

5.10 ZIMBABWE

Introduction

Zimbabwe is a land locked country bounded on the south by South Africa, on the southwest and west by Botswana, on the north by Zambia, and on the northeast and east by Mozambique. It has an area of 390 310 km², a population of 7 532 000 (1982), and lies on the great central plateau of southern Africa. The high rim of the plateau forms the border with Mozambique for some 450 km. To the north and south of which vast gaps have been eroded through it by the Zambezi and Limpopo Rivers, the beds of which constitute the northern and southern boundaries of Zimbabwe. Some 70% of the total land surface is above the 600 m contour, and it is virtually all (more than 99%) above 300 m. The principal physiographic feature of the interior is a broad ridge which runs 650 km from southwest to northeast across the whole country, from Plumtree (20°30'S/27°50'E) through Gweru (19°27'S/29°49'E) to Macheke (18°05'S/31°51'E). About 80 km wide, this ridge ranges in altitude from 1220-1675 m, finally rising to the summit of Inyangani (18°18'S/32°54'E) in the east, 2595 m high on the rim of the plateau. From here, both north and south, the edge of the plateau is mostly above 1500 m, with an outlier in the south, Mt. Binga, rising to 2436 m just inside Mozambique (19°47'S/ 33°03'E). The broad SW-NE ridge across the interior forms the major watershed of the country from where northward flowing rivers are tributary to the Zambezi and southward flowing ones tributary to the Limpopo. The lowest points in Zimbabwe are on the border with Mozambique in the Save and Limpopo valleys. Major faulting from southwest to northeast, some 100-130 million years ago, formed the middle Zambezi Trough, in the north, now partly flooded by Lake Kariba. Other faulting, in both east-west and north-south directions, affected the depressions of the Save (Sabi) and Limpopo Rivers.

Climate

Zimbabwe is entirely tropical, but enjoys a relatively cool climate because of its altitude, although solar radiation is very high, most of the country receiving more than 3200 hours of sunshine per year. Towards the end of the hot dry season from August-October, easterly monsoon winds, that have crossed the Indian Ocean and Mozambique, cause precipitation on the Eastern Highlands. The eastern districts consequently receive the heaviest rainfall, and have a more prolonged rainy season (from October into April) than the rest of the country. Here many of the high peaks receive mean annual falls of over 2000 mm, and large areas on the eastern slopes receive more than 1500 mm of rain each year. A substantial part of the country, comprising the northeastern and central districts, and an isolated patch in the west adjoining Botswana and the Caprivi Strip, perhaps 60% of the total land surface, receives mean annual totals of 800-1000 mm. The west of the country is arid, with mean annual totals of about 600 mm, while parts of the Save and Limpopo River valleys receive less than 400 mm/yr. The altitude of the broad plateau of western Zimbabwe helps to guarantee fine weather with clear skies for most of the

country during the cool, dry months of May-August. July is generally the coolest month, and October the warmest. Harare, the capital, at an altitude of 1500 m, has mean monthly minima and maxima of 6 and 21°C for July, and 15 and 29°C for October, while Bulawayo (1350 m) farther west has comparable figures of 7 and 21°C for July and 15 and 30°C for October. It is warmer in the west, and in the Zambezi Valley, while at low altitudes in the Limpopo Valley, temperatures often exceed 40°C in summer.

Wetlands

The principal drainage systems are those of the Zambezi in the north, the Save in the east and the Limpopo in the south. In the west the small Nata River drains into the Makgadikgadi Pans in Botswana. The mountains of the Eastern Highlands are spectacular, and many streams, rising there in sponges, flow east for short distances before plunging dramatically over escarpments in waterfalls hundreds of metres high. The highlands are deeply dissected by the many streams they spawn, especially those flowing into the Save and Limpopo Rivers. Extensive swamps and floodplains are lacking in Zimbabwe because the river valleys are steep and narrow. A small floodplain area exists in the mid-Zambezi Valley, in the Mana Pools district, where the course of the Zambezi River has slowly been moving northwards. Another floodplain occurs on the Save River upstream of its confluence with the Lundi at the Mozambican border. There are numerous pans in the west of the country, numerous impoundments in the mountains, and Lake Kariba in the north.

Wetland Flora & Fauna

The flora is described for each site individually since they are so different. However, the spectrum of reptiles and mammals utilising the various sites is fairly constant and represents the few resident wetland species and those that live in the surrounding savanna and bush, and which visit the wetland systems regularly, at least during the dry seasons.

The reptiles include the snakes *Ambylodipsas polylepis*, *Amplorhinus multinzaculatus*, *Bitis arietans* (W Pans), *B. gabonica* (E Pans), *Crotaphopeltis hotaniboiea*, *Dromophis lineatus*, *Linznohis bicolor*, *Lycodononzorpus mlanjensis*, *L. rufulus*, *Naja melanoleuca*, *N. mossambica*, *Natriciteres sylvatica*, *Philothamnus hoplogaster*, *P. irregularis*, *Psammophis sibilans* and *Python sebae*, together with the arboreal species *Dasypeltis medici*, *D. scabra*, *Dendroaspis angusticeps* and *Thelotornis oatesi*. *Crocodylus niloticus* and *Varanus niloticus* are widespread and the terrapins *Pelomedusa subrufa* and *Pelosos* spp. are present.

The resident mammals comprise *Aonyx capensis*, *Atilax paludinosus*, *Dasymys incomtus*, *Herpestes ichneumon*, *Felis caracal*, *F. lybica*, *Genetta tigrina*, *Hippopotamus amphibius* and *Redunca arundinunz*. The regular or seasonal visitors include *Acinonyx jubatus*, *Aepyceros melampus*, *Alcelaphus lichtensteini*, *Cephalophus* spp., *Connochaetes taurinus*, *Crocota crocuta*, *Damaliscus lunatus*, *Diceros bicornis*, *Equus burchelli*, *Giraffa camelopardalis* (W Pans), *Hippotragus equinus*, *H. niger*, *Kobus ellipsiprymnus*,

Loxodonta africana, *Lycaon pictus*, *Mellivora capensis*, *Neotragus moschatus*, *N. moschatus livingstonianus*, *Oryx gazella* (W Pans), *Ourebia ourebi*, *Panthera leo*, *P. pardus*, *Phacochoerus aethiopicus*, *Potamochoerus porcus*, *Raphicerus campestris*, *R. melanotis*, *Sylvicapra grimmia*, *Syncerus caffer*, *Taurotragus onyx*, *Tragelaphus angasi*, *T. scriptus* and *T. strepticerus*.

Zimbabwe List of Wetlands Described

1. The Mid-Zambezi Valley and Mana Pools
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1. The Mid-Zambezi Valley and Mana Pools

Country: Zimbabwe

Coordinates: 15°36'-16°24'S/29°8'-30°20'E

Area: c. 36 000 ha (total riverine expansion floodplain)

Altitude: c. 490-510 m asl

Nearest Town: Chirundu

General: Some way after leaving the Kariba Gorge the Zambezi River is joined by the Kafue River near Chirundu, where it is also crossed by the Otto Beit Bridge into Zambia. From here the river broadens and has something of a braided course for almost 130 km to the Mupata Gorge. The many fragmented streams produce between them numerous low lying sandy islands, containing pans and pools, with further pans and pools along the river banks. The lower valley floor is 12 km wide in this region and the multi-channelled river bed may account for up to 5 km of this, as for example at Nyamatusi Islands (15°40'S/29°29'E), to the northeast of Mana Pools. Much of the flat valley floor, and some shallow river terraces along its margins, used to be inundated when the river was in high flood, but now that discharges are regulated at Kariba this no longer happens; the river now does little more than spread over its broad bed to unite all its channels and inundate most of the midstream islands and the fringes along its banks. However, several small tributaries flow down through swampy land to the Zambezi in the Mana Pools region. From west to east these are the Nyamuchera, Chiruwa, Mbera and Sapi, and if floods in these coincide with major discharges from Kariba substantial areas along the south bank of the Zambezi may be inundated. The Mana Pools proper, are small permanent pools that mark depressions in former river channels which were abandoned

as the main flow moved progressively northwards, towards the Zambian bank. The pools have flat, grass and reed covered banks, and are approached quite closely by surrounding forest. Some of the pools are higher than others, being situated along the southern bank on shallow river terraces; the two largest and best known depressions in the Mana region are Long Pool and Chine Pool. These are situated just above the channel bed of the river. When flow is low, much of the river bed is dry, save for several deep channels, and the area is characterised by numerous sand and pebble banks, one of which in the Mana region has an area of 6000 ha.

Hydrology: The main pools are permanent, deriving their supplies principally from precipitation and ground water seepage, and only occasionally from flooding. The area of the Mana Pools per se is but a fraction, say 3%, of the total area that the Zambezi once used to flood in this region, perhaps amounting to a few hundred ha of open water and equivalent areas of adjacent swamp.

Flora & Fauna: The area has a particularly rich riparian flora, all species of which show some degree of flood tolerance. A clear pattern of succession can be followed on the sandy islands of the river bed, modified on the higher ones as more terrestrial species come in. *Phragmites mauritianus* and various sedges colonise backwaters, the margins of pools and bends away from the current, producing extensive reed banks. *Phoenix reclinata* often grows behind these, and there may be small patches of *Cyperus papyrus* in backwaters. Sand binders, *stoloniferous grasses*, sedges and *Convolvulaceae*, grow on the alluvial islands and pebble spits, eventually providing conditions suitable for the germination of woody species, such as *Acacia albida* and *A. erubescens*. Thereafter seedling thickets of these trees help bind the new, sandy deposits. The floras of the islands are less diverse than those of the outer river banks over this stretch above Mupata Gorge, but the larger islands may support as many as 20 arborescent species. *Commiphora ugogensis*, *Kigelia africana*, *Terminalia sericea* and *Trichelia emetica* are common on the larger ones. Other trees sometimes found on the islands, but common in the riverine forest, include *Acacia galpinii*, *A. nigrescens*, *Balanites maughamii*, *Berchemia discolor*, *Cassine aethiopia*, *Combretum zeyheri*, *Cordyla africana*, *Diospyros mespiliformis*, *Fagara leprieurii*, *Garcinia livingstonei*, *Lannea stuhlmannii*, *Lecaniodiscus fraxinifolius*, *Lonchocarpus capassa*, *Olea africana*, *Schrebera trichoclada*, *Syzygium cordatum*, *S. guineense*, *Tamarindus indica*, *Terminalia prunioides*, and the woody climbers *Acacia schweinfurthii*, *Artobotrys brachypetalus*, *Capparis sepiaria*, *Dalbergia martinii* and *Rhoicissus revoilii*. Some trees, e.g. *Berchemia discolor*, attain heights of 30 m in riverine woodland. A few species are virtually confined to the riverine woodland and are seldom found elsewhere in Zimbabwe and thus deserve special mention. These are *Cassine schlechterana*, *Cassipourea gossweileri*, *Ficus zambesiaca*, *Strophanthus courtmontii* and *Triplochiton zambesiacus*. This last species is endemic to the Zambezi Valley. Other trees, like *Combretum imberbe*, are most common along the dry streambeds of small tributaries.

Dense low riverine scrub occurs on the islands and river banks, beneath the frontal forest trees, and in tumbled rock and boulder clumps in the river. It contains such species as *Allophyllys africanus*, *Bauhinia tomentosa*, *Bridelia cathartica*, *Byrsocarpus orientalis*,

Cadaba kirkii, *Canthium frangula*, *Cleistochlamys kirkii*, *Combretum albopunctatum*, *C. mossambicense*, *C. paniculatum*, *Cordia goetzei*, *C. pilosissima*, *C. sinensis*, *Croton megalobotrys*, *Deinbollia xanthocarpa*, *Diospyros quiloensis*, *D. senensis*, *D. squarrosa*, *Dombeya kirkii*, *Ehretia anioena*, *Euclea divinorum*, *Excoecaria bussei*, *Feretia aeruginescens*, *Friesodielsia obovata*, *Gardenia resiniflua*, *Grewia bicolor*, *G. flavescens*, *G. gracillima*, *G. pachycalyx*, *Hippocratea parvifolia*, *Holarrhena pubescens*, *Holmskioldia tettensis*, *Hugonia orientalis*, *Iboza riparia*, *Markharnia acurninata*, *Maytenus senegalensis*, *Nuxia oppositifolia*, *Ochna rovomensis*, *Oncoba spinosa*, *Phyllanthus reticulatus*, *Phoenix reclinata*, *Pouzolzia hypoleuca*, *Premna senensis*, *Pteleopsis myrtifolia*, *Rhus gueinzei*, *R. tenuinervis*, *Salvadora persica*, *Sesbania sesban*, *Strychnos madagascariensis*, *S. potatorum*, *S. spinosa*, *Tarenna luteola*, *Tricalysia allenii*, *Vernonia amygdalina*, *V. colorata*, *Ziziphus abyssinica* and *Z. pubescens*. All the foregoing species may be found in sites subject to seasonal flooding.

About 40 species of fish are found in the area including *Distichodus mossambicus*, *D. scheuga*, *Heterobranchus longifilis*, *Hydrocynus vittatus*, *Protopterus annectens* and *Tilapia* spp. The sand banks and spits of the middle Zambezi provide ideal habitats and breeding sites for *Crocodylus niloticus* and there are thought to be over 1000 adult crocodiles on the Zimbabwean side of the valley in the vicinity of Mana Pools. Several species of aquatic or semi-aquatic snakes present in the riverine vegetation as listed in the introduction.

Over 380 species of birds have been recorded in the area including *Agapornis lilianae*, *Circaetus cinerascens*, *Erythrocerus livingstonei*, *Glareola nuchalis* and *Nicator gularis*. *Merops nubicus* breeds in holes in the sand islands and river banks in large numbers. A wide range of mammals visits the wetland area; especially towards the end of the dry season when other watering places have dried out. An account of the seasonal patterns of large mammal distribution in the area is given by Jarman (1972), and the species concerned are listed in the introduction.

Human Impact & Utilisation: The area is not conducive to permanent human habitation on account of the wide spectrum of tropical diseases such as sleeping sickness, bilharzia, malaria and onchocerciasis. The natural flood regime of the valley has been seriously altered since the completion of the Kariba Dam in 1958. A potential threat lies in the proposed hydroelectric scheme at Mupata Gorge, where the Zambezi crosses the 500 m contour line. The lake so formed would obliterate a further 85 000 ha of the Zambezi Valley and would halve the area of the Mana Pools proper. Du Toit (1982) has published a preliminary assessment of the environmental impact of the proposed scheme.

Current problems in the area include the poaching of fish and the destruction of habitats by elephants. The Mana Pools National Park is only partially developed as a tourist centre, but it is popular and the available facilities are prone to saturation, although the number of cars allowed into the park at any one time is limited. There is a tourist camp at Chekwenya on the confluence of the Sapi and Zambezi Rivers, but there are no tarred roads and numbers of visitors are strictly limited. The Sapi and Chewore Safari Areas are subdivided into various hunting concessions which are allocated to hunters on a tender

system. Many of the hunters who submit tenders each year are commercial safari operators who use the concessions for hunting by foreign clients.

Conservation Status: Almost all the riverine floodplain and riparian forest is included in the Mana Pools National Park or adjacent safari areas. The park was established in 1963. The adjacent safari areas of Chewore, Urungwe, Sapi and Doma have extensive frontages along the Zambezi River, and hunting in Chewore has been licensed since 1930. The whole area has been submitted for recognition as a World Heritage Area.

2. Wetlands of the Save River System

Country: Zimbabwe

General: Chipinda Pools (22°15'S/31°50'E) is the name given to a cluster of large perennial pools in the bed of the Lundi (Runde) River. The flow regime of this stream has been seriously affected by increased siltation and by impoundments on its major tributaries, and the river no longer overtops its banks in this region. Chipinda Pools are situated in the northern half of the Gonarezhou National Park and lie more than half way down the eastern escarpment, under the rainy upper slopes of the Eastern Highlands and below Chirowandoma (Chivilila) Falls, the foot of which is almost on the 500 m contour. At the foot of the falls the Lundi debouches onto gently undulating country across which it flows for 50 km, descending into a broad valley some 450-350 m asl. Chipinda Pools lie on the river bed here c. 400 m asl, and are visible only in the dry season. Numerous small depressions occur in the open woodlands far from the river, apparently being filled by direct precipitation and local surface drainage in most years. Some of these are surrounded by narrow *Cynodon dactylon* lawns.

Below Chipinda the Lundi flows quietly for a further 75 km northeast to its confluence with the Save River on the border with Mozambique near the town of Mavue (21°22'S/32°24'E). Immediately prior to the confluence, there is another wetland, as during the rainy season the flood waters of the two rivers mingle over the triangular piece of land between them, inundating between 3000-4000 ha. This land is known as Tamboharta Pan, although it is more properly a floodplain with several incorporated pans. The confluence of the Lundi and Save Rivers occurs at the lowest point in Zimbabwe. Bilharzia and malaria are rife in the area.

Flora & Fauna: Areas of dense forest occur along the Lundi River, in which trees and shrubs characteristic of hot, low altitude swamp or riparian forest are common. The species present all thrive in deep sandy alluvium, tolerate inundation, and include *Azima tetraacantha*, *Cordyla africana*, *Croton megalobotrys*, *Diospyros mespiliformis*, *Ficus capreifolia*, *Guibourtia conjugata*, *Pteleopsis niyrtifolia*, *Salvadora angustifolia*, *S. persica*, *Strychnos henningsii*, *S. madagascariensis*, *S. spinosa*, *Terninalia gazensis*, *T. sericea* and *Xanthocercis zambesiaca*.

Fishes present in the rivers and pans include *Hydrocynus vittatus*, *Nothobranchius* sp.,

Protopterus annectens and *Tilapia* spp. *Megalops cyprinoides* and *Pristis microdon* both penetrate the Save as far as Zimbabwe. Many snakes are associated with the pans, floodplains and riverine vegetation of the Save and Lundi Rivers. *Cyclodernza frenatum* also occurs in the system and *Crocodylus niloticus* and *Varanus niloticus* are common.

The area including Chipinda Pools, the nearby courses of the Lundi and Save Rivers, and Tambohartia Pan, is rich in bird life. Notable species include *Alcedo semitorquata*, *Anas undulata*, *A. sparsa*, *Anhinga rufa*, *Ardea goliath*, *A. melanocephala*, *Casmerodius albus*, *Centropus grillii*, *Ceuthzochares aereus*, *Charadrius asiaticus*, *C. tricollaris*, *Circus ranivorus*, *Corythornis cristata*, *Dendrocygna viduata*, *Egretta intermedia*, *Falco biarmicus*, *Geronticus calvus*, *Hagedashia hagedash*, *Halcyon senegalensis*, *Megaceryle maxima*, *Melittophagus bullockoides*, *M. pusillus*, *Merops boehmi*, *Nettapus auritus*, *Porzana pusilla*, *Recurvirostra avosetta*, *Sarkidiornis melanotus*, *Scotopelia peli*, *Tringa glareola* and *Urocolius indicus*.

Resident mammals include *Aonyx capensis*, *Atilax paludinosus*, *Cercopithecus albogularis*, *Dasymys incomtus*, *Galago senegalensis*, *Lutra maculicollis*, *Otomys irroratus*, *Paraxerus cepapi* and several bats. The red squirrel *Paraxerus palliatus* is sympatric with the yellow-footed squirrel here, but the former is more common in dense riparian forest and the latter in trees around pans. A spectrum of large mammals visits the pools and floodplain and some, including elephants, are said to migrate between Gonarezhou and the adjoining areas in Mozambique and the Kruger National Park in South Africa to the south. This means that they have to cross the Limpopo River, but when not in spate this is often reduced to broad strips of sand, with mere streamlets of water and large isolated pools.

Human Impact & Utilisation: The flow regime and water quality of the Lundi and Save Rivers have been influenced by upstream impoundment for irrigation purposes. The Gonarezhou Park is open to visitors in the dry season from May-October. There is a rest camp in the park near the Lundi River at Chinguli and camping is permitted throughout the National Park.

Conservation Status: Chipinda Pools are entirely situated in Gonarezhou National Park which was established as a nature reserve in 1968, and achieved National Park status in 1975. Tambohartia Pan is unprotected.

3. Gorhwe and Manjinji Pans

Country: Zimbabwe

Coordinates: 21°45' S/31°40' E (Gorhwe); 22°10'S/31°28'E (Manjinji)

Area: c. 4000 ha (total)

Altitude: c. 600 m asl

Nearest Town: Mabalauta

General: Gorhwe Pans are a series of shallow pans associated with ephemeral drainage

lines on one of the subsidiary plateaux leading down from the great escarpment to the lowlands of the Gaza Province of Mozambique. They are surrounded by open savanna woodland and fringed by reeds and sedges, and tend to dry out, save for water-holes, during the dry seasons. They are situated entirely within the Gonarezhou National Park. Manjinji Pan consists of a substantial pan on a stretch of floodplain of the Mwenezi (Nuanetsi) River. It is deeper than the Gorhwe Pans and used to be perennial, but was topped up artificially by a local farmer who pumped water from the Mwenezi River. Now that this has stopped the pan is becoming occluded with reeds and grasses, and is more frequented by cattle than wild animals. The Manjinji Pan lies just outside the Gonarezhou National Park and is unprotected, but fishing is not permitted in the Mwenezi (Nuanetsi) River. All the pans attract large numbers of birds, and the Gorhwe Pans are important watering holes for a variety of large and small animals. Bilharzia is present in the Mwenezi River and all the pans, and malaria is endemic in the area.

4. Pans of the Western Districts

Country: Zimbabwe

Coordinates: 16°58'S/25°30'E; 20°58'S/26°25'E; 20°58'S/27°10'E; 18°22'S/26°29'E

Area: Difficult to assess. 15 000 ha (conservative estimate of total)

Altitude: 935-1250 m asl

Nearest Towns: Masue; Hwange; Gwai

General: A large number of small seasonal pans are situated in the west of Zimbabwe, close to the border with Botswana. In this area mean annual precipitation is generally close to 600 mm, but may reach 700 mm in the north towards the Zambezi. Proceeding along the Botswana border from south to north, Stoffelo, Kakulwane, Namabwe, Misses, Nanyani and Kazuma Pans are the most important sites, but there are in addition many small subsidiary pans. The Kazuma Pans are situated in the Kazuma Pan National Park; the others to the north are in the Matetsi Safari Area, while Stoffelo Pan is in Zambezi National Park. Drainage in this whole area is rather diffuse but is principally from SW to NE, towards the Zambezi, and some small pans occur on the floodplains of ephemeral rivers. However, the majority are endorheic pans, and are filled by surface run-off each year.

To the south of this area, in Hwange (Wankie) National Park, there are hundreds of small seasonal saline pans. The climate here is dry and tropical with a mean annual precipitation of 550-600 mm over the pans. The mean maximum temperature in October is 32.5-35°C, depending upon location, and the mean minimum temperature in July is 3.5°C, during which time frosts are frequent. These pans are situated well into Zimbabwe, away from the border, but some moderate sized pans do occur on, and even straddle, the border. The most important of these, from north to south, are Dandari (18°50'S/26°06'E), Ngwasha (19°30'S/26°14'E) and Dzivanini (19°44'S/26°32'E) Pans. In the Hwange Park drainage is also diffuse but tends to be from NE to SW into Botswana. Immediately to the south of Dzivanini Pan the ephemeral Nata River flows across the border providing the

major influx of water to the Makgadikgadi Pans.

Flora & Fauna: These pans are important habitats for waterfowl and are visited by a variety of game. The area is remote and forms part of the Victoria Falls-Matetsi-Hwange complex. The surrounding countryside is flat or very gently undulating, and in the north is covered with moist savanna forest comprising species such as *Baikiaea plurijuga*, *Pterocarpus angolensis* and *Terminalia sericea*. However, this quickly gives way, in passing southwards, to much drier country, in which grassy *Colophospermum nzopane* savanna or open, dry Kalahari woodland predominates. Acacia species fringe the pans. Snakes, including *Bitis arietans*, *Psammophis jallae* and various cobras are ever present, and the pans are an important waterfowl habitat with large numbers of *Alopochen aegyptiacus*, *Anas erythrorhyncha* and *Sarkidiornis melanotos*. Raptors seen on the pans include *Gyps bengalensis*, *G. coprotheres*, *Necrosyrtes monachus*, *Terathopius ecaudatus* and *Torgos tracheliotus*. During the rains other birds hawk for insects over the pans, some by day and others by night, e.g. *Apus apus*, *Cainaroptera brevicaudata*, *Caprimulgus rufigena* and *Pseudhirundo griseopyga*. Most mammals of the plains utilise the pans when they contain water and many locally threatened and vulnerable species depend upon the pans. Up to 30 000 buffaloes and 15 000 elephants live within the area defined by the co-ordinates given above.

Human Impact & Utilisation: The northern area is so remote that it is virtually undisturbed, but wildfire spreads into the area from villages and towns in the east along the Victoria Falls-Bulawayo Road, and from the south where there are many small farms. Visitors need 4 wheel drive vehicles to reach the pans and, since most are situated in National Parks or Safari Areas, they must first obtain permission.

Conservation Status: The pans are mostly within the parks and therefore fully legally protected. Fire is the major hazard and all the protected areas are criss-crossed by 100 m wide fire-breaks and watch is kept from numerous watch-towers. Animals move into Botswana which is very sparsely populated, but those in the Hwange National Park are now isolated from the Gwai River to the northeast, where animals once used to congregate in the dry season. In order to cope with increasing animal numbers, no less than 62 artificial waterholes have been established in the park to provide water in otherwise seasonally dry areas.

5. Artificial Impoundments

Country: Zimbabwe

Lake Kariba is the major impoundment, shared with Zambia, but in addition there are about 120 large dams and well over 10 000 farm dams.

(a) Lake Kariba

Coordinates: 16°33'-18°01' S/27°00'-29°05'E

Area: 536 130 ha (294 930 ha in Zimbabwe)

Altitude: 484 m asl (at capacity)

Nearest Towns: Hwange (80 km SW); Harare (250 km SE)

General: Lake Kariba was filled in 1958, and at maximum capacity its waters cover 536 130 ha of what was the Gwembe Trough. The lake is subject to considerable wave action, and the inflowing rivers still move their bed loads along their original courses beneath the surface. In addition to the Zambezi, the principal tributaries are the Sebungwe, Sengwa, Ume and Sanyati on the south bank, and the Mwenda, Zhimu, Zongwe, Nangombe, Chezya, Chibue and Lufue on the north bank. The lake has a maximum depth of 119 m and a mean depth of 29.5 m at capacity; it lies between Zambia and Zimbabwe. It is about 280 km long, in a SW-NE direction, and has a mean width of 19 km. Direct precipitation on the lake varies both seasonally and with location, with mean annual totals of 400-800 mm. Water in the lake has a mean residence time of 4 years.

Hydrology & Water Quality: Annual inflow from the Zambezi and the several rivers which discharge directly into the lake is about one quarter of the total volume of the lake. The water is well oxygenated at the surface, where temperatures vary between 17°C and 32°C. The chemistry of the lake water has changed substantially since it was first filled, and a detailed account of the physico-chemical characteristics of the lake water in its early years is given by Coche (1968), while the subject is also dealt with in a more comprehensive analysis by Balon & Coche (1974).

Flora & Fauna: During the early years the lake was highly eutrophic, but it has now apparently stabilised at a much lower level of productivity. *Lemna gibba*, *Pistia stratiotes*, *Salvinia molesta* and *Spirodela* spp. occur in sheltered bays. *Salvinia molesta* covers the largest areas, today about 2 % of the lake surface, and it is deemed to be advantageous because it provides a substrate for fish food organisms, and cover for several fish species at times when submerged macrophytes are scarce. Sometimes *Scirpus stolonifera* grows in mats of *Salvinia* and forms small patches of floating 'sudd-type' vegetation. Since 1964 submerged macrophytes such as *Ceratophyllum demersum*, floating leaved species of *Potamogeton*, and a few emergents including *Panicum repens*, have begun to spread around the shallow margins, providing a basis for a periphyton and habitats for aquatic invertebrates. These vegetation beds provide good grazing for fishes when they are submerged, and for ungulates when exposed following draw down. In spite of seasonal fluctuations in the water level, these plants are now well established. The eutrophication of the young Lake Kariba is described by Balinsky & James (1960).

The lake is not particularly productive, but supports 42 species of fish including *Distichodus mossambicus*, *D. schenga*, *Heterobranchus longifilis*, *Labeo altivelis*, *Mormyrops deliciosus*, *Mornzyrus longirostris* and *Tilapia rendalli*. *Oreochromis mortimeri*, which was present in the middle Zambezi before impoundment, was further introduced, and now dominates the commercial catches of cichlid fish. *Hydrocynus vittatus* is a popular sporting species. *Limnothrissa miodon* has also been introduced and is prospering in the vacant lacustrine habitat. Baton (1974) described the fish fauna of Lake Kariba once it had begun to stabilise, and accounts of the fish populations and

fisheries potential of the lake are given by Marshall (1979). The marginal fish fauna is described by Mitchell (1976).

Crocodylus niloticus is comparatively abundant in the lake. Each year as many as 400 adults visit the Matusadona National Park, which adjoins the lake, and these animals also occur around the rest of the southern lake shore, although their distribution density varies locally. The avifauna includes *Actophilonzis africana*, *Anhinga rufa*, *Egretta* spp., *Haliaeetus vocifer*, *Lybius torquatus*, *Merops pusillus*, *Phalacrocorax* spp., storks, plovers, and herons such as *Ardea goliath*. A number of large mammals visit the lake.

Human Impact & Utilisation: The initial flooding of the valley had an enormous impact on the area, and it will probably be many more years before the whole system has finally stabilised. Much forest and much animal life was lost in its creation, and the baThonga people were displaced from their homeland.

In addition to the provision of water and hydroelectric power, private and commercial fishing is encouraged on the lake, although it is restricted in certain areas. Fish are marketed fresh, deep frozen, dried or smoked. *Hydrocynus vittatus* and *Limnothrissa miodon* are canned, although the bulk of the *Limnothrissa* catch is sundried and sold throughout the country. Gill-nets (5-15 cm mesh) and beach seines are used. The sardine industry uses purse seines (encircling seines) and lift nets. Traditional methods such as basket traps, and rod and line fishing account for a great deal of the subsistence catch. In many tribal areas the local community operates a fishery administered by the tribal authority. Two inshore concession areas are granted to commercial interests, all other shore based fishing is by local residents, and it is estimated that there may be over 600 selfemployed peasant fishermen on the Zimbabwean side of the lake. The major industrial fisheries operate by concession in open water areas. In 1979 the total recorded catch from the Zimbabwean sector was 5560 tonnes, of which *Limnothrissa* accounted for 4880 tonnes, while the estimated total catch was believed to be about 6000 tonnes. The maximum sustainable yield of *Limnothrissa* from Zimbabwean waters is estimated as 6700 tonnes, and there are fears that over-fishing may have occurred since 1981, with catches in excess of 8000 tonnes.

Near the end of the dry season in October/November the outflow sluices at Kariba are opened to make room for the floodwaters from the inflowing rivers during the forthcoming rainy season. The resultant fall in lake level has varied from 3-8 m in different years. In shallow areas along the edges this alternate flooding and drying helps renew the lake with valuable nutrients. This is further facilitated by the feeding, trampling and waste production of visiting herds of herbivores. Some domestic cattle are grazed on the lake shores in tribal areas. The area is utilised for tourism.

Conservation Status: The entire lake on the Zimbabwean side of the border lies in the Lake Kariba Recreational Park, excluding only the waters contained in the Matusadona National Park. It has total legal protection, although angling and commercial fishing are encouraged. Much of the shoreline is protected in National Parks and Safari Areas.

(b) Lake Kyle

Coordinates: 20°15'S/31°10'E

Area: 9105 ha

Altitude: 1000 m asl

Nearest Towns: Masvingo (10 km NW); (Harare 275 km N)

General: Lake Kyle provides the second largest expanse of open water in Zimbabwe. It is an impoundment to provide water for irrigation, located at the confluence of the Mshagashe and Mtilikwe Rivers. Parts of the lakeshore are steep and rocky and covered by open woodland which contains succulent Euphorbia trees. The lake is situated in the Lake Kyle Recreation Park, which is bounded on three sides by tributaries of the Mtilikwe River. It has a maximum depth of 56 m and a mean depth of 14.6 m at capacity. Water temperatures vary between 16-27°C. The vegetation of the park consists of grassy plains and savanna woodlands, interrupted by more densely wooded ravines. Apart from the lake itself there are no important wetlands. Despite stable water levels over the years the surface of the lake supports little vegetational cover due in large measure to the size of the herbivorous *Tilapia rendalli* population. Investigations have been aimed at the establishment of artificial cover.

Fauna: Fish in the lake include *Barbus marequensis*, *Micropterus salmoides*, *Mormyrus longirostris* and *Tilapia* spp. *Oreochromis macrochir* was introduced from Zambia in the 1950s and is now the basis of the commercial fishery on this lake. Crocodiles are present in the lake and tributary streams, and there is a crocodile pond in the park. Waterfowl are present on the lake and there are several species of piscivorous birds, including kingfishers and herons. There are resident populations of *Atilax paludinosus* and *Lutra maculicollis* along the tributary streams, and several water snakes. Various large mammals have been re-introduced to the park and utilise the lake including *Ceratotherium simum* and *Connochaetes gnou*.

Human Impact & Utilisation: Given that the park is entirely artificial and designed for recreational purposes, as well as water storage, the major impact has been the drowning of 9000 ha of highland valleys. The park was established in 1963 and contains hotels, caravan sites and camp sites. It is heavily utilised for recreation and the lake is renowned for bass fishing. Commercial fishing concessions have in the past been awarded to 14 companies, but it has been proposed to reduce the number to two. In 1979 the total reported catch from all sources was 55 tonnes, while the estimated catch was 100 tonnes.

(c) Impoundments on the Hunyani River

Coordinates: 18°00' S/31°06' E; 17°55' S/30°50' E; 17°45' S/30°45' E

Area: c. 19 000 ha (total of three reservoirs)

Altitude: 1350-1450 m asl

Nearest Towns: Chitungwiza; Norton; Darwendale

General: There are three major impoundments on the upper reaches of the Hunyani River in the highlands to the south of Harare. The Prince Edward Dam at Chitungwiza is small, c. 2000 ha of open water surface. This spills over into Lake MacIlwaine downstream.

Lake MacIlwaine, near Norton, provides the main water supply to Harare and is 14.5 km long and up to 4 km wide. It had an open water surface of 2630 ha when full, but the holding capacity and surface area have recently been increased. It had a maximum depth of 27 m and a mean depth of 9.5 m when constructed, but these figures will have altered. It is situated 1400 m asl. Both lake and environs were created as a recreational park. Water temperatures in the lake vary from 14 to 27°C and in the summer the lake becomes stratified. The lake became highly eutrophic in the 1960s due to the addition of treated sewage effluent. The conductivity of the water nearly doubled between 1959-1970. Sewage diversion began in the early 1970s and total dissolved solids had dropped to the 1959 level by 1976. Dense algal blooms occurred, and although fish production was high, there were large kills every year from 1969-1973 because de-oxygenated bottom water upwelled. A slight drop in fish catches has been observed since 1976. There is a recurrent problem with luxuriant growth of the water hyacinth *Eichhornia crassipes*, which began in 1971. Mechanical removal at first proved ineffective and the worst areas were sprayed with the herbicide 2-4D. By treating areas successively, the area of rotting vegetation at any one time was minimised. A permanent weed control unit now keeps the weed under control. During the early periods of eutrophication, fish downstream were killed by the release of bottom water enriched with H₂S.

At least 23 species of fish occur in the lake, including *Barbus inarequensis*, *Clarias gariepinus*, *Hydrocynus vittatus*, *Labeo altivelis* and *Tilapia* spp. *Haplochromis codringtoni* has recently been introduced to the Hunyani impoundments to control mollusc populations. Crocodiles are present, and some 250 bird species have been identified in the park, many associated with the lake. These include cormorants, darters, ducks, egrets and herons. Various game animals occur in the area naturally, and visit the lake. The lake water carries bilharzia.

The third impoundment, Lake Robertson, towards Darwendale, is also encompassed by a recreational park, contiguous with that at Lake MacIlwaine. This is the largest of the three impoundments, and at capacity has an open water surface of 8100 ha. It is situated 1350 m asl, has a maximum depth of 23 m and a mean depth of 5.7 m. Water temperatures fluctuate between 16-24°C. The flora and fauna associated with this lake are similar to those of Lake MacIlwaine, as is the bilharzia problem.

Human Impact & Utilisation: The reservoirs are utilised for water, for domestic supplies and irrigation, and for commercial fishing. Sport fishing by license is popular. The total catch from the Hunyani Lakes during 1979 was estimated at 600 tonnes, although the reported catch was less than this. An assessment of fish production in Lake MacIlwaine is given by Marshall (1978).

Conservation Status: The parks in which the reservoirs are situated are under the control

of the Department of Parks and Wildlife who manage them for recreation and issue fishing licences. Some of the lakeshore areas are leased to farmers, but most of the southern shore of Lake MacIlwaine is managed as a game park. A bird sanctuary is proposed on the northern lakeshore, in an area containing a wide variety of natural and man-made habitats. The remainder of the north bank is set aside for visitor facilities.

(d) Other Impoundments

General: Other major impoundments occur on the Sebakwe River, ultimately a tributary of the Sanyati River. The impoundments here are at Dutchman's Pools Dam (18°50'S/29°55'E) and Sebakwe Dam (19°01'S/30°15'E). The latter dam is the larger and subtends an open water surface some 8 km long with a maximum width of 2 km at capacity. The smaller Ngezi Dam (18°41'S/30°20'E) in the Ngezi National Park, is situated on another river of the same name, which is also a part of the Sanyati system. All these reservoirs eventually drain to the Zambezi via Lake Kariba. Lake MacDougall (20°35'S/31°37'E) on the Chiredzi River, a tributary of the Lundi, and Siya Dam (20°15'S/31°36'E) on the Turgwe River, both eventually feed the Save River system.