the use of mathematical models that incorporated field measurements of plant survival rates and local elephant densities, I found that the northern Botswana region can sustain more elephants than the current estimate for the elephant population without incurring biodiversity loss (Ben-Shahar, 1996a,b). Currently, average elephant densities in northern Botswana approximate 1 elephant/km^2. A year round presence of more than 10 elephants/km^2 will induce an irreversible decline of plant densities and plant biomass. These estimates were derived for worse scenario conditions represented by consecutive years of drought.

If current conditions prevail, the elephant population will continue its growth until food resources become scarce. In the long term, once the elephant population reaches a certain capacity, it will level off and may subsequently decline as a result of increased

mortality and reduced recruitment rates. In this natural process, elephants will change their habitats, namely vegetation structure, but will not induce an irreversible change culminating in the loss of existing biodiversity. It is impossible to predict that the current climate patterns, composition and abundance of fauna and flora and the extent of human pressure will remain for many years thereafter. In any case, my findings exonerated the elephant as a principal factor to induce biodiversity loss. On the contrary, occasional and localized reductions of biodiversity resulting from intensive elephant activity will contribute to the resilience of the ecosystem. From an ecological perspective, the pertaining issue for wildlife managers, thus, will be the acceptable form of vegetation structure, as opposed to the contemporary level of the elephant population.

While severe elephant impact on the vegetation in northern Botswana is unlikely to affect the biodiversity of plant communities, high elephant densities will alter the structure of woodland habitats. A concern is often expressed as to the future welfare of the indigenous Chobe bushbuck. A small population of this subspecies dwells in the thickets that characterize the Chobe river front. With the opening of the vegetation due to elephant browsing and excessive trampling, it is feared that the bushbuck that relies on its food sources and cover protection from the unique vegetation that grows along the south river bank will become extinct. It appears, however, that the dozen or so individuals found along a defined strip on the eastern part of the Chobe river (Ben-Shahar, unpublished data), represent a marginal decline in numbers by comparison to an earlier survey conducted more than two decades before (Simpson, unpubl.). Although the sample size is too small to yield weighty scientific evidence on the population trend of the Chobe bushbuck, it nevertheless suggests that large aggregations of elephants along the Chobe river front did little to affect the indigenous bushbuck.

Even though the change of habitat structure as a result of elephant activities will not bring the demise of plant and animal species, management policies can, rightly, propagate the preservation of present habitat conditions. Such a policy may be anchored for example, in the retention of a landscape form for the maintenance of natural aesthetics for tourists. Alternatively, a particular woodland habitat may present a unique combination of plant communities and a landscape form not found elsewhere in the region.

In northern Botswana, management objectives pertaining for the preservation of a specific plant community and vegetation structure are most effective if they are applied on a localized scale. If the agents of habitat change are identified and the magnitudes of influence of individual factors are verified, it would still be a difficult task to control the factors on a regional scale. Yet, management activities that concentrate on relatively small areas and successfully isolate the obtrusive factors are likely to succeed. Specifically, if current pristine conditions of riverine woodlands along the Chobe river are to be preserved then the protection of defined areas from the activities of elephants and the occurrence of fire are likely to attain the objective. For example, some areas along the eastern part of the Chobe, close to Kasane include pristine woodlands that grow on the rocky slope toward the river front. Although these trees are common elsewhere in Botswana and southern Africa, the landscape formation is unique in the region. If the assemblage of tall crowned trees, such as the Natal mahogany *(Trichilia emetica),* the African star-chestnut *(Sterculia africana)* and the baobab *(Adansonia digitata)* is to be protected from the harmful effects of elephants, then sections of the pristine woodlands can be fenced off with fire barriers to ensure the preservation of this unique and picturesque landscape.

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