Human Health Problems Associated with the Okavango Delta

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I had the pleasure of living in Maun from June 1972 to July 1974, and travelled extensively in and around the Delta during that time. I have visited the area on several occasions since moving to Gaborone. During my stay in Maun, I was also able to research health records before 1972 and some of these facts are presented later.

The Okavango Delta has health problems unique to itself when we compare the area with the rest of the country. Trypanosomiasis (sleeping sickness) is only found in the Delta region, whilst Malaria is particularly bad in the area; most of the country's few Leprosy cases are found there. The relevant isolation of the area helped to prevent the spread of Smallpox to the Delta during the 1972-73 epidemic in the country — transmission reached Makalakalawe and no further. The extensive wildlife in the area poses a constant threat of injury to travellers and injuries from hippopotami and crocodiles are only found there (other than in Chobe district). Cases of drowning are commonest in this part of the country. Bilharzia has been recognised as a problem in recent times.

HEALTH FACILITIES: The area is served by a hospital at Maun with 140 beds; clinics at Maun village, Sehitwa, Gomare, Etsha, Shakawe and Seronga, with a small maternity unit at Gomare opened this year. There are also a series of health posts in the area — these are health units without permanent health staff, other than a Family Welfare Educator (who receives three months' training and works with families as health motivator); health posts are visited at regular intervals by staff from Maun or the nearest clinic. Health posts are found at Seepoa, Nokaneng, Qasiwa, Tsau, Toteng, Makalakalawe and Sherobe.

HEALTH STAFF: There are three doctors in the area; two at Maun Hospital and one Regional Medical Officer who visits all health units outside Maun. The Matron at Maun Hospital is assisted by a Sister, Staff Nurses, Enrolled Nurses, Dispensers, Health Assistants and General Duty Assistants.

Clinics are staffed by Staff Nurses or Health Assistants, together with one or more Family Welfare Educators.

A regional health team is based at Maun consisting of Medical Officer, Public Health Nurse, Health Inspector and supporting staff.

Special teams are based at Maun for (1) Malaria control, (2) Plague surveillance and (3) Trypanosomiasis surveillance.

HEALTH TRANSPORT: Several vehicles are available for the different health work carried out in the area, ranging from four-wheel drive, five-ton trucks to Land Rovers and Ford 250s. A boat and outboard motor engines are available for travel into the Delta.

HEALTH SERVICES: These services are carried out by a combination of Government (Hospital, Regional Health Team and special teams), Council (clinics and health posts), Mission (Sehitwa Clinic) and private (weekly plane service by Mine Labour Organisation, Venela, Maun to Shakawe, taking medical officer and nurse). The Red Cross have an active unit in Maun.
HEALTH PROBLEMS

Malaria

This disease is the worst problem in the area, the incidence in the Delta being the highest in the country, and poses a particular threat to all persons living or working in the Delta. The disease tends to be worst in the northern parts and is particularly bad in the area of Serumga on the eastern side of the Delta.

The responsible parasite is Plasmodium falciparum, causing malignant tertian malaria, the most dangerous form of the disease in that it can cause cerebral malaria, but, conversely, is easily cured in the early stages and does not relapse after proper treatment. A recent survey showed that about 2% of malaria cases were due to another parasite, Plasmodium malariae. Plasmodium ovale and Plasmodium vivax are not found in this country.

The vector of the parasite is the efficient Anopheles mosquito (Anopheles gambiae), found throughout Africa. A second vector is found less commonly in the area, but is present particularly in the Serumga area — Anopheles funestus. Several other Anopheles species are known in the area, but are not proven to be vectors of the Malaria parasite.

Transmission of malaria is associated with the intense mosquito activity which occurs during the rainy season from December to May; the peak of transmission is found during the months of March and April. Malaria is easily prevented by taking the prophylactic drug chloroquine; one tablet twice a week for adults, with correspondingly lower doses for children. The drug Daparin is not recommended, as its preventive action is not as efficient as that of chloroquine. Paludrine is even less efficient as a prophylactic, and should not be used.

MALARIAN CONTROL: This is carried out by special teams working under the direction of the regional health team. The teams, three in number, carry out spraying of all buildings with DDT insecticide. In recent tests, DDT was found to be an efficient killer of the target: Anopheles mosquitoes. The timing of the spray operations has recently been refined, so that maximum effort is put into the work in the months October to December, prior to the transmission season. The insecticide (after application) has a lethal action for from four to six months. The spray cycle is now carried out once a year only, in the months indicated above. A recent review of the required logistics was carried out, and the operation is now a lot more efficient than in past years. Some larviciding is carried out in a few places, such as Maun, as an adjunct to the spraying of buildings.

Presumptive treatment of fever cases is now carried out at all health units in the Delta. It is also carried out by certain other individuals, eg. teachers, under the general supervision of the regional health team. Blood slides are taken from suspect cases whenever possible and are examined at the laboratory in Maun, and sometimes in the field.

Control work has been considerably improved, following advice given during two visits by an inter-country malaria consultant team of the World Health Organisation, which is based in Tanzania. The team of four (Malariologists, Enomologist, Technical Officer Laboratory and Technical Officer Operations) visited Botswana in January/February 1974 and September/October 1975. They carried out extensive surveys of the disease, both in the human and mosquito, reviewed the control activities then in use and held training courses for all grades of health workers. A report was submitted to Government following both visits, and their recommendations have helped to improve the efficiency of the control work now carried out.

Some recent statistics on the disease are presented below:

<table>
<thead>
<tr>
<th>Place</th>
<th>Number of blood slides examined</th>
<th>Number of slides with malaria parasites</th>
<th>Crude parasite rate (%)</th>
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</thead>
<tbody>
<tr>
<td>Serumga</td>
<td>55</td>
<td>71</td>
<td>74.7</td>
</tr>
<tr>
<td>Sepopa</td>
<td>120</td>
<td>68</td>
<td>57.5</td>
</tr>
<tr>
<td>Nokaneng</td>
<td>100</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>Tsetse</td>
<td>100</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Matlapaneng</td>
<td>80</td>
<td>25</td>
<td>30.9</td>
</tr>
<tr>
<td>Ngamiland</td>
<td>496</td>
<td>216</td>
<td>43.5</td>
</tr>
</tbody>
</table>

Tuberculosis

This is a considerable problem in the area, as it is in the rest of the country. One large building at the hospital in Maun is devoted to Tuberculosis alone, a disease which is preventable by BCG vaccination.

BCG vaccination started in the area during 1973, when 5,046 children below the age of 15 were vaccinated, and continued in 1974 with 6,224 vaccinations, 1975, with 6,499 vaccinations, and by the end of April 1976, a further 729 children had been vaccinated. It is estimated that around 75% of children below the age of 15 have now been protected against the disease. This will be a continuous programme, vaccinating all newborn children, as from 1977, revaccinating children at school-entry age (6 years of age).

The number of newly-diagnosed Tuberculosis cases has now fallen for the past three years from the peak in 1972 when 225 cases were notified. There were 212 cases in 1973, 178 cases in 1974 and 148 cases in 1975 — a 34% reduction in three years. Only 25 new cases have been notified in the first quarter of this year, indicating a further substantial fall in 1976.

The area was involved in the National Tuberculosis Programme since its inception on 1st January 1975. The programme co-ordinates all activities in the country concerning the disease and aims to:

1. Prevent the disease through BCG vaccination of all children.
2. Find new cases of the disease and treat them.
3. Examine contacts of new cases for other cases of the disease.
4. Trace and treat those cases which commence treatment but stop before the 16-month course is completed — around 40% of newly-diagnosed patients.

The outlook is fairly optimistic.

Bilharziasis

As recently as 1973, it was thought that the area was free of infection from bilharziasis, even though the snails which are involved in the transmission of the disease have been known to be present for some years.

During 1975, cases were confirmed in expatriate workers in Maun and in secondary school children.

Since that time, an increasing number of people have been confirmed as being
infected with Bilharzia manom (the majority of infections) or Bilharzia lumatobum (the minority of infections).

In 1975, 233 new cases were confirmed, of which 226 were *B. manom* and seven *B. lumatobum*. 164 persons presented themselves for diagnosis, while 69 were found by surveys. 130 infections were found in females and 103 in males.

The cases are all from Maun village or areas adjacent to Maun. No cases have been discovered outside the area of Maun, though the search will continue for other areas which could possibly be involved.

The life cycle of the Bilharzia parasite is closely linked with water and human contamination by that water. The parasites' eggs are voided in stool or urine. If the eggs come into contact with water, they hatch, releasing Miracidiae. These are mobile and seek out the small snails which are involved in the life cycle of the disease — *Biomphalaria* and *Bulinus* species.

After some days, Cercariae are released from the snails. These are mobile and seek out humans when they enter water and penetrate intact skin, travel to the blood-vessels of the pelvis, and eventually produce eggs to complete the cycle.

The Ministry of Health is looking into the problem of the disease throughout the country, including the Delta, and hopes to introduce appropriate control methods fairly soon. Control is achieved by the treatment of infected humans, killing snails with a molluscicide, and preventing, as far as possible, the entry of humans into water, including contamination of water by human waste.

Trypanosomiasis (sleeping sickness)

This disease is only found in the Okavango Delta; no other area of the country is involved.

The minute blood parasite, *Trypanosoma rhodesiense*, is transmitted to man by the bite of an infected tsetse fly. There are several known species of tsetse fly, but only *Glossina morbax* is found in the Okavango Delta.

Maun Hospital is the base for two technicians who examine blood-samples from suspected cases, treat the cases under the supervision of the medical officer and survey people living in tsetse-fly-infested areas.

There has been a decline in diagnosed cases in recent years from the peak of 272 in 1971. There were 55 cases in 1972, 57 in 1973, 42 in 1974 and only 12 in 1975. Seven cases were reported in the first quarter of this year.

The large majority of cases present themselves at a health unit when ill. Few are found by survey methods. In 1974, 11 cases were found from 2,346 people surveyed (blood-samples) and in 1975, no cases from 2,826 people surveyed were found.

Treatment is always given in hospital and in 1975 11 cases were cured and one died due to presentation at a late stage of the disease.

Control of the tsetse fly is the responsibility of the Tsetse Fly Control Unit of the Veterinary Department. They are now involved in aerial-spraying trials, using the insecticide Endosulpham. The fall-off in human cases of the disease seems to be linked with these trials, which have covered some large tracts of infected country, and is the only major epidemiological factor to change in recent times. The man-fly contact is probably not as intense as in 1971, when the population around the Delta entered the interior of the Delta to a greater extent than the usual seeking of food and water during the drought.

Leprosy

This is a relatively minor problem in the Delta region, as there are few new cases confirmed annually. However, of the known cases of the disease in the country, about 95% are found in Ngamiland.

A search through hospital records back to the early 1960s, revealed around 140 cases of proven leprosy, many of which are now cured.

There were 19 in-patients recorded in 1973 and 17 in 1974.

Questioning of where the new cases had caught their disease revealed that many had known leper cases in Angola or Capriv, and that the Ngamiland cases were a southerly extension from those areas associated with population movements at various times.

Wild animal injuries

Surprisingly few persons sustain wild animal injuries each year, in spite of the abundance of wildlife in the Delta.

In 1975 there were about a dozen cases reported. Buffalo attacks were the commonest and most severe, crocodiles bit three persons and various other animals completed the total. There were no injuries reported that year from lions or elephants.

There were nine snakebite injuries seen at Maun Hospital, of which the worst was a girl whose arm was gangrenous on admission, but was successfully amputated.

Drowning

The Delta poses a constant threat of death through drowning with each year some persons succumbing, though the number is never more than around 10.

People drown easier in the fast-flowing rivers of the northern Delta, but also succumb in the quieter Thamalakane River in Maun.

Water-borne bacterial diseases

There are not a particular problem in the Delta. Cholera is not present in Botswana, although plans are ready to deal with this disease should it ever occur. It is present, for example, in Rhodesia.

Typhoid fever is no particular problem in the country, with only a few sporadic cases annually.

Gastro-enteritis is a problem, particularly in children, as it is in many parts of the country. This should decrease with improvements to water supplies, as with the piped and treated supply to Maun village.

Plague

This used to be endemic in Ngamiland, but has been absent for nearly years now. However, the disease has a habit of recurring, even after an absence of years. A surveillance team is based in Maun whose job it is to look for evidence of recurrence of the disease. The team is able to deal with an outbreak should it ever occur.

SUMMARY

The Delta poses special health problems, amongst which malaria is particularly severe. Trypanosomiasis is only found in the Delta, though numbers of new cases annually are fairly small. Bilharziases is being increasingly recognised as a problem in Maun village and is certainly on the increase. Tuberculosis, which causes considerable morbidity and some mortality, is now on the decline and the outlook for its control in the area is good. The country's Leprosy cases are nearly all found in Ngamiland, though numbers of new cases per annum are small. Wild animal injuries
and death by drowning are a constant threat in the Delta, though the number of persons affected annually is small. Plague was present in the Delta some years ago, and a team continues surveillance activities for possible recurrence of the problem.

It might sound as though the Delta is an unhealthy place to live in or visit, but this cannot be said to be true, and many of the problems mentioned are easily prevented. Malaria can easily be prevented by taking a prophylactic, bilharziasis by keeping out of water, tuberculosis by BCG vaccination, these bugs can be minimised by simple precautions (adequate clothing, insect repellents, vehicle-screening and insecticides) and a blood-sline taken if ill, will reveal the parasites at an early stage when simple treatment can easily effect a cure.

The Delta is a fascinating part of the country, and none should be put off from a visit there because of health reasons, providing the simple precautionary measures mentioned above are followed.

### SLIDES EXAMINED AT MAUN HOSPITAL LABORATORY — 1974
*(From suspect in-patient and in-patient cases)*

<table>
<thead>
<tr>
<th>Months</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
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<tr>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Number examined</td>
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<td>525</td>
<td>628</td>
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<td>30</td>
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<td>7</td>
<td>7</td>
<td>3</td>
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</tbody>
</table>

### General Discussion

Dr. von Richter pointed out that Mr. Fleming's paper exposed many areas where present knowledge was seriously deficient, particularly in the field of mammal conservation, illegal local hunting, etc. Mr. Biggs pointed out that wildlife hunting is a major revenue-earner, and was assured by Mr. Fleming that this had been included in the proposals for an overall wildlife conservation programme. Mr. Matenge stated that so long as wildlife hunting proved profitable, it was likely to continue.

Dr. Worthington discussed the possibilities of cropping wildlife and asked whether meat of crocodiles could not be eaten, as well as the meat sold. He pointed out that Mr. Graham's paper was the first really worked-out proposal suggested for future utilisation of the Delta. Mr. Graham and Mr. Campbell pointed out that the meat was not eaten, except by the Hambukushu, but that all crocodile products can be utilised in one way or another, and that roe was not necessarily confined to the skin. Mr. Okello asked if the crocodile-cropping plan was a model for other fauna-cropping programmes, and Mr. Graham replied that there would be three models worked out for different species by the time his research was completed.

There was considerable discussion on wildlife utilisation. Mr. Fleming stated that wildlife had been worth P375m in 1974, and that this figure would rise. Much of the value originated in Botswana. Dr. von Richter stressed the need to take wildlife into account when planning future land-use, and Mr. Graham pointed out that if a high return from wildlife is expected from the Okavango, then the whole Delta environment must be maintained. He stressed that the Delta is primarily a source of water and that plants and animals are secondary. Knowledge about these is now forthcoming and it is apparent that heavy investment in development of the Delta will not be reaped through the latter. In addition, large settlement in the Delta is impossible, and this should be planned for the perceived, together with cattle-ranching and crop-raising. Livestock and agriculture are two obvious industries which should be developed, but their development should be confined to their present locations and should not be allowed to encroach into the Delta, as this would most certainly be to the detriment of wildlife. He felt that the mixing of buffalo and other wildlife would be most unwise until more is known about the transmission of foot and mouth disease.

Mr. Vet asked about the possibilities of game farming in the Delta, and Mr. Graham replied that inherent in game farming is private utilisation of land, fencing and human settlement. Because land is privately owned, immediate problems would be created and he felt that game ranching is not a practical preposition at this stage. A discussion then developed on the merits of wildlife utilisation in an area, and its benefit to the local person. It was felt that few people could benefit under the present system, since safari hunting companies were owned by expatriates. Mr. Graham pointed out that in certain instances it was best for Government to manage a resource, since it is difficult for individuals to do this. Government could then collect the revenue that comes through direct taxation on companies and licences and distribute it, so that it benefited a maximum number of people.

Mr. Podhrepa asked why much better facilities were not put into tourism areas, and Mr. Campbell replied that such facilities might well destroy the wilderness, which is what people are paying to see in Botswana.

Dr. Locke pointed out that whatever is done with the Delta, there is bound to be far more human contact and that this must aggravate the disease problem. Bilharzia was first reported in Nyasaland as recently as 1963. Low floods have a probable relationship with the steady increase in incidences of bilharzia. By 1974 quite a high
proportion of the Maasai population was suffering from the disease. A discussion on the Salvinia problem ensued, and Mr Ernest showed, by using a model on the blackboard, what is likely to happen if Salvinia should penetrate into the Delta. He postulated a probable water gain in the upper reaches, particularly so far as open water areas are concerned.

Mr Campbell explained that presently tourism is confined to a very few good areas, such as the Chobe River, the Savuti and the Moremi Wildlife Reserve. It is also confined to a very short season. If the season could be extended, this would make investment by private enterprise much more attractive. This could be done by utilising other areas, such as Nxai Pan, the Makgadikgadi and the northern Central Kalahari Game Reserve, which are good during the off-season. He also suggested that more use should be made of attractions that do not depend on wildlife, such as the Tsodilo Hills; the caves at Gwihaba; and boating on the Okavango River. This would not only expand the season and put less pressure on the present attractions, but would also expand the range of attractions. Mr Matenge agreed that tourism should be expanded beyond the Delta, but also pointed out that the Department of Wildlife and Tourism has a limited commitment towards tourism, and that it is involved with the conservation of wildlife and control of humans rather than the setting-up of an infrastructure for the development of tourism.

The Bangweulu Basin of Zambia

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Introduction

The Bangweulu Basin is one of the major wetland areas of central Africa, being comparable in extent to the Okavango Delta.

The object of this paper is to present a general outline of the Bangweulu Basin, in order that its broad features may be compared with other wetland areas. The information is drawn from a survey conducted between 1969 and 1973, which was centred on the ecology of the black lechwe antelope (Grimsdell and Bell, 1973).

Description of the area (see Map 1)

Structure and Geology

The Bangweulu Basin is situated at the centre of an ancient stable land surface, or cratonic platform, and has experienced little structural disturbance for about 2,200 million years (Vail, 1968). This cratonic platform (the Bangweulu craton) is surrounded on three sides by rift valleys and associated areas of relatively recent geological activity; pressures from this activity have subsequently affected the surface of the craton. Lake Bangweulu itself has been formed by local subsidence of the end-tertiary (20 million years ago) (Davies, 1943). Observations suggest that the down-warping that caused the lake may have continued until very recently, causing a slight tilting of the basin towards the north-west, and, in turn, causing the lake and river systems to migrate in that direction. Tilting of the basin floor will be mentioned below in connection with changes in hydrology.

Topography and soils

The Bangweulu Basin features as a shallow depression in the generally subdued topography of the craton. The basin floor has been filled with alluvium to form an extensive and intricate wetland system, which is roughly circular with a diameter of about 160 km and a total area of about 20,000 km².

As a result of its great age and the acidity of much of the parent material, the soils of the craton are exceedingly infertile (Mansfield et al, 1973). However, the soils of the Bangweulu wetlands are fertile, relative to those of the surrounding plateau, as a result of alluvial accumulation, but by normal agricultural standards are still classified as deficient in many respects.

Rainfall and hydrology

The dominant influence in the Bangweulu system is the seasonal flooding regime, prevailing every aspect of the ecology and economics of the area. The catchment covers a large proportion (90,000 km²) of the north Zambian plateau, and the basin is fed by 17 principal rivers; 90% of the total inflow is lost to evapotranspiration, the remaining 10% leaving by the single outlet of the Luapula River, a headwater of the Congo. The water level in the centre of the basin varies seasonally by between 1-2 m, causing the floodplain to advance and recede by as much as 45 km at the periphery.

Mean annual rainfall varies from 1,100 mm to 4,000 mm, with a gradient of increasing rainfall towards Lake Bangweulu. Stepwise, multiple regressions between a number of water level gauges in the basin and rain gauges in the catchment, recorded since 1953, show that the annual flooding pattern at any point in the basin is most
closely related to rainfall at the point or in its immediate catchment, while it is likely that the swamp (see Vegetation) has a storage effect, causing flood levels to be related to previous years' rainfall.

A very important influence on the human and animal ecology of the Bangweulu Basin has been a long-term change in the general water levels in the basin, the most marked of which was a general rise of about two metres between 1936 and 1943. This caused large areas of settlement to be abandoned, and is thought to have contributed to the decline of the wildlife populations (see below).

It has previously been argued that these long-term water changes in Bangweulu are of a cyclic nature (Breiford, 1946). However, examination of all the evidence available suggests that the rise of 1936 was part of a continuous trend in the flow pattern, caused by tectonic tilting of the basin floor towards the north-west.

**Vegetation.**

The vegetation of the Bangweulu Basin falls into clearly-defined zones in relation to the depth and duration of flooding. The principal zones are, working from the edge of the basin:

1. Miombo woodland and dambo drainage:
2. Peripheral grassland (e.g., *Laudiae simplex*):
3. Intermediate grassland (e.g., *Trimea triandra*):
4. Shallow water floodplain (e.g., *Acrocaris maxima*):
5. Deep water floodplain (e.g., *Oryza barthii*):
6. Permanent swamp (e.g., *Cyperus papyrus, Typha capensis* and *Phragmites communis*):
7. River fringes (e.g., *Vetiveria zizanioides*):
8. Open water (e.g., *Nympheas caerulea*):

These zones have been further sub-divided into 15 vegetation types, depending on the principal species of grasses, sedges, herbs, and trees.

Unlike the Okavango Delta, the Bangweulu Basin is dominated by open floodplain and swamp; patches of woodland are infrequent within the floodplain and although a number of islands occur, few have any woodland remaining on them, as the trees have been felled to make way for crops (mainly *cassava*).

**Ternigateria.**

A characteristic feature of the floodplains is the enormous number of terrigertia, ranging in diameter from a few cm to several metres. As many territe species are unable to establish a mound under conditions of annual flooding, most of the terrigertia in the floodplains may, therefore, have been formed when the area was drier than it is now.

**The human population.**

By Zambian rural standards, the population density of the Bangweulu Basin is high; that is, about three times the national rural average. The reason for this is mainly due to the fishing industry (one of the largest in Zambia*), for the area has generally very low agricultural potential. From our own estimates, based on aerial photography of villages to obtain house-count data, the current population using the southern and eastern floodplains is about 22,000.

Although the national population has been increasing at about 3% per year, the rural populations of northern Zambia (including the Bangweulu Basin) have been, and are, declining. This seems to be due to a long-established pattern of migration from rural to urban areas on account of the copper-mining industry, which provides
a lucrative means of employment. However, should the mining industry be reduced or eliminated, we would expect a reversal of this trend leading to increased human pressure on the Bangweulu Basin.

Wildlife populations
The Bangweulu Basin supports a diverse fauna, not unlike that of the Okavango Delta. Over the past 30 years or so, most of the larger mammals have been heavily exploited by man, so that the present populations are generally well below the carrying capacity of the area.

The existing large mammal species, with approximate population estimates, when available, are listed below:

Hippopotamus (rare)
Sitatunga (at least 5000)
Black lechwe (c.30 000 — see below)
RedBACK (common)
Oribi (common)
Tessebe (c.2000)
Roan antelope (scarce)
Eland (scarce)
Lichtenstein’s Hartebeest (scarce)
Sable antelope (scarce)
Zebra (scarce)
Bushbuck (common)
Puku (common; Kasanka N.P.)
Waterbuck (scarce)
Duiker (scarce)
Bushpig (common)
Warthog (scarce)
Rhino (very rare)
Elephant (c.200)
Buffalo (c.400)
Lion (c.20)
Leopard (scarce)
Cheetah (rare)
Hyaena (common)
Wild dog (rare)
Jackal (common)
Otter (common)

The area also contains a rich variety of birds and fish.

The Black Lechwe
This species is the dominant large mammal of the Bangweulu floodplains, and the one for which most information is available. Its ecology and its past and present status have been the subject of a detailed report (Grimsdell and Bell, 1975).

The history of the population may be summarised as follows:

1. 1900-1936: Gradual decline from some large, but unknown number greater than 200 000 as a result of intense hunting pressure.
2. 1936-1945: Draastic reduction in numbers from at least 150 000 to 60-40 000, caused by a general rise in water levels (see above). This reduced the range available and made the copped populations more susceptible to mass hunting techniques.

3. 1945-1969: Continued reduction to about 16 000, as hunting pressure was greater than the maximum sustainable yield of the reduced population.
5. 1972-1973: Population increase of the order of 25% in one year, presumed to be partly due to a relaxation of hunting pressure. Some 25 000 present by October 1973.
6. 1975: Population increased to about 30 000 (J. P. A. Manning, pers. comm.).

At present, therefore, the Black lechwe population is showing good signs of recovery and may again become a major exploitable resource.

Management and land-use
Management plans for the Bangweulu Basin have been formulated and submitted to the Zambian Government. A preliminary outline of this plan is given by Bell and Girdled (1973). Briefly, this proposal recommends the establishment of a special Game Management Area (GMA) to include all the southern floodplains of the Bangweulu Basin, except for permanently-settled areas. The special GMA would permit the following: (a) fishing, as at present; (b) hunting of lechwe and other species according to their numbers and stage of population growth, but would impose restrictions on: (a) settlement; (b) agriculture and land development, and (c) channel-cutting.

For various reasons, the area is not suitable for large-scale agriculture, so that no land-use conflicts are anticipated in this respect. As far as is known, little extra channel-cutting is likely to take place, the effect of which is to alter the hydrology on a local scale. However, a major hydro-electric scheme has been proposed involving two dams on the Luapula River. This would undoubtedly have a considerable impact on the ecology of the Bangweulu wetlands; that is, by raising the water levels as the wetlands would act as a reservoir for the dams. The ecological implications of this scheme have been considered in a recent report (J. P. A. Manning and P. de V. Moss; unpublished report).

As regards hunting of lechwe, we have made recommendations based on sustained yield principles. Various lines of evidence suggest that the present lechwe range could support some 100 000 animals at carrying capacity. Assuming that the maximum sustainable yield (MSY) is 1/2 the carrying capacity population (i.e., 160 000, and that the rate of increase at that level is 14% per year, the MSY is about 11 200 lechwe, yielding some 390 mt of meat annually. This is the MSY given by unselective harvesting; sex-selective harvesting could increase the MSY significantly.

At present, the Black lechwe is a protected species; on paper at least, but if present trends of increase continue, the population could be exploited in the future. The method of doing this is uncertain at this stage, but heavily-capitalised cropping schemes should not be attempted. It may be feasible to issue hunting quotas to local inhabitants, but this has yet to be tested.

Hopefully, the monitoring of the Black lechwe population will be continued, this being essential to the long-term success of sustained yield harvesting. But if the hydro-electric scheme on the Luapula becomes a reality, it will probably have a detrimental effect on the lechwe’s habitat through excessive flooding. This would lower the carrying capacity for lechwe, and in turn, the MSY.

Finally, there are possibilities in the field of safari hunting and tourism, although both these are virtually non-existent at present. Black lechwe may not be shot under licence at present, although the population would be unaffected if a small number of
males were shot each year. As the Black lechwe is a unique trophy, high licence fees could be charged.

The Bangweulu wetlands, like the Okavango Delta, are unusual and attractive, as well as supporting a unique variety of mammals and birds. There is a definite potential for a small tourist industry, catering for the specialist tourist who wishes to escape from the “milk-run” circuits of east and South Africa. Both the Kasanka and Luangwa Valley Parks lie nearby, and so provide additional attractions. Therefore, both safari hunting and tourism could be developed, at the same time providing an extra source of income and employment for the local people.

REFERENCES