Elephants or Fire—Which to Blame?

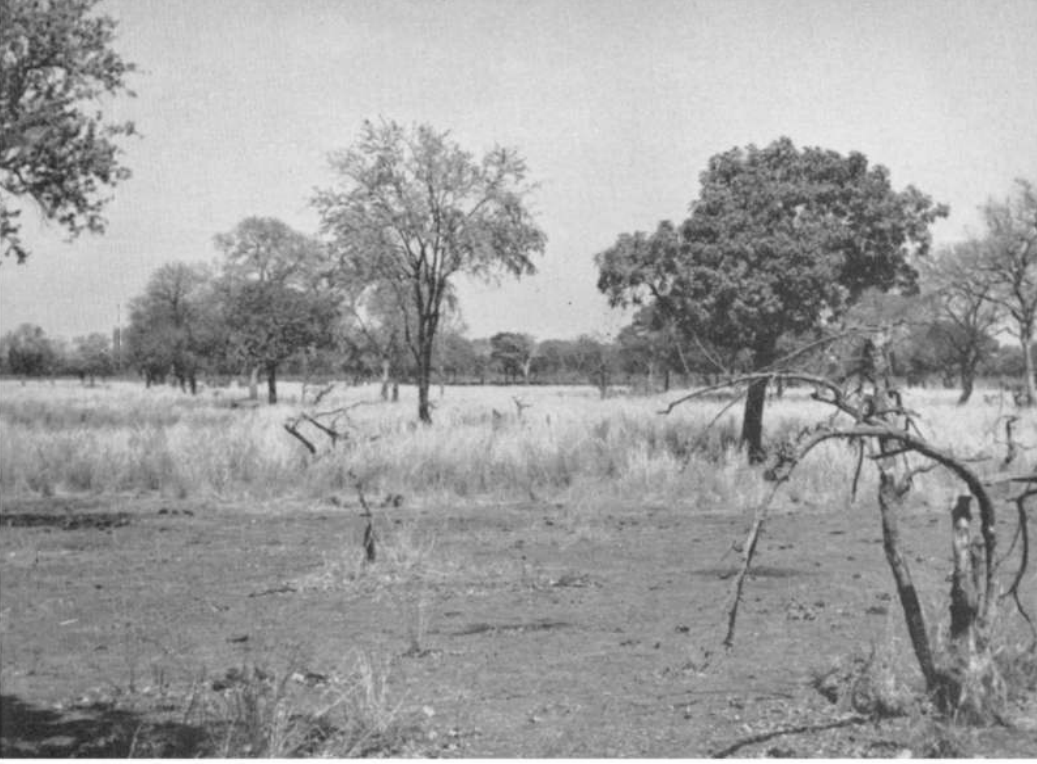
R. M. Lawton and Mary Gough

Is it always necessary to cull large populations of wild animals such as elephants and hippos, when they appear to be destroying their habitat? In ORYX May 1969, C. A. R. Savory argued the case for doing so in Rhodesia, and the question of whether to crop elephants in parks such as the Tsavo and the Kruger has caused heated controversy. In this article the authors, drawing on their experience of the Luangwa Valley in Zambia, where a cropping scheme was started in 1966, suggest that what appears to be destruction there may not necessarily be so, and that the real vegetation killer is fire in the dry season. R. M. Lawton is an ecologist with the Land Resources Division of the British Directorate of Overseas Surveys, and Mrs Gough is a skilled observer of animal behaviour with considerable experience in Zambia.

In the past few years it has become popular to crop wildlife in some of the large game reserves and national parks of Africa. One of the reasons given for doing so is that wildlife, in particular big game, elephant, buffalo and hippopotamus, are destroying their own habitats. This conclusion has usually been reached without even short-term, let alone long-term ecological observations; at the most it is based on a few aerial reconnaissances and the advice of visiting scientists, who, although eminent in their own fields, may have little knowledge of the vegetation or habitat conditions of the area, and in any case are only able to pay a fleeting visit. Large game populations are often accused of over-grazing and over-browsing, although neither term is clearly defined; the destructive effect of fire is sometimes ignored or only mentioned briefly in passing. The extremist view is well expressed by Savory (ORYX May 1969) who has introduced the term 'biological collapse' to give the impression of a rapid break-down of game habitats.

Where wildlife migratory routes have been closed by human settlement and cultivation, it may be necessary to reduce game populations. This is usually done by shooting the animals that leave the parks, and some game departments run elephant control services to deal specifically with this problem. But the problem may solve itself, for there is evidence that elephant may regulate their own population; in the Murchison Falls National Park in Uganda, where elephant are confined, Buss and Smith (1966) have found that there is more than a threefold increase in the interval between the birth rate of one calf and the conception of the next. The normal interval is thought to be 24.1 months; in the Murchison Falls park it is now 81.8 months.

Another destructive force in game reserves and national parks is the so-called wildlife ecologist, who has to shoot two or three hundred wildebeest, or elephant, to study their feeding or breeding pattern, because he has insufficient time to spend in the field collecting detailed obser-



LUANGWA VALLEY, ZAMBIA Plates 11 and 12

Above: Reserve of grazing at the end of the dry season in the riverine zone.

Below: Pollarded stems of mopane two-three metres high and browsed trampled grass. All the photographs on plates 11–18 are of the Luangwa Valley taken by R. M. Lawton in November 1968.

Left: Plates 13–15
Top left: *Diospyros mespiliformis* reduced to coppice and maintained by browsing in the riverine zone.

Top right: Crown of *Piliostigma thonningii* shaped by browsing.

Bottom left: *Combretum ghazalense* browsed and grass trampled. All three photographs in the riverine zone.

Plates 16 and 17
Above: The light patches are the ash remains of burned mopane poles. In the background the Muchinga escarpment.

Right: Leaflets of *Isoberlinia angolensis* coppice browsed by elephant.

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Plates 18 and 19
Left: Soil surface crack on the burned section of the Chifungwe Plain.

Below: Fire halted by an elephant path in the Chifungwe Plain.

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vations, preferably on foot. There are, of course, experienced field ecologists who do not find it necessary to destroy game for scientific purposes. For the past forty years or more the local African has been persuaded to create game reserves and to protect the animals therein; what effect will large-scale cropping schemes and shooting for scientific purposes have on his attitude to wildlife?

The Luangwa valley in north-east Zambia is one of the finest remaining game habitats in Africa. It owes its survival partly to its inaccessibility, for only a few rough tracks descend the difficult Muchinga escarpment to the west, and the clay soils make it impassable to motor transport during the rains. The valley contains two large game reserves: the Luangwa South, 3200 square miles (9288 sq km), and the Luangwa North, 1790 square miles (4636 sq km), separated by the Munyamadzi corridor approximately 20–25 miles (32–40 km) wide and 40–45 miles (64–72 km) long. The centre of the corridor is dominated by the undulating grassy Chifungwe plain, situated between two rivers, which is an important game habitat. Some observers believe that large populations of elephant, buffalo and hippopotamus are destroying the habitat through over-grazing, over-browsing and by causing erosion, so in 1966 a game cropping scheme was started (Bainbridge 1967). Our observations, on the contrary, suggest that there is no ecological evidence of habitat destruction in the Luangwa Valley to make game cropping necessary. In the following discussion of habitat utilisation all our examples are taken from the Munyamadzi corridor.

Grazing

Throughout the dry season one of the dominant grasses of the Chifungwe plain, *Setaria eylesii*, remains palatable and is grazed by elephant, buffalo, roan antelope and zebra among others. By the end of the season, provided it has not been burnt, there is still a good reserve of grass left. The plain could therefore carry a larger game population than it does at the present time. Unfortunately fire often sweeps across the plain in September or October and the animals are then forced, at a most difficult time of the year, to find alternative grazing and browse. Some herds move down to perennial tributaries of the Luangwa; others move into the lower escarpment woodland.

The riverine zone near the Luangwa and other rivers is intensively utilised. The perennial grasses, notably *Echinochloa stagnina*, *E. pyramidalis* and a *Setaria* sp., remain palatable and are grazed throughout the dry season. In November 1968, at the end of the dry season, in an area near the Luangwa that had not been burnt, there was a good reserve of grazing left: plate 11 shows the area at the time; there is a herd of buffalo in the background but they are difficult to see. If this area had been over-grazed most of the perennial species would have been replaced by annuals; the photograph is evidence that this is not so. Puku graze throughout the dry season on the short perennial grasses and sedges near the rivers, and although the grazing is intensive they have not been destroyed. *Phragmites mauritianus* is kept down to

3–4 inches (8–10 cms) by continuous hippopotamus grazing, but it is not killed.

If grasses are well grazed and trampled the destructive effect of late fires is likely to be reduced; conversely tall ungrazed grass burns fiercely and is destructive to the woody vegetation. The large areas of palatable perennial grasses, particularly on the Chifungwe Plain and in the riverside zone near the Luangwa, suggest that there is adequate grazing to support the present wildlife population. The reserves of dry grass at the end of the dry season, if unburnt, support this view. If there are any areas of over-grazing these must be small local patches of little significance.

Browsing

Trees and shrubs provide cover, shade, fruits and browse in a game habitat. One of the most important sources of browse in the Luangwa Valley is the shallow-rooted mopane tree *Colophospermum mopane*. A tall stand of mopane may be an attractive sight, particularly to a forester, and it provides shade for game. But in a game habitat mopane is really important as a reserve of browse, and once the elephants have reduced it to a height of about two metres (plate 12) its leaves are brought within reach of browsing animals. This is not destruction (Bainbridge, 1967); it is utilisation. Aerial photographs show that there is a large reserve of mopane woodland in the Luangwa valley.

Some trees and shrubs are reduced to coppice and maintained at ground level by repeating browsing (plate 13). The shape of the crowns of many trees has been formed by years of browsing e.g. *Piliostigma thonningii* (plate 14). Browse is most important during the latter part of the dry season when there is a succession of available species; the deep-rooted *Combretum ghazalense* provides browse in late September (plate 15), before the mopane flushes with the first rains in late October. It is obvious that browsing is intensive, but there is no evidence that trees are killed by browsing; if they were, many species would have been killed long ago. The destruction is most likely caused by late fires that burn back the coppice and pollarded re-growth just after it has flushed (plate 16).

Darling (1960, page 91) referred to elephant as 'rough in habit of grazing, browsing, digging roots; delicate in fruit picking and eating pods'. This may be so, but their browsing habits can also be delicate; we have seen elephants wrapping their trunks around coppice re-growth of *Isoberlinia angolensis* and pulling off the leaflets, but very few leaflets were dropped (plate 17). *Combretum ghazalense* is also browsed with the same care, but climbers, scandent shrubs and shrubs are treated more roughly. Sometimes elephant will break up a tree or strip a bark, but the tree will usually coppice. In any case the stem has probably been damaged by fire in the past.

Fire and Erosion

Fire is the principal agent of destruction of grazing and browse plants in the game habitat. Natural fires may be started by lightning at the

beginning of the rains, that is in early November, but the rain will bring a flush of new grass and woody re-growth; at any other time of the dry season fires are destructive. In 1968 the Chifungwe plain was 'accidentally' burnt towards the end of September; by November the soil surface had cracked (plate 18), but on a small area where the fire had been halted by an elephant path (plate 19), the mulch of trampled dry grass had protected the soil surface and no cracks could be found.

Many elephant paths cross the Chifungwe plain but none were seen that opened up into erosion gulleys. The surface cracks, following exposure due to fire, are more likely to be the source of erosion gulleys. The first heavy thunderstorms falling on the bare earth will wash down the cracks and start the formation of gulleys. The large game population, particularly elephant, has been blamed for causing erosion; but the real cause is the exposure of the soil surface and subsequent cracking which follow the removal of the vegetative cover by fire. Trampling protects the soil surface from insolation and reduces the effect of late season fires; if large game populations are reduced there will be less grazing, browsing and trampling, and fires will be more widespread and more destructive.

The Effect of Floods

Occasionally, perhaps once in 20 years or even less, a long heavy rainy season may lead to flooding, and some trees, if they are standing in water for two or three months, may die. Flooding may also account for the dead trees often found around the edges of depressions. Because flooding occurs so infrequently it is often overlooked as a major habitat factor.

Discussion and Recommendations

Unlike the North American and European game populations, African wildlife has a full complement of carnivores and herbivores, which will achieve a balance provided all carnivores are not shot for trophies. If browsing can kill trees and shrubs, it seems very unlikely that the most palatable species could have survived to the present day. The concept that trees are killed by 'over-browsing' is not supported by ecological observations; it is not browsing but frequent late fires that destroy the new flush and eventually kill the tree, and in the Luangwa valley death by flooding is another possibility. Fires early in the dry season destroy the grazing and so disrupt the habitat, causing the animals to move and change their feeding habits, forcing them, if the grass has been destroyed, to browse at the wrong time of the year. Fires, which start erosion by exposing the soil surface to insolation, causing surface cracking and the formation of erosion gulleys, are clearly the major destructive force in a game habitat. One of the principal aims of management must be to prevent man-made fires, and in limited areas, such as game reserves and national parks, this can be done by early-burning fire breaks and by frequent dry-season patrolling.

In some of the ex-colonial forest departments representative stands of particularly fine natural forest were laid aside as 'inviolate plots' or

botanical reserves, where no exploitation or disturbance was allowed. This concept could be extended to wildlife habitats. Parts of game reserves and national parks that have a rich fauna and flora should be set aside as sanctuaries and only patrolled by members of the game department. Similarly areas with rare or uncommon species should be made sanctuaries.

Sanctuaries would be surrounded by areas suitable for tourism, with access to the edge of the sanctuaries so that tourists could have the opportunity to see rare species. Outside the tourist area an outer zone could be devoted to controlled hunting, game cropping and ranching, where predators would be controlled and herds of ungulates built up and cropped. This type of management is complex and would require the allocation of large tracts of land for wildlife, as well as the services of experienced ecologists. In Africa there are suitable areas for this, and the Luangwa valley is one. It may be necessary to have a mosaic of sanctuaries and tourist areas with flexible boundaries that change with game movements, though the boundaries between the tourist area and cropping or ranching areas would have to be more rigid; it is not advisable to drag an elephant carcass in front of a game-viewing group of tourists! A similar method of management has been outlined by de Vos (1968).

The establishment of semi-domesticated herds of eland or similar ungulates, like the herd started by Bainbridge (1966) at Chilanga, in areas now remote from natural game populations, is to be commended; it may prove to be the most suitable way to exploit African wildlife.

Bibliography

BAINBRIDGE, W.R. 1966 The role of wildlife in exploiting the undeveloped areas of Zambia. *Zambia* Dec. 1966, pages 24–37. Published by Zambia Information services, P.O. Box RW 20, Lusaka, Zambia. Falcon Press Ltd, N'dola.

BAINBRIDGE, W.R. 1967 The reaping of the game harvest in Zambia. *Zambia* January 1967. Published by Zambia Information Services, P.O. Box RW 20, Lusaka, Zambia. Falcon Press Ltd, N'dola.

BUSS, I. AND SMITH, N. 1966. Family planning among elephants. *New Scientist* November 1966, No. 519, page 215.

DARLING, F.F. 1960 Wild Life in an African Territory, page 91. O.U.P. 1960.

DE VOS, A. 1968 Problems in national parks management in East Africa. *Unasylva* Vol 22 (3) No. 90. 1968.

SAVORY, C.A.R. 1969 Crisis in Rhodesia. *Oryx* Vol X No 1 May 1969, pp. 25–30.

Guards for the Black Lechwe

The Zambian Wildlife Conservation Society has given the money to build 12 houses for extra wildlife guards to protect the black lechwe in the Bangweulu Swamps. In eight months last year the guards arrested over 100 lechwe poachers.

A seminar on natural resources education is to be held at the University of Zambia in Lusaka, on May 28–30, to draw up a plan for improved conservation education and publicity.