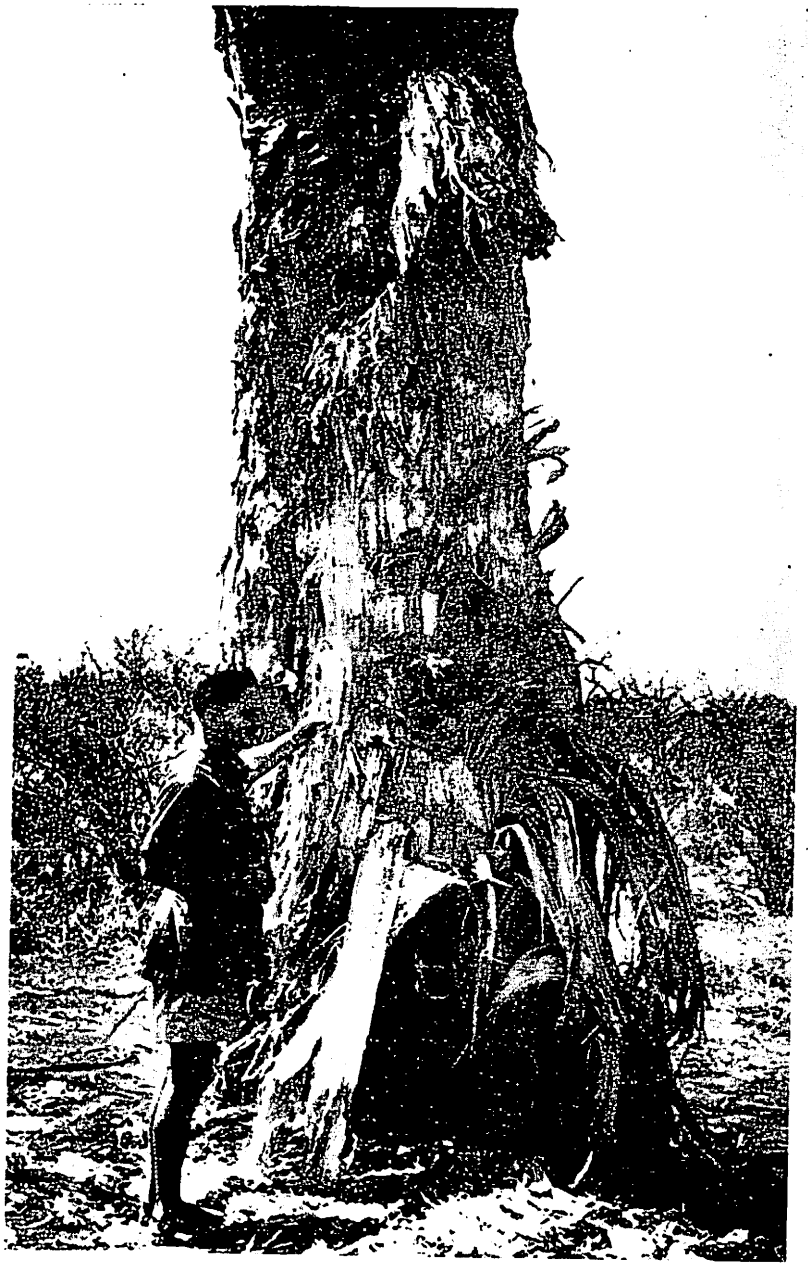

Fig. 9: Baobab bole damaged by elephants, near the Mayani Gate. D. L. W. Sheldrick indicates its size.

Photo: F. Bourliere)

Ecological notes on the Tsavo

DR. F. BOURLIERE

MUCH has been said during the last four years about the elephants in the Tsavo. The press has made much of the so-called invasion of this pachyderm into this National Park; the most fantastic theories have been advanced to explain this invasion. In the circles concerned with Nature Conservation the possibility of a considerable reduction of the elephant numbers in this part of Kenya has been discussed and is still being considered. The most plausible *a priori* arguments were advanced in support of this or that proposal, without even an ecological study of the situation having ever been made. Thus it was with great pleasure that, at the 8th General Assembly of the International Union for Conservation of Nature which was held in September 1963 in Nairobi, I accepted the invitation of Colonel Mervyn Cowie, Director of the National Parks in Kenya, to pay a week-end visit to the Park, together with the two British Botanists Professor A. R. Clapham and Dr. J. D. Ovington.

The Tsavo National Park, the largest Park in Kenya, is approximately 20,000 square kilometres. As can be seen from the accompanying maps, it is situated to the South East of the country, lying across the main route Mombasa-Nairobi; this road divides it into two unequal portions, West Tsavo (7,500 sq. Km.) and East Tsavo (12,500 sq. Km.). The region is on a vast plain ranging in altitude from 300 to 600 metres, with fairly numerous rocky elevations, of which the most important are the volcanic Yatta plateau and the Ngulia mountains of crystalline and metamorphic rocks. It is crossed by two permanent streams, the Athi and the Tsavo, which unite to form the Galana. There are also two intermittent rivers, the Tiva in the North and the Voi in the South; during the dry season these two are but sandy river beds, in which the elephants dig "wells", which serve as water holes for a large number of animals, from the rhinoceros to the gangas.

The area has a dry and arid climate, the lower portions having an annual rainfall below 250 mm. The soil is generally a rich red interspersed, in the areas with poor drainage, with pockets of black cotton soil. The most widespread vegetation is a tree-savannah with *Commiphora baluensis*, *C. riparia* and *Acacia tortilis*, with here and there a few large trees, mainly *Delonix elata*, *Melia volkensii*, and the Baobab, *Adansonia digitata*. Amongst the smaller trees may be mentioned *Sterculia rhyncocarpa*, *S. africana*, *Lannea alata*, *Platycelyphium voense*, *Boscia* sp. and *Boesnellia hildebrandtii*. Shrubs are represented by *Cordia gharaf*, *Grewia* sp., *Bauhinia taitensis*, *Terminalia*

Fig. 1: **Fine male of Lesser Kudu photographed in West Tsavo by Pierre Ichac, September 1961**

orbicularis, *Premna resinosa* and *Sericocomopsis pallida*. Trees and shrubs cover about a third of the soil surface. Under the trees and bushes *Sansevicra ehrenbergii* is plentiful. The lower vegetation stratum is mainly composed of grasses of the genera: *Chloris*, *Cenchrus*, *Panicum*, *Brachiaria*, *Aristida*, *Eragrostis* and *Tetrapogon;* the soil surface is bare between what remains of their stalks at the end of the dry season. In the cotton soil pockets, however, the grass covering remains decidedly denser.

Numerous Doum palms (*Phoenix redinate*) grow along the river banks (which, judging by the number of young plants, regenerate readily), as also a poplar (*Populus ilicifolia*), whose stands were greatly decimated by the 1961 end-of-the-year floods, and some *Acacia elatior*, *Tamarindus indica*, *Newtonia* and *Ficus*.

The large game includes a considerable series of ungulates and carnivores making this one of the most spectacular regions in Kenya. To give an indication here is the list of the species and the number of individuals of each, as seen on 22nd September, 1963, between 11 a.m. and 3 p.m. along the route Voi-confluence Athi-Tsavo-Mayani Gate-Voi. In a strip ± 200 metres on each side of this 95 kilometre run, I counted 26 elephants, 15 buffalo, 5 giraffe (*G. camelopardalis*) 1 rhinoceros, 13 waterbuck (*K. ellipsiprymnus*), 22 lesser kudu (*Strepsiceros imberbis*), 4 gerenuk (*Lithocranus waleri*)

65 impala (*Aepyceros melampus*) 2 Kongoni (*Alcelaphus cokei*), and one warthog. The two species of greatest interest to the mammalogist are assuredly the Lesser Kudu and the Fringe-eared Beisa (*Oryx beisa callotis*) with its fawn coat and ears fringed with hair. The lesser kudu seems to have social habits similar to those of numerous other African ungulates. Of 21 individuals, seen during a period of 48 hours, five were solitary adults (3 males and 2 females), 8 were females with their young (in groups of two or four) and eight formed a bisexual group (1 fine adult male, 2 juvenile males, four females and a small young). The 12 beisa seen were in one herd. The avian fauna also includes some spectacular species. For instance, the superb Starling (*Cosmopsarus regius*) with a long tail, which I saw as solitary individuals, or in groups of two to four, along the banks of the Galana. With its green head, purplish-blue back, amethyst throat and its under parts a golden yellow it certainly is one of the most beautiful of African birds.

The main ecological interest, however, is centred on the elephant and in the black rhinoceros, which pose a whole series of unsolved problems. When in 1948 the park was proclaimed, this practically uninhabited region was one vast tree-savannah as mentioned above. Unfortunately no attempt was made to estimate the numbers and the density of these two, the largest ungulates, in the Park. For at least a decade nobody seemed to worry about the consequences, to

Fig. 2: **Portion of a herd of 12 *Oryx beisa callotis* (Fringe-eared Beisa)**

(Photo: F. Bourliere)

Fig. 3: **Rhinoceros photographed September 1961 by Pierre Ichac on a salt lick in West Tsavo. It is in anything but a well nourished condition**

the protected area, of too great an increase in the numbers of these pachyderms, each of which needs approximately 150 Kilogrammes of fresh vegetation per day. (See African Wild Life 18 (IV) page 331, and 17 (IV) 325). On the contrary, an implacable campaign was carried out against poachers who killed a couple of dozen per annum. It was not until 1956 that it was noticed that the baobabs, (*Adansonia digitata*) were being damaged. (African Wild Life 14 (2) 143 and 17 (1) 11.). It was during the extreme drought of 1960 and 1961 that the authorities began to be alarmed at the deaths, en masse, of the black rhinoceros, about 300 being found dead during this period: severe malnutrition was the only cause of death which the veterinarians could establish.

The photograph taken in September 1961, by Pierre Ichac, clearly shews how emaciated the animals were by then. Some zoologists, who studied the existing conditions after the Arusha Conference, concluded that the pitiable condition of the rhinos was due to the competition for food with the elephants, which had become superabundant: they proposed that the only sure remedy was to reduce by one third the elephant population. With the co-operation of the Royal Air Force two aerial counts were made, one in June and one in September 1962, not only in the East and the

West sections of the Park, but also in the adjoining regions. These counts gave the following figures:

	June 1962	*September* 1962
West Tsavo	1,394	1,386
East Tsavo	5,431	9,413
Total	6,825	10,799

The large difference in the two totals, based on observations made under excellent visibility and after an interval of only three months, leads obviously to the conclusion that the elephant population of the Tsavo is not a fixed one, but fluctuates largely during the course of the seasons. (See also African Wild Life 15 (1) 75). Not only do the animals become concentrated near the rivers during the dry season, to scatter throughout the park during the rains, but also large migrations of about 5,000 head most certainly took place between June and September between the park zones and the adjoining areas, as can be seen on the two maps (fig. 4 and fig. 5) where each dot represents ten elephants.

These two aerial counts of 1962 give respective densities of 0·34 and 0·54 elephants per square kilometre. These figures are small in comparison with those of other regions in Africa: 1.1 per square Km. in the Aberdare mountains (Holloway); 1.7 per square Km. in the Rwindi-Rutshuru Plains of the Parc National Albert (Bourliere and Verschuren); 1·72 per square Km. in the Queen Elizabeth National Park (Bere); 1.8 per square Km. in the Murchison Falls National Park (Buechner and Dawkins). But it is a high density when one considers the aridity of the Tsavo compared with the above National Parks, and the low annual production of plant material that goes with the aridity.

No complete count had been made in 1963, thus we availed ourselves of the opportunity of making a partial count on the morning of the 22nd September between 8 and 10 a.m. Flying at 300 feet above ground level our Cherokee Piper covered about 300 Km. in a straight line between the following flight points: Voi air strip, P4 air strip along the Banks of the Athi; P. 6 air strip along the Tiva to Aruba Lodge and Voi. This allowed us to form some idea of the extent of the damage done to the vegetation; this damage is most impressive for a dozen or so kilometres on either side of the rivers in East Tsavo (Fig. 6), and somewhat less marked in other parts, even though the fallen trees are easily visible on the vast plain which separates Route P.6 from the Galana River, a plain completely void of game at the time of our visit. In West Tsavo the damage done appears far less important.

Throughout the Park the elephants are easily visible, and their

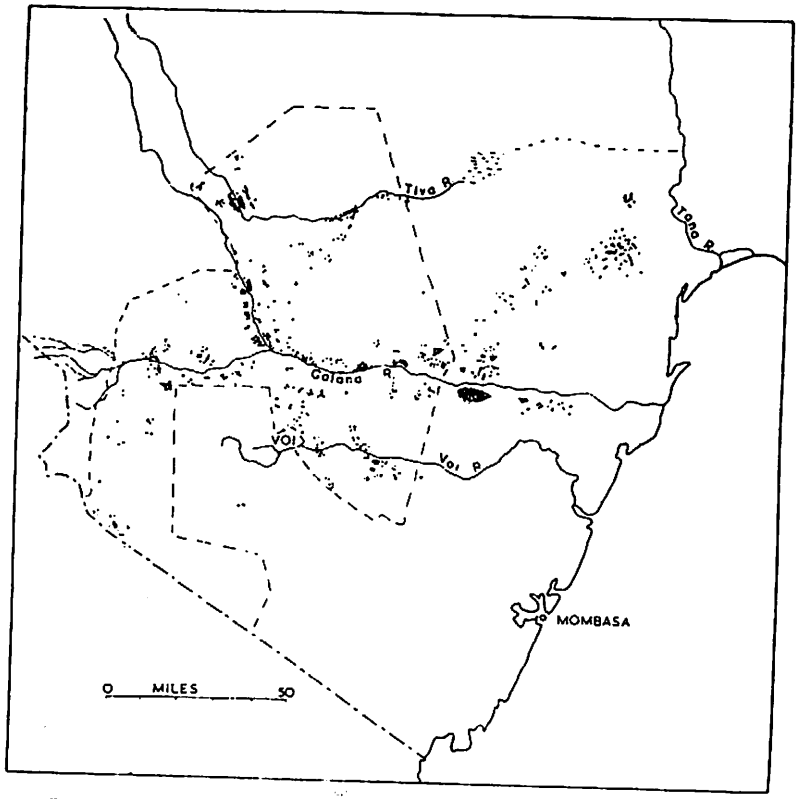

Fig. 4: **Elephant distribution in the Tsavo in June 1962. (The park is outlined with a broken line)**
By J. Glover. (Courtesy of East African Wildlife Journal)

numbers in this relatively open countryside can be estimated with a margin of error of 10%. For other species of game the difficulties are far greater and the counts definitely less accurate. During two hours. in a swathe of ± 1 kilometre on either side of our line of flight we counted 643 elephants, 29 rhinoceros, 170 buffalo and 44 giraffe. It is thus seen that the elephant density had not diminished in comparison with the September 1962 counts. It is interesting to note that the proportion of the year's young amongst the elephants as seen from the aeroplane, and from ground level, during the two trips was in the region of 10%, that is comparable with the percentage calculated for the central section of the Parc National Albert. Among the 29 rhinos seen from the air, there were two groups of 3 head, and eight pairs formed by an adult with young (fig. 7). There once again the birth rate seems to be normal. It is to be noted that the number of rhino seen by us on the ± 600 square kilometre run, is not

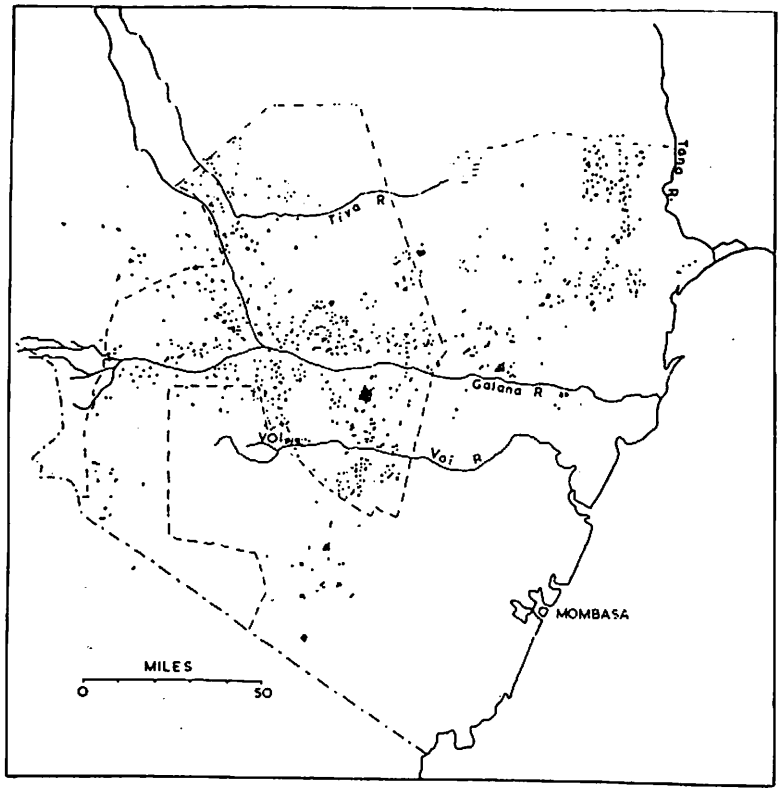

Fig. 5: **Elephant distribution in the Tsavo, September 1962**
By J. Glover (Courtesy of the East African Wildlife Journal)

abnormally low (density of ± 0·05 per square Km.) as was confirmed by an aerial count made after our visit (on the 15th and 18th October 1963) in the richest rhino sector of the park, and which gave a total of 782 *Diceros bicornis* per 5,000 square Km., that is a density of ± 0·15 per square Km. This is not too bad, when one compares this figure with that obtained by Roth and collaborators in the Zambesi Valley during the Kariba "Operation Noah" 0·08 per square Km. The rhino situation in the Tsavo is thus far from being desperate.

The destruction of trees by elephants in the Tsavo is as striking as in the Rwindi-Rutshuru Plains of the Albert Park and in the Murchison Falls National Park. In many places of the east Tsavo, the uprooted tree trunks are strewn over the plain (fig. 8); those trees which are still left standing have their branches broken and the bark stripped; the Sanseviera disappears and the ground becomes completely bare. The trunk, even of the baobabs, is battered with the tusks and eaten by the elephants (fig. 9). From the aeroplane I

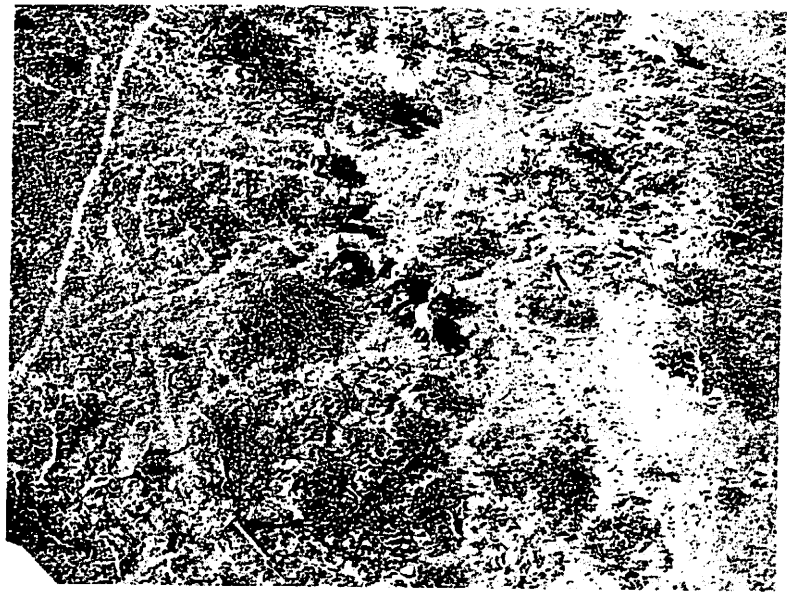

Fig. 6: **A small herd of eleven elephants, seen from a plane at about 100 metres altitude. Note the large number of uprooted trees and numerous criss-cross paths resulting from the repeated passage along them by the elephants**

(Photo: F. Bourliere)

even saw a fine fallen specimen surrounded by a dozen or so elephants which were feeding on it. Frightened by the low-flying Piper circling them, they decamped, but a big male remained to seize a 2 metre piece of wood with his trunk. What is it the elephants are seeking when they chew baobab trunks or sansevieras? Possibly a need for water. The former is always moist to the touch and is made up of up to 76% of water; the latter when compressed may give up to 30% free water. In all events these two plants are particularly sought after during the dry season. It is noteworthy that some trees and shrubs are always avoided by the elephants: for example *Dobera glabra*, *Boscia coriacea*, *Melia volkensii*, *Salvadora persica* and *Platycelyphium voense*, which tend to increase in the ravaged zones. In the course of a few years the tree savannah gradually clears giving way to a grass savannah. As in the Parc Albert and in the Murchison Falls Park the elephants will certainly adapt themselves to the changed vegetation. Buss has shewn that in the Murchison Falls Park 88% of their food is now herbaceous and is not doing them any harm. But the problem undoubtedly is quite a different one for the Black Rhinoceros, a confirmed browser who only eats the leaves and twigs and cannot adapt himself to grazing. If the whole of the

tree savannah of the Tsavo were to change to a herbaceous plain it is quite evident that the black rhinoceros would disappear.

The question has been asked whether the elephants destroy the trees, here as elsewhere, merely for the sake of the leaves? Ten thousand elephants need about 1,500 metric tons of vegetable matter per day. It is quite probable that a sub-arid habitat, such as obtains in the Tsavo, cannot stand the daily removal of so much vegetation. But it is also manifest that the elephant has a marked predilection for the bark of trees. P. Napier Bax and D. L. W. Sheldrick had the curiosity to analyse their food and were surprised to find that most of the barks commonly sought after were poor in proteins but very rich in calcium (from 3·04 to 5·68%), as also the two preferred herbs *Commelina benghalensis* (7·11%) and *Indigofera schimperi* (4·42%). The grasses on the other hand are rich in proteins (at least when still fresh and green) and poor in calcium, the percentage never exceeding 0·18 to 0·33. Hence Napier Bax and Sheldrick conclude that the main reason for the "bark-stripping" is the search for an indispensable trace element, which other ungulates obtain by eating earth. It is an interesting hypothesis and deserves to be followed-up experimentally.

Under the present circumstances and bearing in mind the paucity of exact scientific facts at our disposal to help us to come to a decision, what practical measures can be suggested for putting a stop to the damage being done to the tree savannah by the elephants in the Tsavo?

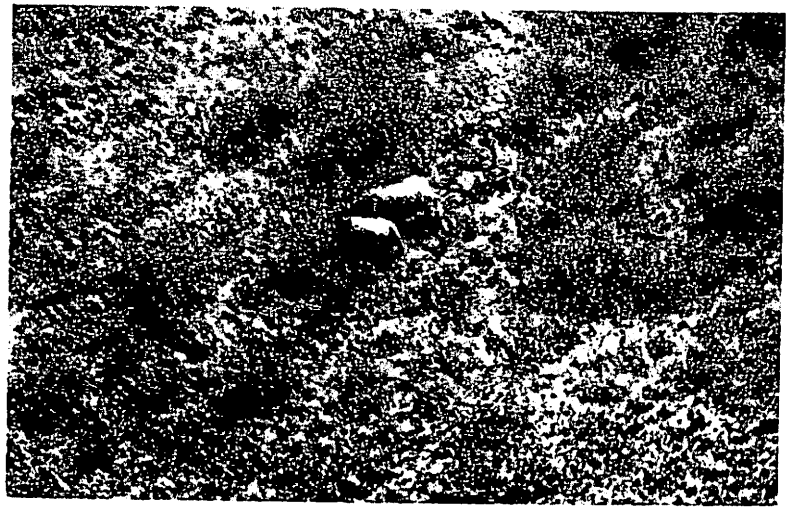

Fig. 7: **Two rhinos (in all probability one female and an older juvenile) as seen from an altitude of about 100 metres above the Yatta plateau**

(Photo: F. Bourliere)

Fig. 8: **Typical of the savannah between Voi and the Galana River**
(Photo: F. Bourliere)

To carry out the plan of mass destruction as advocated in 1961 does not seem possible at present. Technically it would be difficult to kill off 3,000 elephants in one year in a National Park, and psychologically a very delicate matter. The native populations in the adjoining districts certainly would not understand why they were so severly punished but a few years ago for poaching a couple of dozen elephants. If this were done conservation to them would be synonymous with conservatism and colonialism. One can hazard a guess as to the logical conclusions at which they would arrive. What is more, this mass slaughter would not solve the problem. For here, as in the other National Parks already mentioned, the high density of elephants is due not only to the natural increase of the resident population but also to the immigration from the surrounding areas. Every national Park situated in the middle of areas, which are professionally being put under cultivation, automatically becomes the centre of attraction for all the disturbed animals, and is exposed to the risk of overpopulation. Thus the most urgent need is to halt this immigration. This cannot be achieved without creating a "Sanitary cordon" around the park, where all elephants, whether coming from outside the Park or leaving the Park, would be killed. Thus all increase by immigration into the Park would cease and a portion of the excess of "local residents" would be eliminated.

Secondly where there are still intact areas of the preferred habitat of the rhinoceros some could be set aside as rhino preserves from which all elephants could be excluded. Enclosures of about 100 square kilometres could easily be "camped off" by trenches 2 metres wide by 2 metres deep.

Experience in the Aberdares National Park has shewn that these trenches form a physical barrier, as also an effective psychological one for *Loxodonta africana*. That such trenches can be made in a short while, with modern earth-moving equipment, was demonstrated by engineers who laid a pipe line, in record time, leading water from the Mzima Springs in the Tsavo to Mombasa. Those elephants which would be left in the rhino preserves after delimitation could be removed with the aid of tranquilizers or they could be shot out.

The provision of artificial "salt licks" could also be tried out to test the calcium deficiency hypothesis, easily assimilable calcium salts could be added to the usual salt licks.

These measures, however, could only be emergency palliatives. Not only should regular counts of the large ungulates be done at least twice per annum, but also studies of the plant life and plant succession should be undertaken and the natural primary productivity of the various types of vegetation should be studied, to give an objective indication of the maximum carrying capacity of the habitat. When we know exactly how much vegetation, and in what form, the Tsavo can produce annually, then it will be a simple matter to calculate the optimum density permissable of the principal ungulates, without risking deterioration of the food supply. Only then will it be possible to fix the density ceiling which may not be exceeded for each species. To act otherwise would be trivial; for the management of a habitat can only be done as a result of an expert quantitative ecological study.

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