

2.9 TANZANIA

Introduction

Tanzania has an area of 939 760 km², a population of 19 730 000 (1983), and thus a mean population density of 20.9 persons/km². It stretches approximately 1200 km from north to south between latitudes 1°00' and 11°36'S, and 1230 km from west to east between longitudes 29°21' and 40°29'E. It is bounded by Mozambique in the south, by Malawi, Zambia, Zaire, Burundi and Rwanda in the west, by Uganda and Kenya in the north, and by the Indian Ocean in the east. The Indian Ocean coast is highly indented and some 1300 km long, excluding offshore islands, while in the southwest there is a frontage of 305 km to Lake Malawi and another of 650 km to Lake Tanganyika in the central west. In the northwest there is a frontage of 1420 km on to Lake Victoria.

The coastal plain is only 15-30 km wide, and rises by slopes and scarps to an interior plateau 1000-1500 m asl north of the Rufiji River. This plateau is fringed by mountains except along the shore of Lake Victoria. In the northwest a highland range lies parallel with the Rwanda border, while in the west other mountain ranges occur along the shores of Lake Tanganyika. In the southwest the border with Zambia is mountainous, and around the head of Lake Malawi the Kipengere Range rises to 2595 m asl at Mt. Rungwe (9°08'S/33°41'E). Highland ranges also extend along the northwestern side of the Rufiji Valley, and then northwards parallel with the coast to culminate in the Usambara Mountains, close to the Kenyan border. The Eastern or Gregory Rift bisects this interior plateau, crossing the border into Kenya. Mountains also line both margins of this valley, the highest point here being Mt. Loolmalasin (3°02'S/35°48'E), 3648 m asl, on the eastern side. The isolated volcanic massifs of Mt. Meru (3°15'S/36°44'E) and Mt. Kilimanjaro (3°04'S/37°04'E) are situated on the plateau 100 and 150 km east of this rift respectively. The summit of Mt. Meru reaches 4565 m asl, while that of Mt. Kilimanjaro, at 5895 m asl, is the highest point in Africa. Between Mt. Kilimanjaro and the Usambara Mountains, along the Kenyan border, are the North Pare and Pare Mountains.

South of the Rufiji Valley the coastal plain rises more gently to another plateau, 500-700 m asl, but with isolated outcrops reaching 1500 m, and even higher peaks along the shores of Lake Malawi. The altitudinal range in Tanzania, from sea level to the summit of Kilimanjaro, is greater than in any other African country, while the bottom of Lake Tanganyika, 697 m below sea level, is the lowest point in Africa.

Drainage

Drainage is complex. Because of the general declination from the western highlands towards the Indian Ocean, much of the country drains to the ocean. This is accomplished by a series of rivers and numerous small streams. The principal watercourses are, from north to south, the Uмба, Pangani, Msangasi, Mligasi, Mandra, Ruvu, Rufiji, Matandu, Mavuji,

Mbwemburu, Lukuledi, Mambi and Ruvuma Rivers. All these drain the eastern margin and slopes of the interior plateau exclusively, except for the Rufiji and Ruvuma Rivers, which are much larger and rise in the west of the country. The Rufiji has sources in the Kipengere Mountains at the head of Lake Malawi and drains a huge basin in central southern Tanzania, while the Ruvuma rises farther south, but even closer to Lake Malawi. This latter stream marks the border with Mozambique for most of the way between Lake Malawi and the sea.

The northwestern highlands, along the Burundi border, drain either to Lake Victoria via the Kagera River, or to the endorheic Lakes of Burigi and Ikimba. Farther south the western slopes of the highlands along the Western Rift Valley drain by short streams to Lake Tanganyika. In the northern half of the country the eastern slopes of these mountains also drain to Lake Tanganyika via the Malagarasi River, which turns west and cuts through the highland range to enter the lake. However, in the southern half of the country these eastern slopes drain either to the endorheic Rukwa Basin, or to the Indian Ocean via the Rufiji and Ruvuma Rivers.

In addition to the Rukwa Basin, there are two other important regions of internal drainage. One is the trough of the Eastern Rift Valley, where streams draining the internal slopes discharge into a series of soda lakes. The other is near Dodoma (6°09'S/35°41'E), close to the geographic centre of Tanzania, where streams flow into a swampy basin which is flooded seasonally.

Land peripheral to Lake Victoria drains directly to that lake by short streams, but the watershed between the Lake Victoria and Malagarasi catchments approaches to within 25 km of the southwestern lakeshore. The western slopes of Mt. Meru drain into the Eastern Rift Valley, while the eastern slopes, and the slopes of Mt. Kilimanjaro, drain to the Indian Ocean via the Pangani River, or through Kenya via the Tsavo/Galana System.

Climate

The climate is dominated by three major wind systems, the SW Monsoon which intrudes into the country from the Zaire Basin, the moist SE Trade Winds which sweep in from the Indian Ocean, and the dry NE Trade Winds which blow down from Ethiopia and Somalia. The principal rains occur between January and May, but northwestern regions have an additional peak in October-November. The SE Trades predominate between the March and September equinoxes, but once the moist air stream reaches the interior it veers southerly or southwesterly. Mean annual rainfall declines southwards along the coast, from some 1300 mm in the Tanga District, to 1110 mm at Dar es Salaam (6°47'S/39°17'E) and 936 mm at Lindi (9°59'S/39°42'E). The offshore islands of the north are wetter however, with mean annual falls of 1964 mm at Wete (5°03'S/39°44'E) on Pemba Island. Similarly the coastal hills of the north experience high annual falls and precipitation exceeds 2250 mm/yr in the Usambara Mountains, and is generally over 1900 mm/yr on the lower seaward flanks of this range.

Where there are no mountains rainfall tends to decrease away from the sea, and the northern and central interior plateaux are comparatively dry, with falls below 600

mm/yr in the north. The southern and western thirds of the country are wettest, with falls exceeding 1400 mm/yr along the hills northwest of the Rufiji Valley and around the head of Lake Malawi, and between 950-1400 mm/yr over most of the southern interior and in the lands adjacent to the Western Rift Valley. Rainfall is 1130 mm/yr at Sonoga (10°40'S/35°39'E) and 2300 mm/yr at Tukuyu (9°16'S/33°38'E). Sonoga is situated on the plateau, 96 km north of the Mozambique border and 112 km east of Lake Malawi, at an altitude of 1153 m asl. Tukuyu is 1450 m asl in the Western Rift Valley north of Lake Malawi, and is more strongly influenced by the SW airstream than is Sonoga.

The western side of the Lake Victoria basin is much wetter than the eastern side. Mean annual rainfall at Bukoba (1°20'S/31°48'E), 1144 m asl on the western shore, is 2025 mm, while it is 1010 mm at Mwanza (2°32'S/32°56'E), 1133 m asl on the southern shore, and 752 mm at Musoma (1°32'S/33°48'E), 1148 m asl on the eastern shore at the mouth of the Mara River.

Temperatures are moderated by altitude, and by onshore breezes at the coast. The mean annual temperature at Wete is 26.2°C, while the mean maximum of the warmest month is 31.9°C and the mean minimum of the coldest month is 20.7°C. Absolute maxima and minima are 35.9 and 18.1°C. The corresponding figures for Dar es Salaam are 25.7, 31.4 and 18.7°C, with absolute recordings of 34.4 and 15.0°C. At Lindi the figures are 26.1, 31.2 and 18.8°C, with absolute recordings of 35.2 and 12.3°C. At altitudes of approximately 1100 m around Lake Victoria the corresponding temperatures for different centres are; Bukoba, 21.1, 25.7 and 15.2°C, with absolute values of 30.6 and 10.0°C; Musoma, 23.4, 29.4 and 17.2°C, with absolute values of 35.0 and 12.2°C; Mwanza, 23.4, 29.7 and 11.4°C, with absolute values of 35.0 and 6.5°C. In the south the figures are 21.0, 28.4 and 12.7°C, with absolute values of 33.0 and 7°C at Sonoga. Frosts are not uncommon over 4000 m asl and there is permanent snow on Mt. Kilimanjaro.

Vegetation

The total forested area of Tanzania is small and is largely confined to the major highland areas. However, a type of coastal forest occurs sporadically within a zone, 30-60 km wide, along the Indian Ocean. The southern and central interior plateaux support miombo woodland dominated by *Brachystegia*, *Isoberlinia* and *Julbernardia* spp, often associated with *Pterocarpus angolensis*. This occurs where rainfall is typically 800 - 1200 mm/yr with a single wet season, but it seldom has a continuous distribution and usually occurs in catenary associations. It is present on the best drained red and grey soils of the central plateau, but gives way to *Combretunz* spp. in less well drained sites, and to deciduous *Acacia-Comnziphora* bushland on hard-pan soils. This latter vegetation dominates much of the arid northern interior. The mountains support evergreen Afro-montane vegetation. Within these broad vegetational zones there are large areas of edaphic vegetation, including the dense Itigi thicket (*Baphia massaiensis* and *Bussea massaiensis*) on duricrust soils in central Tanzania, and pure stands of *Borassus aethiopicum* where the water table is always high. Most rivers carry galleries of forest or woodland, some dominated by a *Syzygiunz guineense-Ficus* spp. association, as in the Tabora district, and there are extensive grasslands on river floodplains. 'Mbugas' develop on boggy sites with *Digitaria regularis*, *Setaria holstii* and *Themeda triandra*,

while secondary grass/fernlands, with *Pteridium aquilinum*, occur in the southern hills.

Wetlands

It has been estimated that there are some 5 439 000 ha of lakes and swamps in Tanzania, representing 5.8% of the total land surface, but this does not include seasonally inundated floodplains. Some 25 % of the country is now protected in National Parks or Game Reserves, and these tend to be centred on wetland systems, thus a high proportion of the country's wetlands are protected. The principal wetland systems comprise the lakes of the Western and Eastern Rift Valleys, Lake Victoria, numerous minor lakes, riverine floodplains and permanent swamps, tidal swamps at the coast, and a number of artificial impoundments.

List of Wetlands Described

1. Tidal Wetlands
2. Riverine Wetlands
 - (a) The Kagera River
 - (b) The Moyowosi/Malagarasi System
 - (c) The Mara River
 - (d) The Pangani River
 - (e) The Wami River (0 The Ruvu River
 - (g) The Ruaha/Rufiji System
3. Basins of Internal Drainage
 - (a) The Rukwa Basin
 - (b) The Bahi Swamp
 - (c) The Eyasi & Yaida Basins
 - (d) The Lake Natron Basin
 - (e) The Lake Manyara Basin
 - (f) The Burigi & Ikimba Basins
4. Natural Lakes
 - (a) Lake Victoria
 - (b) Lake Tanganyika
 - (c) Lake Malawi
 - (d) Minor Lakes & Swamps
5. Artificial Impoundments
 - (a) Nyumba ya Mungu Reservoir

- (b) Mtera Reservoir
- (c) Other Reservoirs

1. Tidal Wetlands

General: There were approximately 196 000 ha of mangrove swamps at the coast in 1982. Mangroves are present in all sheltered creeks on the mainland and offshore islands. They are well developed in creeks of the Tanga District, between latitudes 4°42' and 5°13'S, and on Pemba and Zanzibar Islands. In the delta of the Wami River (6°05'- 6°15'S) and in the estuary of the Ruvu River (6°22'S) they have transitions with fresh water swamps. Then, in passing south, mangroves occur at the mouth of the Mzinga River at Dar es Salaam and in creeks sheltered by offshore islands between Ras Buyuni (7°10'S/39°30'E) and Kisiju (7°24'S/39°20'E). However, they attain their best development on the entire East African coast in a stretch between Mohungu (7°42'S/39°16'E), north of the Rufiji Delta, and Samanga (8°23'S/39°17'E), south of the delta. Here the swamps cover offshore mudflats and encompass small coral islands, and extend seaward for a maximum distance of 26 km immediately north of the main river mouth and opposite Mafia Island. Other good and floristically diverse mangrove stands occur in several large sheltered inlets farther south, e.g. in the bay at Miteja (8°32'-8°38' S/39°17' - 39°23'E), in the Matandu Estuary (8°39'-8°46'S/39°18'-39°24'E), in the bay at Kilwa Masoko (8°51'-9°01'S/39°20'-39°30'E), at the head of Mtandura Bay (9°11'-9°14'S/ 39°30'-39°34'E) and at the Ruvuma River Mouth on the Mozambique border (10°24' -10°31' S/40°20' -40°26'E).

Flora & Fauna: The flora and fauna of these swamps is as indicated in the regional introduction. There are many transitions with coastal dune forest and fresh water swamp forest. *Lepidochelys olivacea* nests near large river mouths in the south of Tanzania and both it and other turtles visit mangroves.

Human Impact & Utilisation: Mangroves have been intensively exploited for firewood, poles, and masts for Arab dhows.

Conservation Status: Currently unprotected.

2. Riverine Wetlands

(A) THE KAGERA RIVER

General: The wetlands on the Kagera River are described more fully in section 2.6.11. The Kagera forms the border between Rwanda and Tanzania for a distance of about 210 km, and for 180 km it traverses a shallow swampy valley (1°19'-2°11' S/30°33' -31°01'E) at altitudes between 1270 and 1300 m asl. In this sector it flows sluggishly, almost due north, through permanent swamps which reach 18 km in width, but which are generally only 1-2 km wide on the Tanzanian side of the border. Very locally they extend 10 km into Tanzania. There are many papyrus fringed lakes in depressions on either side of the river, and those in Tanzania are, from north to south, Lakes Gwelu (1°20'S/30°39'E), Nyakatale (1°22' S/30°39' E), Nyaruwale (1°23'S/30°41'E), Lubuga (1°26'S/30°47' E), Ishaka (1°27'S/30°47' E), Duko (1°30'S/30°46'E), Kashani

(1°34'S/30°49'E), Twamwala (1°36'S/30°50'E), Mujunju (1°36'-1°44' S/30°51' -30°55' E), Kashanga (1°53' S/30°51' E), Lweru Kwa Kalambi (1°59'S/30°52'E), Katabi (1°59'S/30°57'E), Kazinga (2°01'S/ 30°56'E) and Bisongo (2°08'S/30°58'E).

The river rises and floods, following rains over the catchments along the Western Rift Valley in Rwanda and Burundi. About 35 000 ha of the wetland is situated in Tanzania. The swamps are dominated by papyrus, but there are patches of swamp forest, and seasonal floodplains outside parts of the permanent swamp system. There is a rich fauna including frogs, crocodiles, terrapins, monitors, snakes, birds, otters and rodents, but *Hippopotamus amphibius* is now scarce. The lakes and river are fished intensively by artisans, and there is some hunting. The area is unprotected in Tanzania, but most of the wetland on the Rwanda side of the border is included in the Kagera National Park.

(B) THE MOYOWOSI/MALAGARASI SYSTEM

General: The Malagarasi River, with its tributaries, drains a large part of northwestern Tanzania. Wetlands occur on the upper Malagarasi and its headwater tributaries, but these are very largely situated in Burundi and are dealt with in section 2.1.3d. The principal tributary, the Moyowosi and its major affluent, the Nikonga, both rise in low hills close to the southern shore of Lake Victoria and both flow south, away from the lake. Their gradients flatten as they reach a plain and they overtop their banks seasonally in traversing a vast zone of permanent swamps (3°55'-5°05'S/ 30°50'-31°35'E) oriented roughly N-S. Here the Moyowosi divides into a network of channels into which the Nikonga flows on the eastern side. The permanent swamp zone is 160 km long, reaches 36 km in width, and covers some 320 000 ha. Seasonal floodplains extend along two other affluents, the Kigosi and Gombe Rivers, which join these swamps from the east.

The Kigosi Floodplain is 35 km long and occupies about 14 000 ha, while that on the Gombe River is 60 km long, 4-6 km wide, and covers 32 000 ha. However, other floodplains occur on tributaries of the Gombe. The largest of these covers a large area beset with low hills, producing a mosaic of dryland and wetland at high water (3°50' -4°34' S/32°16'-33°02'E). This wetland drains to the Gombe by two streams, the Mtoni which leaves the southwestern corner and the Igombe which leaves the southeastern corner. The area of wetland here varies from year to year, but during wet cycles it approaches 250 000 ha.

There are two small lakes at the southern extremity of the permanent Moyowosi swamps, and just above them the flow swings westwards, and the network of Moyowosi channels reunite, before a confluence with the Malagarasi River. A belt of permanent swamps with a peripheral floodplain continues below this confluence for 40 km, approaching the point where the Ugalla River joins the Malagarasi on its south bank.

The Ugalla and its several tributaries drain the plateau and some low hills to the south and east, and many of the rivers of this subsystem have seasonal floodplains. The floodplain on the Ugalla develops 20 km above its confluence with the Malagarasi and extends for 40 km, past the mouth of the Ziuwe River, a right bank tributary. Thereafter it is discontinuous for nearly 60 km, but then widens again and extends up the Wala River to its headwater basin, a distance of 200 km. In total there are about 90 000 ha of

seasonally inundated land on the Ugalla/Wala Rivers. An extensive floodplain/lake/swamp system occurs on the Ziuwe River, reaching 24 km in width above Lake Sagara (5°14'S/31°07'E) which the river both feeds and drains. There is a total of about 85 000 ha of wetlands on the Ziuwe, including nearly 8000 ha of permanent swampland along the river to the east and west of Lake Sagara.

Flora & Fauna: This is essentially as described in the regional introduction for the western districts of Equatorial East Africa. All the headwater streams carry gallery forest or woodland containing *Acacia* spp., *Borassus aethiopum* and *Phoenix reclinata* among others. Substantial sections of the galleries are flooded for short periods each year. The permanent swamps are dominated by papyrus, which detaches from the banks of rivers and lakes to produce islands of floating vegetation, and in the Moyowosi/Nikonga Swamp these frequently cause channel blockages. Shallow depressions on the floodplains and the fringes of permanent swamps carry swamp forest, while the floodplains proper carry grassland. The surrounding country is covered by *Brachystegia spiciformis-Julbernardia globiflora* miombo woodland, but there are patches of groundwater forest at sites where the water table is always near the surface, e.g. in the area (5°02'-5°12'S/31°00'-31°16'E) between the Moyowosi Swamp and the swamp around Lake Sagara.

Noteworthy animals include *Crocodylus niloticus*, *Hippopotamus amphibius*, and *Tragelaphus spekei* in the swamps, and *Damaliscus lunatus*, *Equus burchelli*, *Kobus ellipsiprymnus*, *Panthera leo* and *Syncerus caffer* on the floodplains. Almost the whole spectrum of small mammals cited in the regional introduction for this district is present in these wetlands, and there are several hundred species of birds.

Human Impact & Utilisation: Fishing is practised by artisans on the rivers, lakes and floodplains, and some crops are cultivated on the floodplains when the waters recede. Hunting occurs almost throughout the system.

Conservation Status: A substantial proportion of the wetland is protected in the Moyowosi Game Reserve which extends between the Moyowosi and Malagarasi Rivers above their confluence.

(C) THE MARA RIVER

General: The Mara rises on the western slopes of the Mau Escarpment in Kenya and flows to Mara Bay on the mid-western shore of Lake Victoria in Tanzania. It traverses the Masirori Swamp (c. 1°27'-1°37'S/34°11'-34°38'E) some 45 km long and up to 14 km wide on the lacustrine plain. This is a permanent papyrus swamp of some 30 000 ha, situated 30 km east of Musoma. The flora and fauna are essentially as described in the regional introduction. The swamp is fished and is unprotected.

(D) THE PANGANI RIVER

General: The Pangani drains Mts. Meru and Kilimanjaro. Its headwater tributaries are the Kikuletwa and the Ruvu. The Kikuletwa rises on the eastern slopes of Mt. Meru and receives 4 affluents from the southern slopes of Mt. Kilimanjaro en route to Lake Pangani

(Nyumba ya Mungu), an impoundment (3°41'S/37°27'E). The Kikuletwa flows into the northwestern corner of the reservoir through a swamp with a mean area close to 4200 ha, but which fluctuates with the water level. The Ruvu rises as the Lumi on the eastern slopes of Mt. Kilimanjaro and flows into Lake Jipe (3°31'-3°40'S/37°45'E), half of which is in Kenya, and much of which is encompassed by papyrus swamps. This overflows into the Ruvu, and this river, having traversed a stretch of permanent swamps, joins the Kikuletwa in the Lake Pangani Impoundment. From here the combined stream issues southwards as the Pangani River.

Below the dam this river flows through dry deciduous *Acacia-Combretum* bushlands, but at about 750 m asl, it crosses the flat floor of a trough between the Martin Escarpment in the west and the Pare Mountains in the east. Here (4°07' - 4°34'S/37°26'-37°44'E), between Marue and Mbuyuni, it spreads its waters over a broad belt of permanent swamps, surrounded by a seasonal floodplain. The swamps extend 80 km along the foot of the Martin Escarpment on the western side of the trough. The eastward spread of floodwaters is limited by a ridge along the centre of the trough from which 4 conical hills rise to just over 1300 m asl. However, the swamps reach 26 km in width along an affluent stream from the Pare Mountains, which enters the system between two of the hills on the central ridge. There are several minor channels through the swamps, which are dominated by papyrus, but the main stream of the Pangani maintains its integrity throughout. This wetland covers about 90 000 ha. The permanent swamps are fished by artisans at all seasons. The floodplain is fished in the wet seasons and grazed and cultivated in the dry seasons. The system is unprotected.

The Kitwai Swamp and Floodplain (4°51'S/37°11'-37°36'E) is situated at the head of a broad shallow valley, 795-810 m asl, 40 km southwest of the previous system. It occupies an E-W depression containing close to 15 750 ha of wetland in a strip 50 km long and up to 6 km wide, and drains from its eastern end towards the Pangani at high water. South of this there are numerous permanent waterholes scattered over a large area (5°04'-5°22'S/37°00'-38°00'E) drained by right bank affluents of the Pangani.

The principal left bank tributary is the Mkomazi. This river rises on the northeastern slopes of the Pare Mountains and then flows through permanent swamps along the northeastern flank of the range, before passing through a narrow valley between the southern tip of the Pare Mountains and the northern tip of the Usambara Mountains. The swamps (4°12' - 4°24'S/38°04'E) are dominated by papyrus and occupy some 4000 ha in a strip 24 km long and 2 km wide. Northeast of these swamps, and hard against the Kenyan border and the Tsavo National Park, is the Kifuka Swamp (4°05' - 4°15'S/38°11' - 38°24'E), centred on Kifuka Spring (4°08'S/38°14'E). This swamp drains to the NW and appears to be included in the Mkomazi National Reserve, but is not mentioned in accounts we have of that reserve.

Flora & Fauna: The permanent swamps with fluctuating water levels are dominated by papyrus. Small patches of groundwater forest occur near springs and some waterholes, and the watercourses are fringed by gallery forests, parts of which are subject to seasonal inundation. The usual grasses grow on the floodplains, together with species of *Acacia* in the less deeply flooded places. The fauna is as described in the regional introduction for Equatorial East Africa. *Crocodylus niloticus* and *Hippopotamus amphibius* persist in

the system but are now uncommon.

Human Impact & Utilisation: The area is intensively used. The rivers, swamps and floodplains are fished, and the floodplains are heavily grazed during the dry season. Some cultivation is carried out when the floods recede, and the gallery forests are exploited for timber and firewood. Lake Pangani is used to produce hydroelectric power and is fished, but is dealt with in more detail in section 2.9.5.

Conservation Status: Unprotected, except for Kifuka Swamp, but even here poaching of large animals and birds is serious.

(E) THE WAMI RIVER

General: The principal headwater tributary of the Wami, the Mkata River, has sources (7°25'S/37°04'E and 7°25'S/37°08'E) at the head of a valley aligned SW-NE, between the Uluguru Mountains in the east and the Rubeho Mountains in the west. The river flows NE, draining the opposing flanks of these ranges, and spreads over an extensive swamp on the Mkata Plain (6°26'-7°22'S/37°04'-37°25'E). This covers some 80 000 ha and is almost unbroken for 104 km along the river, with a maximum width of 20 km in the north where the Wami and Tomi Rivers are received on the left bank. Papyrus swamps form a central strip along the river throughout this system, and extend away from it on tributaries, backwaters and around ponds. Outside the papyrus swamps there are seasonally inundated floodplains.

The Wami has sources (6°27'S/36°58'E and 6°32'S/36°55'E) in the Kaguru Mountains, farther north on the western side of the valley. From them it flows SE to reach the Mkata in the swamps at the northern end of the Mkata Plain, sometimes called the Lukwatu Plain at this end. Beyond this the combined stream is called the Wami, and another permanent swamp/floodplain is situated (6°16'-6°25'S/37°32'-37°42'E) between the left bank of the river and an affluent which drains the Nguru Mountains. This latter wetland covers about 13 500 ha. Below this the Wami flows due east to reach its delta on the Indian Ocean. Here swamps spread up and down the coast in a floodplain and swamp zone (6°03'-6°16'S/38°45'-38°52'E) which grades into tidal swamps along distributaries.

Flora & Fauna: The upstream swamps are dominated by papyrus with *Miscanthidiurn violaceum*, *Phragmites mauritanus*, *Typha domingensis* and other typical associates. *Phoenix reclinata* is common on levees in the swamps, with, in places, *Borassus aethiopunt*, *Hyphaene coriacea* and species of *Ficus*. The rivers carry gallery forests with a typical East African flora. The floodplains support grasses, and patches of groundwater forest at the back of the delta are dominated by *Chlorophora excelsa*. Swamp forest occurs in the delta and grades into tidal forest along the distributaries. *Barringtonia racernosa*, *Heritiera littoralis* and *Hibiscus tiliaceus* dominate the freshwater/saltwater transition. The fauna is as described in the regional introduction for the eastern districts of East Africa.

Human Impact & Utilisation: The wetlands are fished and hunted, and recession

agriculture occurs locally after the floods have subsided. Areas of the delta are used for agriculture and some swamps have been drained.

Conservation Status: The headwaters of the Mkata River are situated in the Mikumi National Park, but none of the major wetlands is protected.

(F) THE RUVU RIVER

General: The Ruvu and its headwater tributaries rise on the eastern slopes of the Uluguru Mountains at altitudes close to 1500 m asl. They descend steeply to a plain 200 m asl, at the eastern foot of the massif, and spread their waters over a swamp (7°16' -7°29' S/ 37°51'-38°01' E) of 36 000 ha which measures 22 km from SW-NE. The southernmost tributary, the Mgeta, joins the Ruvu about 15 km east of the swamp, and the combined stream then flows ENE to traverse another swamp (7°07' -7°17' S/38°15' -38°23'E) of 7200 ha, 20 km downstream. Thereafter the river meanders NE to reach the coast in a swampy estuary north of Bagamoyo (6°27'S/38°58'E), opposite the southern tip of Zanzibar Island.

The flora and fauna are as described in the regional introduction, with papyrus swamps, grassy floodplains and gallery forests. The system is exploited for floodplain agriculture, hunting and fishing, and is unprotected.

(G) THE RUAHA/RUFIJI SYSTEM

General: The Rufiji is the largest river of Tanzania. Its headwater tributary farthest from the sea is the Hagafira, which with an affluent, rises on a flat seasonally inundated plain (9°26'-9°43'S/34°32'-34°38'E) 2300 m asl. This plain is just 38 km NW of Lake Malawi, and it straddles a watershed from which the Nkiwe River flows SW to that lake. However, the Hagafira, having united with its affluent, becomes known as the Ruhudji. This river winds eastwards, losing height quite rapidly, to the head of a great floodplain (7°44'-9°26'S/ 35°33'-36°56'E) 250 km long and up to 52 km wide, covering 626 500 ha at high water. The floodplain occupies the flat floor of Kilombero Valley, 210-250 m asl. The valley is oriented SW-NE, between a densely forested escarpment, which rises to 2576 m asl (7°47'S/36°36'E) on the northwestern side, and the Mahenge Mountains on the southeastern side. This latter group rises to 1516 m asl (8°45'S/36°39'E) and is grass covered on its upper western flanks.

The Ruhudji receives several important tributaries at the head of the valley and then divides, on the floodplain, into a number of channels which produce an anastomosing network in the central part of the floodplain. Other affluents, draining the mountains on opposing sides of the valley, join the network so that in the central part there are ten major channels flowing roughly in parallel. A zone of permanent swamps, 45 km long, extends up to 4 km away from the west bank of the Kihanse River, which comes down from the high escarpment at the southern end of the floodplain to form the most westerly of the major channels. Otherwise, permanent swamps are closely restricted to the vicinity of the channels and some lagoons. The southern and central parts of the floodplain descend 40 m over a distance of 210 km, i.e.

with a mean gradient of 1 : 5250 .

About two thirds of the way along the floodplain the channels reunite and the main stream is joined on its left bank by the Msolwa River. This stream comes down from the high escarpment and traverses the northern third of the floodplain, skirting another large zone of permanent swampland to the west. It flows SW to its confluence, from which point the main stream, now called the Kilombero River, swings sharply southeastwards, and leaves the floodplain. The Kilombero then continues for 65 km to a confluence with the Luwegu, a large river from the south which has extensive but narrow floodplains. Below this confluence the river is referred to as the Rufiji.

Some 80 km downstream, the Rufiji receives the Great Ruaha River on the left bank. The Great Ruaha rises farther west than the Rufiji, having six major sources in the Kipengere Mountains at the head of Lake Malawi. These streams issue northeastwards from the mountains and unite on the Usangu Flats, a plain about 1300 m asl. Most of the plain, which is 140 km long and oriented SW-NE, is inundated during the rainy season. Like the Rufiji Floodplain, its effluent stream leaves it about two thirds of the way along its length. Other affluents enter the plain from the north and join the main river, which on leaving the plain is known as the Great Ruaha. The zone of inundation extends the full length of the flats, reaching 42 km in width in the SW and 32 km in the NE. At high water over 150 000 ha are inundated, to depths of 3-4 m. A zone of permanent swamps, covering about 4000 ha, lies at the lowest part of the system, 1020 m asl, above the point where the Great Ruaha leaves the flats.

From here the river flows NE to another floodplain ($7^{\circ}12'-7^{\circ}19'S/35^{\circ}17'-35^{\circ}28'E$) of 10 000 ha, generated jointly by the Ruaha and Lufugwa Rivers. The zone of inundation extends for 26 km between the two streams and terminates at their confluence. Then, some 32 km farther downstream, the Ruaha receives the Kisigo on the left bank. The Kisigo rises on a swampy floodplain (20 000 ha) near the town of Itigi, to the north ($5^{\circ}33'-5^{\circ}53'S/34^{\circ}22'-34^{\circ}39'E$), from where, flowing SE, it skirts a small floodplain ($6^{\circ}15'S/34^{\circ}53'E$) before receiving the waters of the Tame River. This river also rises from a floodplain area ($6^{\circ}35'-6^{\circ}50'S/35^{\circ}12'-35^{\circ}32'E$).

A further 10 km downstream the Great Ruaha receives the Bubu, again on the left bank, and this river also traverses a floodplain ($6^{\circ}48'-7^{\circ}05'S/35^{\circ}43'-35^{\circ}59'E$) on its way to the Ruaha. This wetland is 34 km long from N-S, up to 18 km wide from E-W, and covers 24 000 ha at high water. To the south of the Great Ruaha another seasonally inundated plain occupies 20 000 ha ($7^{\circ}31'-7^{\circ}40'S/35^{\circ}47'-35^{\circ}55'E$). It is surrounded by mountains on three sides, the south, east and north, but it drains to the Great Ruaha from the NW via the Mbungu River.

Below the Mbungu confluence the Great Ruaha flows SE through a narrow valley in the Rubeho Mountains to an impoundment at Mtera and finally emerges on the eastern side of the mountains just north of the Rufiji (Kilombero) Floodplain. This it skirts at a distance of less than 5 km before joining the Rufiji on its left bank a few kilometres above Lake Mkalinzu ($7^{\circ}52'S/37^{\circ}49'E$). The Rufiji then veers eastwards and becomes broad and sluggish; its channel reaches more than a kilometre in width in its lower reaches, and locally it encompasses islands. Over the final 180 km above its delta the Rufiji receives numerous tributaries on both banks. Many of the affluents traverse lakes, and

some terminate in lakes, from which overspill to the Rufiji is diffuse and occurs only during the rains. A number (e.g. the Lambo River) rise in swampy valleys in the undulating coastal lowlands. The Lambo, which joins the Rufiji on its right bank, drains the southern end of a large and partly forested swamp (7°22' -7°44' S/38°15' -38°24'E), while the Ruhoi also drains this same swamp, but flows independently from the northern end to the Rufiji Delta.

Flora & Fauna: The Rufiji and Ruaha Floodplains are dominated by grasses, including *Echinochloa pyramidalis* and *Oryza* spp. The permanent swamps along the rivers are *Cyperus papyrus* swamps, with the normal associate species. Upstream the rivers carry gallery forests, with zones of inundation and pockets of swamp forest. These include some Zambezian elements and in southwestern districts comprise such species as *Aporrhiza nitida*, *Ficus congensis*, *Garcinia smeathmannii*, *Gardenia imperialis*, *Ilex mitis*, *Mitragyna stipulosa*, *Raphia* sp., *Syzygiunz cordatum*, *S. owariense*, *Uapaca guineensis*, *Xylopi aethiopica* and *X. rubescens*, while the galleries contain *Acacia albida*, *A. polyacantha* var. *camplyacantha*, *A. xanthophloea*, *Adina nzicrocephala*, *Anthocleista schweinfurthii*, *Canariuin schweinfurthii*, *Dacryodes edulis*, *Erythrophleutn suaveolens*, *Newtonia buchananii*, *Treculia africana* and *Trichelia emetica*. In the coastal section, and at the back of the delta, swamp forests are well developed, but have more typically equatorial and coastal species. Other patches of swampy forest, subject to varying degrees of inundation, occur in and around some of the floodplains, e.g. that on the Lambo.

The fauna is as described in the regional introduction. *Crocodylus niloticus*, terrapins, *Varanus niloticus*, and some snakes occur throughout most of the system. Among interesting birds *Scotopelia peli* is locally very common along the more densely wooded banks of the Great Ruaha. Several species of bat frequent the riverine woodlands, including fruit bats and false vampires. *Nandinia binotata* also occurs here, as do genets, mongooses, otters and cane rats. *Hippopotamus amphibius* is widespread, and *Tragelaphus spekei* occurs in the permanent reed swamps.

Human Impact & Utilisation: All the floodplains are utilised, but the small ones, and the Usangu Flats, are situated in sparsely populated areas. However, a railway runs along the northwestern side of the Rufiji Floodplain, and there are roads on both sides, with villages scattered along them and across the southwestern end of the plain. The large floodplains are fished intensively and there are commercial fisheries on the Rufiji Floodplain. Cattle are grazed on the grasslands and crops are cultivated when the floods recede. The Great Ruaha was impounded 968 m asl at Mtera (7°06'S/35°55'E) in 1980, where the lake surface will be 61 000 ha at capacity (Bernacsek, 1984), and also at Kidatu (7°47'S/37°01'E) in 1975, where the lake covers 1000 ha. Both reservoirs are used to generate electricity, and both support fisheries.

Conservation Status: The left bank of the Great Ruaha is protected for 143 km where it forms the southeastern boundary of the Ruaha National Park, but this sector includes no important wetlands. The NE corner of the Rufiji Floodplain is situated in the Selous National Reserve, as is a 106 km section of the Great Ruaha River above its confluence with the Rufiji, a 270 km section of the Luwegu River above its confluence with the Rufiji, and a 162 km section of the Rufiji. In addition a part of the headwater floodplain

on the Lambo River is included in this reserve.

3. Basins of Internal Drainage

(A) THE RUKWA BASIN

General: Lake Rukwa ($7^{\circ}33'$ - $8^{\circ}25'$ S/ $31^{\circ}46'$ - $32^{\circ}51'$ E) is divided into two basins by a central swamp zone, ranging from 5-20 km wide. The lake occupies much of the floor of a rift valley, the mean level of the water surface in the south basin being 820 m asl. The Rukwa Rift Valley is entirely isolated from the Western Rift Valley, which holds Lake Tanganyika in the west, and from the Malawi Rift Valley to the south, although it represents a northerly extension of the latter. The lake is endorheic and varies in size during wet and dry cycles. It has a mean length of about 140 km and reaches maximum widths of 36 km in the north basin and 22 km in the south basin. It is fed by 17 rivers. These drain the plateau country to the east, the Rungwe Volcano complex at the head of Lake Malawi to the south, and the highlands between Lake Tanganyika and the Rukwa Rift in the west. Seven rivers enter the south basin and 10 discharge to the north basin. The steep escarpment of the Mbizi Mountains lies along the western side of the Rukwa Rift, rising to 2664 m asl ($7^{\circ}24'$ S/ $31^{\circ}19'$ E) in the north and 2236 m asl ($8^{\circ}27'$ S/ $32^{\circ}06'$ E) in the south, but the lake is separated from the western wall by broad alluvial plains, in places 38 km wide. On the eastern side the lake lies close to, and even abuts, the escarpment, so that in places rocky cliffs rise 60 m out of the water, but above this the slopes are more gentle, reaching altitudes of 1600-1700 m asl.

A floodplain at the northern end of the lake is either partly or totally inundated at the height of the rains in wet cycles. This measures 38 km wide and 34 km long, and covers 129 000 ha, of which 53 000 ha close to the lake is a semi-permanent swamp. Other permanent or semi-permanent swamps occupy a strip 50 km long and 5 km wide along the southwestern margin of the north basin, and also cover the intervening section between the north and south basins. These swamps occupy at least 39 000 ha.

An extensive wetland system occurs to the north, on the Katavi Plains, which drain to Lake Rukwa via the Kafufu or Kavu River. This system begins with the Katuma River which has a source on the plateau, on an isolated hill ($6^{\circ}05'$ S/ $30^{\circ}38'$ E) rising to 2015 m asl. The river flows south to a confluence with another stream, above which they develop a joint floodplain ($6^{\circ}23'$ - $6^{\circ}33'$ S/ $30^{\circ}44'$ - $31^{\circ}00'$ E) of 43 000 ha, and below which the Katuma traverses a belt of permanent swamps, 20 km long, to Lake Katavi ($6^{\circ}43'$ S/ $31^{\circ}00'$ E). This is a small lake, 5.2 km long and 2 km wide. There is a swampy floodplain on the western shore of the lake, which drains northeastwards, the river now being called the Kafufu. This flows NE to the village of Sitalike ($6^{\circ}39'$ S/ $31^{\circ}08'$ E), where it swings through 135° to flow SW through another zone of permanent swamps ($6^{\circ}42'$ - $7^{\circ}00'$ S/ $31^{\circ}08'$ - $31^{\circ}11'$ E), 1000 m asl and covering 24 000 ha, before entering Lake Chada ($6^{\circ}58'$ S/ $31^{\circ}15'$ E).

Lake Chada is situated just below the 1000 m contour. It too is a small lake, 5x3 km, but receives another affluent, the Msaginya River which flows in from the Mlala Hills

to the east, through a 22 000 ha floodplain (6°46'-7°02'S/31°16'-31°35'E). This is aligned SE-NW and is 44 km long and up to 12 km wide. The Kafufu leaves Lake Chada at its southwestern extremity and flows south to more permanent swampland (7°05 ' -7°17' S/ 31°19'-31°32'E), which is additionally fed by hot springs (7°15'S/31°23'E). In these swamps the river receives tributaries from both sides of the Rukwa Rift Valley, before flowing 50 km to enter the swamps at the northern end of Lake Rukwa.

The Rungwa River enters the northeastern end of Lake Rukwa and has a large catchment on the plateau to the east. It rises at about 1580 m asl and flows north to traverse a permanent swamp (7°01 ' -7°07'S/33°46'-33°59'E) about 1350 m asl, from where, after receiving many affluents, it reaches Lake Rukwa. It is not a perennial river.

The Mtemba River rises high in the mountains separating Lakes Rukwa and Tanganyika, and flows south to a swamp/floodplain 1400 m asl (8°41'-9°07'S/32°02'-32°24'E). The southern tip of these swamps reaches the Zambian border, but they drain northeastwards via the Mtembwa River, which becomes the Mfafia above the point at which it enters Lake Rukwa.

Hydrology & Water Quality: The catchment of Lake Rukwa exceeds 85 000 km², and direct precipitation over the lake is close to 930 mm/yr. The principal inflows to the south basin are from the Lupa and Songwe Rivers, both of which drain the Rungwe Volcanoes, although the Lupa also has an extensive catchment on the plateau to the east. The Mfafia River, which drains part of the western escarpment, enters the central swamps between the two basins, while the Kafufu enters at the northern extremity. These are all perennial rivers, but the other inflows are seasonal, or seasonal in most years. The water is saline with comparatively high levels of sodium and carbonate.

The lake floor slopes from west to east so that maximum depths occur close to the eastern shore. The north basin is shallow and may dry completely in some years, while the south basin has maximum depths of about 6.5 m, reducing to c. 3 m in dry cycles. At high water the two basins become continuous but the water depth over the barrier seldom exceeds 1 m and is not sufficient to engulf the emergent macrophytes.

Flora & Fauna: The floodplain grasslands around Lake Rukwa are short, and are dominated by the salt tolerant species *Diplachne fusca* and *Sporobolus spicatus*. Papyrus grows in the permanent swamps around the lake, where there is a supply of fresh water from affluent streams, and is dominant in the swamps on the Kafufu River. In most sites it is associated with *Phragmites mauritianus* and other typical species. The small lakes, Cahada and Katvi, have a dense submerged flora and support carpets of waterlilies inside the fringe of emergent macrophytes. All the watercourses of the system carry galleries of woodland, similar in character to those described in the previous section for the western parts of the Ruaha/Rufiji system.

Twenty-four species of fish have been identified in Lake Rukwa, the most important being *Alestes itnberi*, *Clarias mossambicus*, *Hydrocynus lineatus*, *Schilbe mystus* and *Oreochromis rukwaensis*, the latter being both endemic to the lake and the most abundant species. This fish is better able, than the others present, to survive drastic phases of drying such as have occurred several times within the last hundred years. Other species include *Barbus* spp., *Gnathonemus nzacrolepidotus*, *Haplochromis bloyeti*, *Lates fulleborni*,

Mormyrus longirostris, *Oreochromis esculentus* and *Synodontis* sp. *Crocodylus niloticus* is present on the lake margins and along the affluent streams. Among the birds large numbers of *Pelecanus onocrotalus* are present, nesting at the northern end of the lake. Other birds include *Ardea melanocephala*, *Grus carunculatus*, *Nycticorax leuconotus* and *Plegadis falcinellus*. *Hippopotamus amphibius*, *Redunca arundinunz* and *Tragelaphus spekei* are found in the swamps, the latter being common along southwestern shores of the north basin. Large mammals found at the lakeside, i.e. on the short-grass floodplain, are *Damaliscus lunatus*, *Equus burchelli*, *Kobus ellipsiprymnus*, *K vardoni*, *Loxodonta africana* and *Syncerus caffer*. A race of zebras marked with spots instead of stripes is present.

Human Impact & Utilisation: The system is isolated and the population scant, but it has been increasing in recent years. There has long been an artisanal fishery using dugout canoes in shallow water, but commercial fisheries have had a chequered history, having been started and abandoned on several occasions. *Oreochromis rukwaensis* has always been the principal species in the commercial catches, and in the past was smoked and sun-dried for market. The yield has varied from 30-40 kg/ha/yr.

Conservation Status: The Uwanda Game Reserve, established in 1971, protects much of the southwestern and central shores of the north basin and is contiguous with the North Rukwa Controlled Game Area which covers the north end of the lake. Some 50% of these areas, i.e. about 250 000 ha, are subject to seasonal inundation. The North Rukwa Controlled Game Area is contiguous with the Katavi National Park, gazetted in 1974. This contains most of the Katavi Plains wetlands including Lakes Katavi and Chada.

Wetland Name: The Bahi Swamp

Country: Tanzania

Coordinates: 5°51' -6°16' S/34°59' -35°19' E

Area: 125 000 ha

Altitude: 796-804 m asl

Nearest Towns: Dodoma (44 km E); Dar es Salaam (440 km ESE)

General: This seasonally inundated semi-permanent endorheic swamp is situated west of Dodoma and receives affluent streams in radial fashion from the surrounding plateau country, and from hills in the northeast and north. Its boundary is almost exactly delimited by the 800 m contour. It is 54 km long and 30 km wide and supports salt-tolerant grasses such as *Sporobolus spicatus*, and some sedges and reeds. The main road from Dar es Salaam to Mwanza on Lake Victoria runs along the northern side of the swamp. Some hunting takes place here and the area is unprotected. One of the southern affluents is impounded at Nondwa (6°21'S/35°20'E) to produce a reservoir of about 500 ha.

(B) THE EYASI & YAIDA BASINS

General: The Nyahua River rises on the interior plateau (5°52'S/33°21'E) and

flows SW-NE. It develops a floodplain 1-5 km wide for 60 km (5°19'-5°38'S/ 33°09'-33°28'E) with an area of about 11 000 ha, before reaching a confluence with the Wembere. Immediately below this confluence the Wembere traverses a large floodplain, 105 km long and up to 20 km wide, covering more than 140 000 ha (4°12'-5°01' S/ 33°47'-34°11'E) before entering the southern end of Lake Kitangiri (4°00'-4°12'S/ 34°10'-34°24'E), c. 1150 m asl. This lake is 30 km long, has a maximum width of 8 km at the northern end, and an open water area of 11 500 ha. Another river, the Manoga, also feeds Lake Kitangiri, which is a fresh water lake with a conductivity of about 780 μ S/cm and a sodium ion concentration of 156 mg/l. It has an outflow from its northern extremity into the Sibiti River.

The Sibiti receives 6 major affluents above Lake Eyasi (3°24'-3°49'S/34°43'-35°21'E), but it carries water to the lake only in wet years. It enters the southern extremity of Lake Eyasi, which is oriented SW-NE, and is 80 km long, with a mean width of 14.5 km, and an area of 116 000 ha. When the Sibiti does flow, its waters are often quickly dissipated over the lake bed which is usually dry. Two other affluents enter the lake directly, but even during wet cycles the depth of water in the lake is generally less than 1 m. A number of permanent springs exist around the lake margin, but their waters also evaporate quickly on the lake floor. Direct precipitation in this part of Tanzania is generally in the vicinity of 600 mm/yr.

An entirely separate endorheic wetland, the Yaida Swamp, is situated immediately east of Lake Eyasi (3°52'-3°58'S/34°56'-35°08'E) on the floor of the Eastern Rift Valley, but separated from Lake Eyasi by a low ridge. This system is fed by a stream from the north, draining the mountainous eastern rim of the Eastern (Gregory) Rift Valley above Lake Manyara.

Flora & Fauna: The affluent streams carry gallery woodlands, the floodplains are dominated by grasses, and the freshwater swamps by papyrus. The immediate margins of Lake Eyasi are bare, but at a distance they carry short grasslands containing *Diplachne fusca* and *Sporobolus spicatus*, with *Cyperus laevigatus* in boggy sites.

Since Lake Eyasi is dry for much of the time it contains no fish other than *Oreochromis amphimelas* which lives in the springs around the lake. However, the fish faunas of Lake Kitangiri and the Wembere River are representative of the western equatorial part of the region, with species of *Alestes*, *Clarias*, *Hydrocynus*, *Lates*, *Mormyrus*, *Schilbe* and *Synodontis*. The amphibian population of the rivers and swamps is abundant, and the system supports crocodiles, monitors and snakes, as well as a rich avifauna. In total nearly 400 species of birds have been recorded here. The spectrum of mammals in the galleries, swamps and floodplains is as described in the regional introduction.

Human Impact & Utilisation: Lake Kitangiri supports a fishery with an annual yield of 600-4000 tonnes. There were 500 fishermen operating on the lake in the period 1971-1975, when *Oreochromis amphimelas*, *O. esculentus* and *Tilapia rendallii* formed the bulk of the catch. The last two species having been introduced from Lake Victoria. The gallery forest trees are exploited for timber and firewood and there is some cultivation of the Wembere Floodplain.

(D) THE LAKE NATRON BASIN

General: Lake Natron is a shallow endorheic soda lake, situated (2°05'-2°36'S/35°53'-36°08'E) on the floor of the Eastern (Gregory) Rift Valley, reaching the Kenyan border in the north. It is 57.5 km long, has a maximum width of 22 km, a mean width of 15 km, and an open water surface of 85 500 ha at an altitude of 610 m asl. It has a maximum depth of 50 cm and is fed by seasonal streams from the Ngorongoro Highlands in the south, from Mt. Gelai (2942 m asl) in the southeast, the Nkito Hills in the east and the highlands along the western margin of the valley. However, the principal affluent, the Ewaso Ngiro River, is perennial. This rises on the western slopes of the Mau Escarpment in Kenya and flows southwards along the western side of the Rift Valley, under the Nkuruman Escarpment, passing 12 km west of Lake Magadi, before entering Lake Natron through the Ngare Ngiro Swamp (2°01'-2°11'S/35°59'-36°09'E). This wetland comprises a permanent herb swamp of some 4000 ha upstream, and a seasonal floodplain of about 8000 ha, which extends down to the lake and along the eastern lakeshore. Lacustrine sediments above the level of the present Lake Natron suggest that it was at one time continuous with Lake Magadi, 21 km north. The water is highly saline, with chloride concentrations reaching 65 000 mg/l.

Flora & Fauna: The lake is endorheic and highly saline and has no macrophyte flora, but the herb swamp is a fresh water system with a typical spectrum of tall species including *Cyperus papyrus*, *Phragmites australis* and *Typha domingensis*. Stands of *Hyphaene coriacea* and *Raphia farinifera* have been reported here. There is a rich vertebrate fauna in the swamps with an abundance of birds. *Oreochromis alcalicus* is found in springs and creeks around the lake in waters with salinities exceeding 40700.

Human Impact & Utilisation: The swamp is virtually unutilized.

Conservation Status: Unprotected.

(E) THE LAKE MANYARA BASIN

General: Lake Manyara is oriented almost due N-S and lies in a trough, 960 m asl, in the line of the eastern margin of the Eastern (Gregory) Rift Valley. The lake has an area of 41 300 ha at high water and a maximum depth of 3.7 m. An escarpment rises steeply, 200-900 m above the level of the lake, along its western shore, and the Ngorongoro Highlands rise to 3658 m asl, some 45 km to the north. Several perennial streams flow to the lake. The Simba River enters the north end from the Ngorongoro area, and there is a substantial swamp to the east of the river mouth. The Makayuni River drains the plateau lands to the east, while other, semi-perennial streams descend the escarpment and have built alluvial fans into the lake, e.g. the Ardi, Enoobash, Bosayo, Ndala, Chem Chem and Masasa Rivers. The area of the lake is very variable; during dry cycles it contracts to reveal expanses of alkaline mud-flat. The waters are saline, and conductivities as high as 94 000 $\mu\text{S/cm}$ have been recorded, while the pH is usually in the vicinity of 9.5. Sodium is the dominant cation,

with mean concentrations of 2510 mg/l, with calcium the next most abundant at 1.5 mg/l. Chloride ion concentrations reach 1168 mg/l.

On the plateau below the eastern rim of the Gregory Rift Valley is the Shuriro Swamp (4°32'- 4 °58'S/36°08'-36°14'E), 50 km long and up to 12 km wide, with a wet season area of 36 000 ha. This drains northwards via the Tarangire River. Some 20 km WNW of the Shuriro Swamp the Kisaki River rises in another swamp (4°19'- 4 °38'S/ 35°48'-35°57'E). This is situated close to the mountains of the rift valley margin and covers 19 000 ha at high water. On leaving it the Kisaki reaches a confluence with the Tarangire 30 km below Shuriro Swamp, and the river, then flowing due north, enters the Tarangire National Park through yet another swamp (3°50'- 4°31' S/36°08'-36°13'E). This is 61 km long and 10 km wide and has an area of 60 000 ha in wet years. All these swamps are situated very close to 1200 m asl, and flow in the connecting watercourses is sluggish. Yet farther north the Tarangire receives the overspill from Lake Burungi, a small fresh water lake 23 km west of the river. Below this confluence the Tarangire swings NW to reach Lake Manyara. However, another, apparently endorheic swamp, is situated to the east of this system (4°21'-4°35'S/36°16'-36°26'E) at Oljoro, 1100 m asl, and is fed by several short seasonal streams.

All the rivers and streams of the Tarangire system contract to a series of pools during the dry season, and much of the swampland dries out revealing hard black cracking clay soils, especially during prolonged dry cycles. Lake Burungi, however, is perennial.

Flora & Fauna: The low lying alkaline flats around Lake Manyara are covered by short grasses including *Diplachne fusca*, *Odyssea jaegeri* and *Sporobolus spicatus*, with *Cyperus laevigatus* in permanently wet spots. The vegetation is generally zoned according to depth and duration of flooding, but fresh water species become dominant at river mouths, and in these places there are large stands of *Typha doiningensis*. Wherever fresh water influence is high there are patches of groundwater forest and *Cynodon dactylon* swards. The plateau is covered by *Acacia-Commiphora* bushland, but the Tarangire and its affluents support sparse gallery woodlands. The swamps through which they flow contain *Phragmites mauritianus* and *Typha donzingensis*, together with sedges and some short grasses. There are patches of dense groundwater forest which contain *Acacia tortilis* among other species. *Oreochromis amphimelas* lives in springs around the lake, which is its type locality. Over 400 species of birds have been identified in the basin. At times *Phoeniconaias minor* is present in large numbers, while *Charadrius venustus*, *Oxyura maccoa* and *Thalassornis leuconotus* are other important species. *Hippopotamus amphibius* is present on the lake margins and at the mouths of affluent streams, with several large mammals on the surrounding plains and in the gallery forests. These include *Damaliscus lunatus*, *Kobus ellipsiprymnus*, *Loxodonta africana* and *Syncerus caffer*. Small mammals include *Atilax paludinosus*, *Aonyx capensis*, *Lutra maculicollis* and civets, genets and mongooses.

Human Impact & Utilisation: The basin is an important tourist area and there is an hotel just outside the park a few kilometres from the northwest end of the lake. The indigenous population is quite dense to the north, around the town of Arusha, and settlement is increasing on the plateau to the east of the lake, but the wetlands *per se* are not heavily exploited.

Conservation Status: The northwestern part of the Manyara lakeshore and the northern two-thirds of the lake itself is protected in the Lake Manyara National Park. A large sector of the Tarangire Swamps is contained in Tarangire National Park.

(F) THE BURIGI & IKIMBA BASINS

General: These two small lakes are situated in northwestern Tanzania, between the Kagera River and Lake Victoria, being isolated from both, and from each other, by hill ridges rising 1300-1715 m asl. Lake Burigi (2°01'-2°12'S/31°14'-31°20'E) is 18 km long, 4 km wide and has an area of about 7000 ha. It is fed by run-off from its immediate surroundings, and by rivers from hills to the south. The largest of these, the Ruiza, is 108 km long, with a broad, often indiscrete course. It is swampy in its lower reaches, and carries gallery forest. Papyrus swamps occur around the lake, and there are patches of groundwater forest on the flats about the lake. The northwestern part of the lake and lakeshore are situated within the Burigi Game Reserve. *Kobus ellipsiprymnus* and *Hippopotamus amphibius* occur here.

Lake Ikimba has an area of some 12 500 ha. It is situated almost due north of Burigi (1°24'-1°35'S/31°30'-31°36'E) and is also fed by a southern affluent. It is 18 km long and has a maximum width of 12 km. Both lakes are about 1200 m asl, and neither has an outflow. There is little information regarding the biology, hydrology and water quality of these lakes, but the flora and fauna are expected to be typical of western equatorial districts. Lake Ikimba is not protected.

4. Natural Lakes

(A) LAKE VICTORIA

Location: 0°30'N-3°12' S/31°37'-34°53'E

Area: 6 889 000 ha (c. 3 375 600 ha in Tanzania)

Altitude: 1134 m asl

Nearest Towns: Mwanza (on S lakeshore), Musoma (on E lakeshore)

General: In terms of surface area, Lake Victoria is the 3rd largest lake in the world, with 49 % of its area in Tanzania. It has a maximum recorded depth of 85 m and a mean depth of 40 m. It stretches 412 km from north to south between latitudes 0°30'N and 3°12'S, and 355 km from west to east between longitudes 31°37' and 34°53'E. It contains numerous islands and has a highly indented shoreline which Welcomme (1972) estimates as 3460 km long. However, published shoreline measurements are notoriously variable, since they depend absolutely upon the scale of map used for their determination and how far each indentation is measured. Welcomme's estimate appears conservative, especially if island shores are included. The innumerable bays and inlets of the lake margin occupy valleys of the pre-lake system, and they differ in ecology from inlet to inlet, and from inlets to the main lake. Much of the margin is swampy,

being fringed by dense papyrus stands. Mean monthly air temperatures over the lake range from 21.0-25.0°C. February and March are the warmest months, while December and January are the coolest ones.

The lake occupies the shore of a vast shallow basin formed by the upwarping of the eastern and western margins. The geological history of the lake is not agreed, but interpretations of modern data are given by Bishop (1969), Kendall (1969) and Temple (1969), while Greenwood (1965a) and Worthington (1954) deal with the history and development of the fish fauna. It is clear from fossil evidence that an earlier lake, or system of lakes, with a Soudanian fauna, occurred in the area in the early Miocene and persisted until at least 16 million years BP, but when and why this lake declined is obscure. That its fauna was different is clear from the fact that it contained *Lates* and *Polypterus* which are not indigenous to the modern lake. Between the disappearance of the old lake and the development of the present lake it seems that rivers from western Kenya flowed across the area to Lake Edward, and thence it would seem, to the Nile. With the upwarping of land in the west, to create that side of the present basin, these rivers reversed their directions of flow. Although today the pattern of their tributaries, as seen on a map, suggests that they flow to Lakes Edward and Albert, they actually flow eastwards to Lake Victoria. The important rivers in this context are the Katonga and Kafu Rivers, both of which have swampy watersheds close to the Western Rift Valley, from which they flow sluggishly eastwards, as swampy water courses rather than rivers, to Lake Victoria. From the western sides of these watersheds the Katonga still flows to Lake Edward and the Kafu flows to Lake Albert.

It seems that the present Lake Victoria is about 750 000 years old, but because of the slowness of the upwarping along the western margin, it may have continued to discharge to Lake Edward, via the Katonga, until about 20 000 years ago, whether or not the present northern exit had been forged at that time. A series of three raised beaches, 18, 10 and 1 m above present lake level, indicate past periods of higher water level and stability, the last dated at 3700 BP. The causes of these higher levels and the comparatively sudden drops are not known. They could have been due to climatic changes, or to the opening of new effluents at successively lower levels, or a combination of these factors. Certainly the climatic events which led to the disappearance of the great Pleistocene water bodies from the Sahara cannot have failed to have influenced Lake Victoria. It seems that the modern lake shrank below its outflow level at least twice, once between 14 500 and 12 000 BP, and again for a period around 10 000 BP. This is deduced from dated sediments rich in precipitated carbonates, and from the analysis of pollen in cores, which indicate dry conditions contemporary with low lake levels. The lake was high in 1876, possibly close to the level of the lowest raised beach, but had fallen to almost 4 m below it in 1900. From that time until 1961, the level of the lake was stable with inter-annual fluctuations of about 1 m, but in 1961-64 the level rose sharply to the present level, 1 m below the lowest raised beach. High water was then maintained into the early 1980s. The dramatic rise of the water level between 1961-64 has had profound consequences for the marginal habitats of the lake.

A fossil cichlid, provisionally assigned to *Oreochromis spilurus*, which is now confined to the Ewaso Ngiro and the rivers flowing to the Indian Ocean, occur in deposits east of the lake. Again the interpretation of this is not certain, but it may be that the eastern side of

the Lake Victoria Basin was once farther west than it is now. However, there seems no reason to doubt that the fish fauna of the present lake was derived from that of the old rivers flowing west across the area, which would have undergone 'ponding' prior to the development of the lake. This was followed by a burst of speciation in the cichlid stock with the advent of true lacustrine conditions, as has occurred in the great lakes of the Western Rift Valley. Beadle (1981) gives a good introductory account of the history of the lake and its fauna.

Hydrology & Water Quality: The principal affluent is the Kagera River which drains the highlands of Burundi and Rwanda along the eastern rim of the Western Rift Valley. Thereafter the Nzoia River, which enters the northeastern corner, is the most important affluent. This river drains parts of the Mt Elgon Massif and the Cherangany Hills in Kenya, but it is far more seasonal in its discharges than is the Kagera. Other important inflows are from the other rivers of the northeastern and northwestern quadrants. Those of the northeast are very seasonal and comparatively swift flowing, while those of the northwest are less seasonal and very sluggish. The southeastern affluents are of comparatively little importance and drain areas of rather arid plateau country, including the Serengeti Plains. Direct precipitation contributes more water to the lake than riverine inflows. It decreases from west to east across the lake, being 2000 mm/yr on the central western shore near Bukoba, but just over 1100 mm at the southwestern corner and only 750 mm in the southeast. The northern shores receive rather more than 1100 mm/yr. The lake is generally well oxygenated, at least to depths of 30 m, with concentrations ranging from 4.6-9.4 mg oxygen/l, although stratification does occur. Water temperatures range from 23.0-30.0°C, the highest readings being made in shallow bays. Secchi depths range from 35-200 cm. The concentrations of the principal ions, as given by Talling & Talling (1965) are: sodium 10.4 mg/l; potassium 3.8 mg/l; calcium 5.6 mg/l; magnesium 2.6 mg/l; chloride 3.9 mg/l; silicate 4.2 mg/l; and sulphate c. 1.0 mg/l.

Flora & Fauna: The phytoplankton is dominated by cyanophytes. Islands of *Cyperus papyrus*, with its typical associates, detach from the fringing swamps. The lake itself contains submerged species such as *Ceratophyllum demersum* and *Potamogeton* spp. around the margins, while waterlilies and *Pistia stratiotes* are found floating in quiet spots. Copepods and rotifers are abundant in the zooplankton. Enormous swarms of lake flies, mainly chaoborids (especially *Chaoborus anomalus*) and chironomids, rise from the lake surface from time to time, generally a few days after a new moon, and at these times the waters may be churned up by fish struggling to eat the pupae as they rise to the surface to emerge. The fly swarms, which may be over a kilometre long and up to 100 m high, are often attacked by flocks of birds. The total biomass of these flies in the lake is prodigious.

The fish fauna is essentially nilotic, but there are many endemics, including nearly 200 endemic cichlid species and 4 endemic genera. More than 150 of the cichlids belong to the genus *Haplochromis* according to Greenwood (1974a). Many species leave the lake to spawn in the affluent streams. There have also been some introductions, e.g. *Lates albertianus*, *Oreochromis niloticus*, *O. leucostictus* and *Tilapia zillii* were introduced before 1962 and are now widely distributed.

Crocodylus niloticus has been intensively hunted on the lake and is now nearly extinct there. Many of the Equatorial East African animals cited in the regional introduction occur in, or on the shores, including water turtles, aquatic snakes, monitor lizards, a wealth of birds, rodents, otters, *Hippopotamus amphibius*, *Kobus ellipsiprymnus* and *Tragelaphus spekei*.

Human Impact & Utilisation: The shores of the lake are fairly densely populated. The lake is fished commercially by trawling, and by artisans using seines and lines from beaches and canoes. The total annual catch is difficult to estimate but is probably in the region of 130 000 tonnes, with as much as 51 000 tonnes being taken from Tanzanian waters in 1969, when 2600 canoes were operating with gill nets. Yields from Tanzanian waters subsequently went into a decline, despite an increased number of canoes. It is therefore noteworthy that Welcomme (1972) cites the estimated maximum sustainable yield from Tanzanian waters as 21 000 tonnes/yr. The introduced *Lates niloticus* now comprises between 40-55% of the commercial catch, with individual fish weighing as much as 45 kg. Other important fish caught commercially include species of *Bagrus*, *Engraulicypris*, *Haplochromis*, *Mormyrus* and *Oreochromis*.

The lake has long been important for communications, but the construction of a railway and good roads around the northern shore, linking Uganda with the coast has lessened the amount of cargo and the numbers of passengers carried across the lake.

Conservation Status: A very small length of lakeshore in the SW is protected in the Biharamulo National Reserve, and Rubondo Island in the SW (2°25'S/31°50'E) is a National Park. Otherwise the lake is unprotected in Tanzania.

Wetland Name: Lake Tanganyika

Country: Tanzania

Coordinates: 3°21'-8°51'S/29°04'-31°12'E

Area: 3 294 480 ha (c. 1 350 736 ha in Tanzania)

Altitude: 773 m asl

Nearest Towns: Kigoma (on lake); Tabora (340 km E)

General: Lake Tanganyika is 659 km long with a maximum width of 85 km at the parallel 5°55'S. It is slightly brackish and the second deepest lake in the world at 1470 m, at which point its bottom is 697 m below sea level. It lies in the Western Rift Valley and down most of its western side the escarpment plunges straight into the water. In the south basin it continues underwater to the maximum depth of 1470 m, which is reached just 4 km offshore. Only at the northern and southern ends is the underwater slope moderate, and even in these places the 100 m contour is reached inside 10 km. The adjacent mountain ranges exceed 3000 m in altitude at the northern end of the lake, which is fed by several large rivers and countless small streams. These enter all round the periphery, from Zambia, Tanzania, Burundi and Zaire. 41% of the lake surface is situated in Tanzania. The Ruzizi River, draining Lake Kivu, descends the Panzi Falls before entering Lake Tanganyika so that the two lakes are faunally isolated. The Ruzizi has formed a substantial delta at the north end of Lake Tanganyika. The other principal affluent is the Malagarasi River, which drains much swampy land to the south of Lake Victoria and enters from Tanzania. The lake drains from the middle western section, in Zaire, via the

Lukuga River to the Lualaba. Water levels fluctuate over long time periods, much as they do in Lake Malawi to the south, a matter discussed by Camus (1965).

The lake is ancient and was long isolated, which accounts for the fact that it contains a higher proportion of endemic species than any other African lake. It seems clear that in pre-rift days, rivers such as the Malagarasi flowed west across the region to the Zaire Basin, and that rifting interrupted their flow and produced the lake. The original fauna of the lake would have been derived from that of the rivers concerned, but there have been subsequent arrivals from the Zaire Basin via the Lukuga. A good introductory account of the history of the Lake is given by Beadle (1981).

Hydrology & Water Quality: Although it is a freshwater lake the salinity is elevated, 0.5‰, and this may in part reflect the salinity of the input from the Ruzizi which is 0.65700. Direct precipitation makes a significant contribution to the annual inputs, but the bulk of the inflow is riverine. During the rainy season most of the streams draining the escarpments are torrential. Far more water, probably 80-85%, evaporates from the lake surface than leaves by the Lukuga River (15-20%). There is a vast mass of anoxic, stagnant, sulphide charged water in the lake below a depth of 200 m. The concentrations of the principal ions are sodium, 57 mg/l; potassium, 35 mg/l; calcium 9.8 mg/l; magnesium 43.3 mg/l; chloride 26.5 mg/l; sulphate 5.0 mg/l and silicate 0.4 mg/l. Carbonates are present in a concentration of 6.7 meq/l (Talling & Talling, 1965).

Flora & Fauna: *Ceratophyllum denzersunt* is abundant in the vicinities of affluent river mouths, while in the deltas of several rivers *Azolla pinnata* may form immense floating mats, green or red-brown in colour, and there are great submerged beds of *Myriophyllum spicatum*, *Najas marina*, *N. pectinata*, *Ottelia ulvifolia*, *Potamogeton pectinatus* and *P. schweinfurthii*. *Potamogeton* spp. are the predominant macrophytes around much of the shoreline, with occasional rafts of *Nymphaea caerulea* and *N. capensis* in shallow sheltered bays. *Cyperus papyrus*, *Phragmites mauritianus* and *Typha domingensis* dominate the delta swamps, with *Vossia cuspidata* as the principal low growing associate.

The lake contains a large fish fauna comprising some 193 species from 13 families. Although 98% of the cichlids and 57% of the non-cichlid species are endemic, similar proportions to those found in the faunas of Lakes Malawi and Victoria, it is the degree of speciation here, which distinguishes Lake Tanganyika from the others. It contains no less than 8 endemic genera, and some endemic species reveal distinct subspecific forms between the north and south ends of the lake. Zaire Basin species have invaded the lake comparatively recently, presumably by way of the Lukuga River, the most recent effluent. These include *Distichodus fasciatus*, *Hydrocynus goliath* and *Labeo lineatus*. Other interesting species include *Polypterus congicus*, *Protopterus aethiopicus* and *P. ornatipinnis*, also Zaire Basin species which live in lagoons and deltas around the lake, especially the Malagarasi Delta. These are ancient fish and their presence has probably been continuous from the time when the Malagarasi flowed directly into the Zaire basin, before the faulting which led to the development of the Rift Valley and its lakes. There are two fully aquatic piscivorous snakes in the lake. *Boulengerina annulata* lies up in the rocks during the day and fishes nocturnally, while *Glypholycus bicolor*, hunts pelagic fish, chiefly shoals of *Stolothrissa*

tanganicae. A general account of the vegetation is given by van Meel (1952), while Poll (1950; 1952) discusses the fish and Leloup (1952) the invertebrates.

Human Impact: The lake is fished from ports in all four countries which border the lake, but Kigoma is the main port in Tanzania. Historical surveys show that the fishery yields from the lake have varied considerably this century. A sardine fishery (*Stolothrissa*) operates, but is concentrated on ports in Zambia and Burundi, and indeed fishing intensity for all species is higher at the southern and northern extremities than at other parts of the lake. The annual landings of sardines in Burundi ranged from 3500-8900 tonnes during the period 1972-76, while figures for Zambia over the same period were slightly lower. The total catch for the lake in 1971 was 73 268 tonnes, with 44 468 tonnes being landed in Tanzania. Estimates of the total fish biomass in the lake, made by acoustic methods, have varied between 500 000-2 600 000 tonnes, and estimates of the maximum sustainable yield for all species range from 22-100 kg/ha (Smart, 1978). A comprehensive bibliography of fisheries and limnology for Lake Tanganyika is available (FAO, 1982).

There is an important network of steamer services on the lake, the shoreline being unsuitable for the construction of good roads. Only around the northern end of the lake, in Burundi and Zaire, are there roads of importance.

Conservation Status: A small area, which includes a 1 km stretch of lakeshore south of Kigoma, was declared a National Park in 1985, largely to protect the chimpanzees which still occur in the area. This is the only section of the entire lakeshore which is protected.

Wetland Name: Lake Malawi

Country: Tanzania

Coordinates: 9°30'-14°27'S/33°58'-35°19'E

Area: 2 975 000 ha (none in Tanzania)

Altitude: 475 m asl

Nearest Towns: Mbeya (90 km NW); Dodoma (425 km NE)

General: Lake Malawi is situated in the southern part of the Western Rift Valley. Tanzania has 305 km of shoreline, but none of the lake surface is in Tanzania. The lake is 565 km long in a N-S direction, has a maximum recorded depth of 706 m, and is the second deepest lake in Africa. In the north, the Kipengere Mountains fall steeply to the lake surface and continue into the depths of the northern basin. To the east and west, other escarpments form sheer cliffs at the water's edge. Much of the shoreline is rocky, giving rise to sheltered bays in places, but where the escarpments do not descend directly into the lake, there are coastal plains of varying widths, which are subject to flooding when water levels are high. In the south of the lake the topography is less rugged. The lake is of sufficient size to modify the climate locally. Annual rainfall reaches 2500 mm at the northern extremity of the lake but riverine inputs are more important than direct precipitation. The lake level fluctuates by 70-180 cm/yr. The principal water loss (80-90%) is through evaporation, with the remaining 10-20% leaving the southern extremity via the Shire River. Details of the biology, hydrology, water quality and history of the lake are given in section 5.4.6.

Small deltas with fresh water swamps occur at the mouths of some streams entering the

lake on the Tanzanian shore. The lake is covered by a network of steamer routes which connect Tanzanian ports with others in Malawi and Mozambique. The lake is fished both commercially and by artisans from Tanzanian ports. The annual catch landed in Tanzania had reached 21 000 tonnes in 1971, and at that time exceeded the joint catch landed in Mozambique and Malawi (Welcomme, 1972). The lakeshore is unprotected in Tanzania.

(D) MINOR LAKES & SWAMPS

The Balangida/Singida Lakes: Southeast of Lake Eyasi, in the highlands along the eastern rim of the Gregory Rift Valley, there is a collection of small endorheic lakes and swamps. The largest of the lakes are Lakes Balangida ($4^{\circ}22'S/35^{\circ}18'-35^{\circ}24'E$) and Balangida Lelu ($4^{\circ}40'S/35^{\circ}09'-35^{\circ}16'E$). Lake Balangida is 14 km long, up to 3.5 km wide and covers 6000 ha. It is situated in a deep trough close to the 1800 m contour in forested country, and is surmounted by steep rock walls which rise abruptly to 2000 m. Immediately above these cliffs, on the southeastern side, the perfect volcanic cone of Mt. Hanang rises to 3418 m asl. Lake Balangida Lelu, to the south, is 10 km long and about 4 km wide at the northern end. It is close to 1400 m asl, and the northern end is set in forested country.

Ten kilometres west of Lake Balangida Lelu, swamps develop in the wet season in an area 30 km from N-S and 10 km from E-W ($4^{\circ}28'-4^{\circ}48'S/34^{\circ}57'-35^{\circ}06'E$), covering about 25 000 ha. At the northeast corner of these swamps is a semi-permanent lake ($4^{\circ}33'-4^{\circ}38'S/34^{\circ}56'E$) which is fed by two short seasonal streams and seepage from the swamp. A further 18 km west there is another swampy trough, about 15 km long and 4 km wide, oriented SW-NE, with Singida Lake ($4^{\circ}49'S/34^{\circ}44'E$) at its southern end. Two other very small lakes lie immediately south of this.

The surrounding plateau supports *Acacia-Coininiophora* bush, but the streams carry sparse gallery woodlands, and although there are patches of groundwater forest in some of the swamps, these are dominated by reeds, sedges and *Typha* sp. The area is comparatively densely populated and the unprotected areas are heavily grazed.

Ngorongoro Crater: The crater, or more properly caldera, is situated ($3^{\circ}05'-3^{\circ}14'S/35^{\circ}29'-35^{\circ}37'E$) on a volcanic massif, rising to 3648 m asl at Mt. Loolmalasin, in the Eastern Rift Valley between Lakes Eyasi and Natron. The rim of the caldera, 2270-2700 m asl, is nearly 15 km across, and on the floor 610-760 m below, there is a series of fresh and brackish-water lakes and swamps, and some dense *Acacia* woodlands, all protected in the Ngorongoro Crater Conservation Area. The caldera floor supports an abundance of wildlife, including many aquatic and semi-aquatic species, and others which visit the wetlands regularly. A great many of the animals listed in the regional introduction for Equatorial East Africa occur here.

Arusha National Park: This park includes a series of little crater lakes, some less than a kilometre long and only a few hundred metres across. The two largest are the Big and Small Momela Lakes, the small one being 3 km long and 900 m wide. The big one has an equivalent area but is shorter and wider. The other lakes are Lakes Kasare,

Lekandiro, Longil, Sanijo and Tulusia. The Momela Lakes are a haunt of flamingoes.

Serengeti Plains: There are two saline lakes on the Serengeti Plains. Lake Logaria (3°00'S/35°01'E) and Lake Magadi (approximately 2°40'S/35°50'E). These are important to flamingoes. Both are situated within the Serengeti National Park.

5. Artificial Impoundments

General: The total surface area of impoundments in Tanzania is 84 813 ha, if all reservoirs are at capacity. The largest reservoir is at Mtera, where the dam was closed in 1980. The second largest is at Nyumba ya Mungu, where the dam was closed in 1965. This latter reservoir has been intensively studied.

Wetland Name: Nyumba Ya Mungu Reservoir

Country: Tanzania

Coordinates: 3°41'S/37°27'E

Area: 18 000 ha (at capacity)

Altitude: 670 m asl

Nearest Towns: Moshi (50 km N); Dar es Salaam (390 km SE)

General: This reservoir, otherwise known as Lake Pangani, is a multipurpose impoundment of the Pangani River, which was completed in 1965. It is used for the generation of electricity and for irrigation, and supports a fishery. It is 25 km long and 15 km wide at maximum, with a maximum recorded depth of 41 m and an estimated storage capacity of 1.12 billion m³. Retention time is currently close to 9 months. Although Denny (1978) states that it is situated 670 m asl, several maps place it above the 800 m contour. It is situated in a low rainfall zone, c. 500 mm/yr, and is fed by the Kikuletwa River which rises on Mt. Meru, but receives four affluents from Mt. Kilimanjaro, and the Ruvu River which originates at Lake Jipe, but receives three affluents from Mt. Kilimanjaro. Lake Jipe is fed by the Lumi River from Mt. Kilimanjaro. There is a swamp 5.2 km wide and 8.4 km long at the northeastern corner of the reservoir where the Kikuletwa enters.

Denny (1978), Welsh & Denny (1978) and Bailey & Denny (1978) have made detailed studies of the reservoir and its biology.

(A) MTERA RESERVOIR

General: This is a recent impoundment on the Great Ruaha River, just below its confluence with the Bubu River (approximately 7°06'S/35°55'E). According to Bernacsek (1984) this reservoir will have a surface area of 61 000 ha, which will make it by far the largest impoundment in Tanzania, and currently the tenth largest in Africa. This is a new reservoir and we have no information regarding either its hydrology or biology.

(B) OTHER RESERVOIRS

General: There are reservoirs at Hombolo on the Wami River (1500 ha), and at Kidatu on the Great Ruaha River (1000 ha). Other reservoirs are at Igombe (1300 ha), Dobola, Ikowa, Kalimawe, Kerenge, Kisasi, Malya, Manda, Mianje, Muchlur, Nhimbu, Nondwa and Uchama. Taken together these 15 reservoirs account for only 7% of the national area.