Problems of Controlling Fires in Uganda National Parks

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It is necessary before looking into the problem of controlling fires, to introduce Uganda National Parks and to state clearly why we should wish to control fires, in other words what are our management aims.

Uganda National Parks is a para-statal organisation financially supported by the Uganda Government and governed by a Board of Trustees. There are three National Parks covering approximately 2,800 square miles, the largest of the National Parks, Murchison Falls, some 1,500 square miles in area, is the Park which I will deal with in greatest detail, although many of the causes and effects of fires are applicable to all three National Parks.

The National Parks were created by Act of Parliament in 1952 and we are therefore, by American and South African standards, a very young organisation. It became apparent as the Parks developed that there was something going seriously wrong with the habitat in both Queen Elizabeth and Murchison Falls National Parks; heavy grazing by hippopotamus and uncontrolled fires in both Parks, and the destruction of the woodland in Murchison Falls by elephant, were changing a varied habitat into a monotonous one.

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The Board of Trustees therefore decided that as a matter of policy the management aims with respect to the rangelands be clearly stated, and having stated them, management of animal populations and fire would be implemented to achieve the aim. The management aim of the organisation applicable to all her National Parks is "To maintain and create where it has been lost, as diverse a habitat as is natural to the area." The problems of implementing management are similar in the three National Parks, although Murchison Falls has almost certainly lost its diversity to a greater extent than Queen Elizabeth and Kidepo Valley National Parks. I think it the correct approach to look at the worst situation, as from these lessons hopefully will be learnt to avoid similar situations occurring in other National Parks.

Murchison Falls National Park Location, and Description

The Park, 2° north of the equator, is located in North Western Uganda. The Park is relatively flat from 2,000 feet above sea level on the shores of Lake Albert to Rabongo hill 4,235 feet in the Southern sector giving a mean height of 3,117 feet. The Victoria Nile flowing east to west divides the Park into two more or less equal halves, which together with the Islands in the Nile itself gives useful areas of comparison.

The rainfall in the Park falls in two seasons of the year, March–June and September–November. There is, however, usually a trace of rain in every month of the year except January. The average precipitation is 45–50 inches per annum. The average temperature is in the daily range of 20–30 C. However in the driest time of the year, January–February, midday temperature may reach as high as 35–40 C. Strong winds blow from the north during this period.

Buechner and Dawkins state that in 1959 three fourths of the Park were covered by fire climax grassland, and that the next largest physiognomic type included sparsely wooded to wooded grasslands, groves of borasus palms along permanent streams in the Northern Sector. Riperian or gallery forest occurred along streams in damper areas of the Park. In the 12 years to the present date grasslands have become more extensive at the expense of other vegetation forms.

There is a varied fauna in the area with elephant (12,000) buffalo (30,000) and hippopotamus (14,000) being the most common species

on both sides of the Nile, and almost certainly ecologically the most important to management problems.

Past History of the Area

Prior to the scourge of human trypanosomianisis (sleeping sickness) in 1908, the area was heavily populated by humans, especially, as one would expect, along the banks of the Nile. By 1912 all the people in the area had either died or been removed from the area of danger. There is evidence that there had been human habitation in this area for many hundreds of years. Man would almost certainly have used fire to clear his land and to assist him in the hunting of wildlife. Descriptions of the vegetation of the area 65 years ago bears little relation to what exists today. The first detailed map of the region was prepared in 1905 by Vandeleur and shows that the area was well wooded. Winston Churchill visited the area in 1908, and describes the view looking, over what is now the Park, from the high ground of Igisi hill: "in every direction spread a wide sea of foliage, thinning here into bush, darkening there into forest and broken only by the occasional peak of rock."

Other descriptions indicate that there was extreme diversity including Riperian forest, a predominantly *Teminalia glaucescens* woodland, scrub county, especially in the naturally eroded areas along the Nile, and open grasslands, indeed, the very diversity which we now seek.

The southern area of the park is now almost entirely open grassland with five small patches of relic forest about 1.5 square miles in total, scrub and woodland along the stretch of the Nile from the Murchison Falls downstream to the western boundary, and a few badly scared forest species along the slow flowing streams. The last of the former woodlands are visible by stands of dead sun-bleached and fire-scorched skeletons of trees.

The northern area presents a rather better picture from casual observation, but a deeper look indicates that all is far from well. Former extensive woodlands in the Chobe Sector, and the Pandera woodlands in the central sector are being killed by ring barking and fire, hardly a mature tree, except for *Balanites aegyptiaca* and *Kigalia aethiopum*, are without signs of heavy barking. There are rather

more extensive areas of scrub. A factor common to both areas of the Park is the absence of mid-term tree growth.

Thus we have a situation in the southern area of the Park that is contrary to our aims, and in the northern area one that is going that way.

The National Parks Authority, until the implementation of a controlled burning plan, carried out a policy of despair, burning as much of the Park as possible as soon after the end of the rains as they were able, on the assumption that a cool early burn was better than a late hot burn, and in an effort to ensure that the whole Park did not burn in a matter of days.

Causes of Fires in Murchison Falls National Park

There are a number of sources of uncontrolled fires in Park Range lands, and it is necessary to look at the causes before going into the effects of such fires.

Land Clearance:—Fire has probably been used as a tool for clearing land since man started cultivating. This is still the case in Uganda from a slash and burn system of agriculture in the forested areas to straightforward grass clearing for cotton or other crops in wood and grassland areas. This system of clearing would be satisfactory if the fires were thereafter controlled, but all too often, fire, used to clear a few acres will continue to burn many tens of square miles, and when the clearing is near the boundary of the Park it is the Park which suffers. Greatly increased human settlement in the areas surrounding the National Parks has meant a far higher incidence of grassland fires from this source.

Verge Clearance:—In Murchison Falls Park there are public trunk roads, the control of which is not vested in the Park authority. Gangs of men are employed by the Ministry of Works and Communications for upkeeping the roads and keeping the verges clear of tall vegetation. During the wet season verge clearance is maintained by manual cutting of the grass. In the dry season the temptation to clear the grass using as easier a method as fire is too great, and these fires then sweep on into the Park.

Poaching Burns:—Burns to aid in the illegal hunting of animals are carried out both within and outside the Parks with a number of ob-

jectives in view. The pattern of burns is that, as soon as the grass is dry enough to burn at the start of the dry season, small fires are lighted to create a flush of new grass. These miniburns, often away from the Park boundary, draw animals to them where they are hunted or snared. Burns of this kind illustrate that it is physically possible to control this size of burn.

As the dry season continues fires are lighted deep in the Park with the intention, almost always successful, of burning large areas to facilitate ease of illegal hunting and to make it difficult for the Park security forces to approach unseen.

The damage done to the vegetation by these illegal operations is very great indeed, and probably accounts for more damage than the loss of the animals poached.

Malicious Fires:—In our attempts over the last few years to control burning, it has become increasingly obvious that fires have been lighted in areas which have been given special protection for no other apparent reason, other than causing considerable annoyance and work to the Park Authorities.

Other fires are started, I am quite certain, for the thrill of seeing flames roaring across the countryside, as we have evidence of fires that have been illegally lighted which are of no material value to those who start them.

Lightning Strike:—Indubitably, lightning is responsible for starting fires, especially in Murchison Falls National Park, which has a high incidence of lightning, although there is no quantitative data to indicate what factor lightning induced fires are in the overall fire picture.

Park Controlled Burning:—The final cause of fire in the National Parks are those fires which are started by the Park authority as part of a planned control burning programme, about which details are given under range management. Inevitably, accidental fires occur during the carrying out of the controlled burning programme, but they account for a very small percentage of the total area burnt.

Apparent Effects of Fires on Vegetation Communities

Closed Semi-deciduous Forest:—The so-called forest of the Rabongo area is the only example in the Park and appears to be doomed.

The combined effects of over utilization by elephant and fire which scorches the trees on the edge of the forest and eats back into the forest margin. *Cynometra alexandri* is dominant and *Holoptelea grandis*, *Cola gigantea*, and *Pterygota mildbraedii* are common within the forest.

Riperian Forest:—Except in the Banks of the Nile which is an area naturally protected from fire by heavy erosion, the riperian forest in other areas of the Park has virtually disappeared. The former extensive stands are indicated by rotting tree trunks and a few badly scared relics. There is no regeneration evident. *Kyaya grandifoliola* and *Trichilia roka* occur in what remains of these forests.

Deciduous Thicket–Crateva Scrubsavanna:—Where such thickets occur within erosion gullies, there is protection from fire and the thicket is maintained. In all other areas where there is enough grass to support fire, such thickets are gradually disappearing. This is very apparent in the thickets occurring in open grassland. Common tree species in these areas are *Acacia sieberiana*, *Cassia Sieberiana*, *Tamarindus indica*, *Albizia coriaria*, and *Crateva adonsonii*. The common shrubs are *Harrisonia abyssinica* and *Combretum aculeatum*

Woodland:—As already stated, no woodland remains on the south side of the Park. Although it is interesting to note that where elephant have been excluded from area outside the Park, and despite annual fires, there is considerable regeneration, suggesting that the browsing pressure is of considerable importance in failure to obtain regeneration of woody vegetation.

In the northern area the situation, whilst bad, is not as desperate as the southern area, there is however an absence of midgrowth trees the regeneration of which must be inhibited by heavy browsing and fire. The adult trees are heavily ring-barked by elephant, especially near the main rivers which suggests that destruction by elephant starts near the river and moves outwards and away from the Nile. This pattern would appear to have been the case in the southern area also. The most common trees in the woodland are *Terminalia glaucescens*, *Prosopis Africana*, and *Acacia siberiana*.

Borassus Palm Savanna:—This occurs in the northern area only of the Park, spreading from the Tangi River southwards. Except for a

few noticeable exceptions, all the adult trees, *Borassus aethiopum*, are confined to the Tangi River. Young trees 6 feet tall occur in large numbers, although once again there is a disturbing lack of any growth between this height and adult trees. They have been subjected to annual burns, and are heavily browsed by elephants who concentrate on the central lead shoot. The elephants have almost certainly been responsible for the spreading of this tree as they are inordinately fond of the ripe fruit. There would seem to be no reduction of the area covered by the undeveloped trees.

Tall Grass Savanna:—Various species of *Hyparrhenia* and *Pennisetum purpurevry* are the dominant grasses. Many other species including *Setaria Sahacelata*, *Brachyaria* spp. *H. filipendula*, *Paspalam commersonii*, *Imperata cyclindrica Panicum maximum* and *Sporobolus* sp. are also common. Tall grassland now covers a large percentage of the Park. Before the implementation of a controlled burning programme most of the grassland areas were burnt annually. Areas that escaped fire were subjected to even higher grazing pressure especially by elephant who could obtain little food in the burnt areas until the grass had grown again or leaves had appeared on the woody vegetation.

The areas burnt produced a flush of young grass within three to five days after the burn, even without rain.

Short Grass Savanna:—Some limited areas of short grassland occur in the Park in the Buligi area, east Tangi, Lolim and Wangkwar. The Buligi area was burnt annually and appeared to be decreasing in total area with *Hyparrhenia* spp. taking over from the short grasses. The other short grass areas appeared to be undergoing similar changes.

Swamp areas:—Areas of swamp along the slower flowing rivers, and in valley bottoms usually escaped the attention of fire, although these areas come under very heavy grazing pressure from many species following burns in the same area. The dominant grass species are *Setaria setulosa* and *Chloris gayana.*

Seasonal Rivers:—There are a number of seasonal rivers in the Park, which only flow in the wet season. One of these rivers, the Emii, was subject to heavy flooding after heavy rains at the end of the dry season. In 1965, a policy of not burning the bulk of the Emii watershed was introduced and since that time there has been no

serious flooding, and pools of water have remained in the river far longer into the dry season. There is, however, no quantitative data on this.

CONTROLLED BURNING PROGRAMME

The Plan

As already stated the Parks authority followed a policy of despair, burning much of the Park as early in the season as possible. In 1965, however, a firebreak was constructed round the Pamdera woodland in the northern area and the relic forest of Rabongo was similarly protected. In 1966, a more meaningful programme was worked out for the complete area of the Park. Fig. 1 shows the plan for the north western area of the Park.

The block size was a purely arbitrary one, as its boundaries depended on rivers, swamps, erosion gullys, roads and tracks, all of which form satisfactory breaks to normal fires. Despite the lack of knowledge of what the effects of no burning, early burning, and late burning would be, it was felt that, by dividing the Park up in this way, a degree of diversity would be forthcoming.

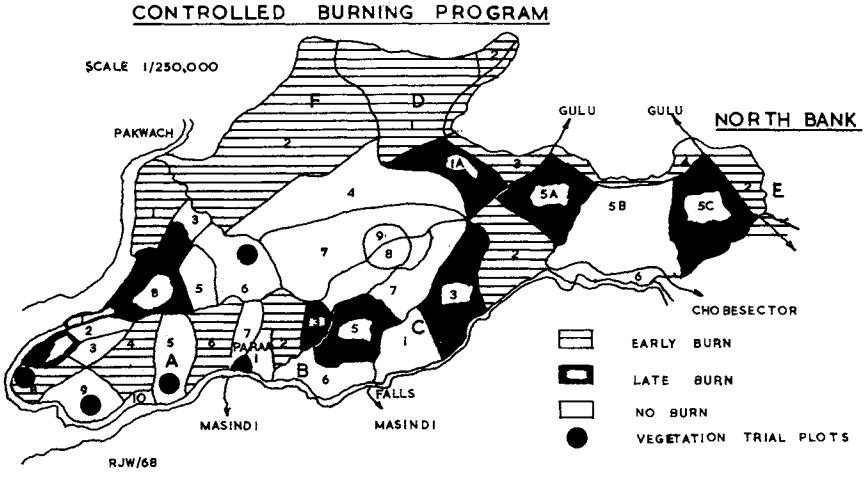

Fig. 1. The burning plan for the North Western area of the Park together with proposed sites for vegetational trial plots.

When deciding on the form of control, the following points were taken into consideration.

1) It was essential that there be a barrier of early burns around the boundaries of the Park to prevent fires from entering from the areas outside the control of the Park.
2) It was essential that there be a barrier of early burns in areas adjacent to main roads.
3) It was essential that there be early burns within the Park to protect areas of special importance such as scrub, forest, and the remaining woodland.
4) Tied into the programme was the need to ensure good wildlife viewing for the visitor to the Park, as without satisfied visitors, the economic importance of the Park would be jeopardized.
5) The need to keep wildlife in the Park and not have them drawn out by burns external to the Park was also considered.

After taking all these points into consideration 39 blocks were designated no burn areas, 33 blocks as early burn and 21 blocks as late burns.

The Implementation

The plan was explained to all Warden Staff in the Park who in turn controlled the junior staff in its implementation. All staff were warned that fires were under no circumstances to be lighted without the authority of a Warden. Punishment for so doing would be instant dismissal. It was appreciated that it would be impossible to maintain anything like 100 percent success as there were too many factors going against success, especially poaching burns, lightning burns, and accidental fires.

Burning of the early burn blocks commenced under the control of Wardens as soon as possible after the rains had finished, this in practice meant just before or after Christmas. The early burn blocks on the borders of the Park were tackled first. These burns continued until completed. On occasions fires coming from outside, or lighted by poachers, fortuitously helped in carrying out the programme.

Attempts were always made to extinguish fires in no burn areas, but due to the area involved (1,500 square miles) this was often not

FIG. 2. The use of a road and a small stream as a firebreak.

possible. Indeed on occasions no burn and late burn plots had to be sacrificed to protect areas of greater importance. Although roads and rivers formed effective fire breaks, especially when back burnt against the wind (see Fig. 2), changes of wind direction often occurred and fire jumped the breaks, little used tracks or cut firebreaks were particularly vulnerable to this.

During the dry seasons from 1967–68 onwards, reconnaissance flights were carried out by myself as and when time permitted, and an accurate record of the areas burnt was plotted on the burning map. The difference between attempting to map fires from the ground and from the air is well illustrated in Figs. 3 and 4.

The importance of this mapping was not just to ascertain the degree of success of the programme, but in making an accurate record for future botanical workers, so that they will be aware of the fire history of the area.

Despite the problems, some measure of success has been achieved as will be seen from Fig. 5 below. Any burn involving less than 10 percent in total of a "no burn" area is counted as a no burn.

Analysis of these figures shows that in terms of overall success; in 1966–67 only 24 blocks out of the 93 were treated in the manner planned, although lack of an aircraft meant 45 of the blocks were unrecorded; in 1967–68 all blocks were recorded, and 53 out of the 93 blocks were maintained according to the plan; the 1968–69 season

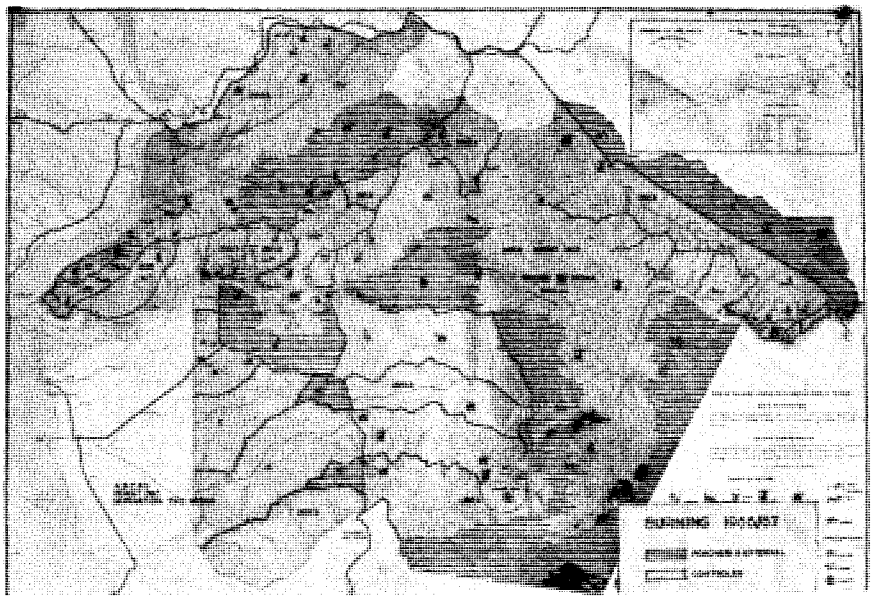

FIG. 3. The 1966–67 fire map recorded from the ground.

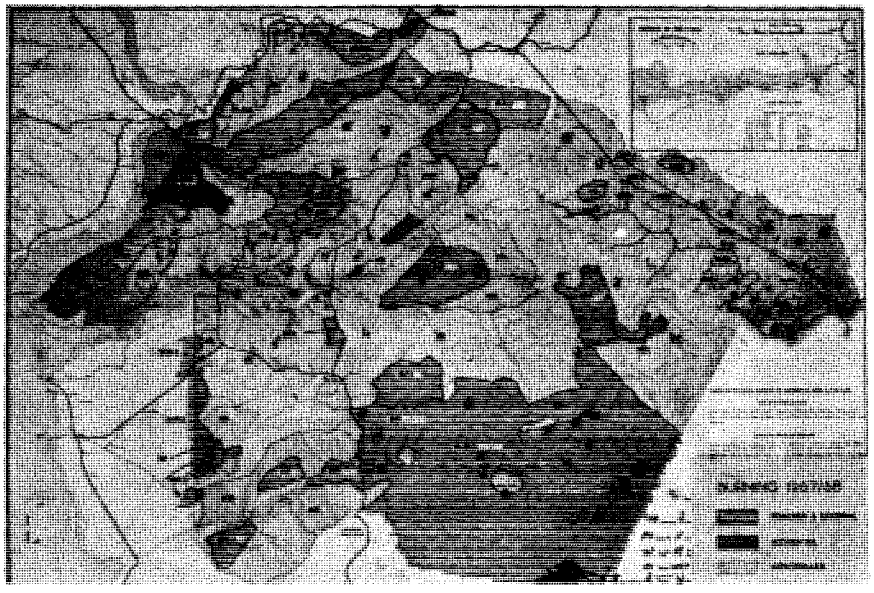

FIG. 4. The 1967–68 fire map recorded from the air. Figures on the map indicate the date when burning occurred.

TOTAL BLOCKS PLAN	NOT BURNT (a)	EARLY BURNT (b)	LATE BURNT (c)	NOT KNOWN	(a)	(b)	(c)	(a)	(b)	(c)
39 NO BURN	2	12	2	23	23	12	4	34	4	1
33 EARLY BURN	2	20		11	4	28	1	4	28	1
21 LATE BURN	2	6	2	11	12	7	2	12	5	4
TOTALS	6	38	4	45	39	47	7	50	37	6
	1966/67				1967/68			1968/69		

FIG. 5. The success and failure of the controlled burning programme in the form of a table.

was even better in that 66 of the blocks were maintained according to the plan. It is of interest to note that of the 139 burns recorded in this period 94 were controlled burns by the Park authority and 37 were by poachers, external, accidental, and lightning.

Thus despite the difficulties of size of the area, size of each block, lack of fire breaks, illegal entry, difficulty of access to some areas some measure of success has been achieved. However it must be appreciated that when one comes to look at individual blocks, success can only be measured in terms of success in successive years, and when this aspect is examined over the past 3 years it is found that only two "no burn" have had 3 years without burning and only 21 two years without burning.

We have however shown that success is possible despite the problems and with more firebreaks and roads, more staff for control purposes both of fire and illegal entry.

RESEARCH

It will no doubt come as a surprise to see research at the end of this paper but I regret that research into the effects of fire and

overpopulation have been neglected. There has been a tendency to look at the animals and not far enough down the ecological ladder to what supports these animals. These shortcomings, whilst it still applies in Murchinson Falls, is now the subject of considerable study in Queen Elizabeth Park, Tanzania National Parks in their research institute, and in Tsavo Park in Kenya.

To return to Murchison Falls National Park, which is the case history for the purpose of this paper, it is of interest to note in broad terms what work has been done.

In 1965, the first exclusion area was dug in the Southern grassland (former terminalia woodland). This was a ditched plot 200 feet $\times$ 200 feet from which animals and fire were excluded. The response to this treatment was, to say the least, shattering. The area looked exactly like Fig. 6, which was taken alongside the ditched plot. The tremendous growth now within the excluded area is shown in Fig. 7, an indication of the effect of exclusion, despite the fact that elephant managed to get into the plot about 2 years ago. This plot was unsatisfactory however in that, whilst it showed what happened in the absence of fire and animals, it did not show what effects different burning regimes would have.

In 1967, therefore, two more ambitious plots were constructed in the Chobe Sector of the Park, one in the Chobe grassland, and one in the Chobe woodland. The exclusion plots are 200 feet $\times$ 600 feet and subdivided into three plots 200 feet $\times$ 200 feet. External to the excluded area are identical sized plots open to grazing. The three plots excluded and not excluded were subjected to no burning, early burning, and late burning. A detailed survey of the vegetation in all the plots, and productivity trials were carried out by members of St. Andrews University, Scotland; they have monitored these in 1969 and will do so again this year (1971) before producing a detailed paper on the changes.

Without going into detail there has again been a rapid growth in the excluded plot of woody vegetation. Initially, the best growth was in the no burn plot, although after a couple of years the growth was being smothered by creepers, and from casual observation the early burn plot was making the best progress in terms of productivity in woody species. The two most interesting factors are that there

FIG. 6. The grassland after a burn in the area adjacent to the ditched plot and is an indication of what the ditched plot area looked like before exclusion.

FIG. 7. A panoramic shot of the Wairingo ditched plot with the tremendous regeneration of woody vegetation clearly visible.

is successful woody regeneration in all three excluded plots and none in the external plots, although there could well be a change in grass species in these plots. Thus in an admittedly limited area we are now getting an indication of what we hoped to obtain from these experiments:

1) The effect on the vegetation in the absence of fire, grazing, and browsing.
2) The effect on the vegetation in the absence of grazing and browsing with early burning.
3) The effect under conditions mentioned above with late burning.
4) The effects of no burning, early burning, and late burning in the presence of grazing and browsing.

It would appear, therefore, that in these particular locations, the major inhibiting factor is browsing and grazing pressure and not fire.

It is planned that similar plots be developed in the short grass area, borasas palm area, eroded area, deciduous thicket, and forest area, which we hope will give some indications as to whether the effects indicated in the first two plots are Park wide or not.

Coupled with these proposals for research are a total of 245 miles of additional road tracks and firebreaks which will be of enormous value in our attempts to control fire.

It may be asked why continue with a controlled burning programme if it is possible that grazing and browsing pressure are the main cause in the change of woodland and scrubland to grassland. Firstly, we are not certain that this is in fact the case in all vegetational zones, and it would be dangerous to change the programme at this stage.

Secondly, if browsing pressure is the main factor against regeneration of woody vegetation, it would be pointless to reduce certain mammals which are too numerous for the range to support, if at certain times of the year the available range is reduced by burning; this applies particularly in the case of elephant.

Thirdly, it is within the National Parks objectives in its search for diversity to apply such diversity to grass species.

SUMMARY AND CONCLUSIONS

Fire has been a feature of the area for countless generations as a tool to remove vegetation for various reasons or as an aid to hunting. Natural fires also occur in the area. It has been apparent, however, that the incidence of fire in the area has greatly increased as a result of a greater human population settling progressively nearer to the Park boundaries, which whilst not within the scope of this paper, illustrates the need for sound land use planning for areas adjacent to National Parks (Wheater, 1968).

The Board of Trustees have stated that management objective is to achieve a diversity of vegetation within the National Parks and that management of mammal populations and control or use of fire would be used to achieve this objective.

A programme of controlled burning has been initiated in Uganda National Parks and the programme has been in operation in Murchison Falls National Park in limited areas since 1963 and on a Park wide basis since the dry season of 1966–67. Despite the many problems involved in tackling an area of this size, the programme has been successful enough to indicate that with more firebreaks and a larger staff a considerably higher degree of success may definitely be expected. The importance of mapping both to indicate success and as a permanent record for research workers has been noted.

The very serious lack of research and the need for far greater efforts in this field have been noted and plans for further plots have already been proposed. It is hoped that a new institute for ecology will be set up in Uganda during the next six months with a field station in each National Park. One of the research priorities will be the examination of the effects of fire on all the vegetational zones in the Park with long term monitoring of our management.

It will have been noted that this paper has dealt with the question of fire and its control in general terms, and without going too deep into detail. The lack of quantitative information and the fact that the research plots will be the subject of a paper, hopefully in the latter part of this year, is the reason for this general approach.

ACKNOWLEDGEMENT

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LITERATURE CITED

Buechner, H. K., and H. C. Dawkins. 1961. Vegetation change induced by elephants and fire in Murchison Falls Park, Uganda. Ecology 42(4):752–766.

Churchill, Winston 1908. My African journey. Garden City Press.

Vandeleur, C. F. S. 1897. Two years travel in Uganda and Unyoro, and on the Upper Nile. Geographical J. 9369–393.472.

Wheater, R. J. 1968. Land use proposals for Murchison Falls National Park and surrounding areas. East Africa Agric. For. J. 33:19.