

2.5 KENYA

Introduction

Kenya has an area of 582 645 km², a population of 18 750 000 (1983) and thus a mean population density of 32.2 persons/km². It is bounded by Tanzania in the south, Uganda in the west, Sudan and Ethiopia in the north and the Indian Ocean in the east, and has a shoreline of approximately 810 km. In the west there is a further shoreline of 550 km on Lake Victoria. The country exhibits greater extremes of altitude than any other African country except Tanzania, rising from sea level to 5200 m at Mt. Kenya (0°09'S/37°19'E), the highest point in the country. It stretches 1062 km from north to south, between latitudes 5°00'N and 4°40'S, and 891 km from west to east between longitudes 33°58' and 40°55'E. Along the shores of the Indian Ocean the coastal plain, below 200 m, widens from south to north. It reaches a minimum width of 21 km just north of Mombasa (4°03'S/39°41'E) and a maximum width of 240 km at Kiamboni on the Somalian border. In passing westwards the land surface rises to a plateau 500-1000 m asl in the north, and 1000-1500 m asl in central and southern districts. Numerous hilly ranges rise above the plateau in the north, the most important being the Huri (1252 m asl), Katigithigira (986 m asl), Lapurr (1481 m asl), Loichangamatak (1175 m asl), Marsabit (1702 m asl), Mogila (1694 m asl), Murua Lokwana (1701 m asl), Pelekech (1585 m asl) and Songot (1752 m asl) Ranges. In the south, the Wundanyi Hills rise to 2209 m asl (3°23'S/38°18'E). In central districts mountains rise much higher above the plateau, among them the isolated volcanic massif of Mt. Kenya.

The Eastern or Gregory Rift Valley crosses the country sinuously, from Lake Natron in the south to Lake Turkana in the north, bisecting the interior plateau. Mountains occur along the valley margins, and several important lakes lie on its floor in central Kenya. On the eastern side of the valley the Aberdare Mountains rise to 3999 m asl at Mt. Lesatima (0°18'S/36°37'E), while on the western side, peaks reach 3098 m asl (0°45'S/36°06'E) on the Mau Escarpment and 3370 m asl (1°15'N/35°26'E) in the Cherangany Hills. West of the Rift Valley land slopes down to Lake Victoria with a water surface at 1133 m asl. Mt. Elgon, 4321 m asl, is another isolated volcanic massif, situated in central western Kenya on the Kenya/Uganda border (1°07'N/34°32'E).

Drainage

Drainage of the far northwest is by very seasonal rivers to the Lotikipi Plain where the Lotikipi Swamp extends into Sudan. Here the Kotome River flows SW from Sudan, and the Nanam Tarach and Narengmor Rivers flow NE from the Kenya/Uganda border, dissipating their waters in the endorheic system. To the south of this the eastern slopes of Mt. Elgon, and the Cherangany and Cherapokot Hills, drain to Lake Turkana in the Rift Valley, by the Kerio, Kalabata, Lokichar and Turkwel Rivers. The eastern slopes of the interior plateau however, drain to the Indian Ocean. In the north a number of seasonal rivers, but most importantly the Laghs Bogal, Bor and Dera, flow into Somalia, and the swamps on their lower courses are described in section 2.7 Somalia. The higher central

part of the interior plateau, including Mt. Kenya, is drained by the Tana River and its tributaries. This, the largest river of Kenya, enters the sea through a delta at Formosa Bay on the central Kenyan coast. Another large perennial river, the Galana, drains the southernmost part of the interior plateau. A series of endorheic soda lakes occupies the central part of the Kenyan Rift Valley, receiving the run-off from the opposing valley sides, but in the south Lake Natron also receives drainage from the western side of the Mau Escarpment via the Ngiro River. This stream, having first flowed SW, cuts back through the more southerly Nikuruman Escarpment into the Rift Valley.

Climate

Rainfall increases from north to south along the coast, and also becomes less seasonal in this direction. Lamu ($2^{\circ}16'S/40^{\circ}54'E$) receives a mean annual total of 889 mm, but 80% of this falls in the three months from April to June, with 345 mm in May. The other 9 months bring less than 50 mm each. Malindi ($3^{\circ}14'S/40^{\circ}07'E$) receives 1022 mm/yr, while Mombasa receives 1040 mm, with an average of 240 mm in May, and more than 50 mm in every month except January and February. There are only 45 rainy days a year on the Somalian border, but 90 such days at Lamu and 140 at Mombasa. At Vanga ($4^{\circ}40'S/39^{\circ}13'E$) on the Tanzanian border it is wet from May to December with scarcely a break. The eastern slopes of the interior plateau are dry, and this part of Kenya is semi-desert. Here in the north, Moyale ($3^{\circ}30'N/39^{\circ}04'E$), 1113 m asl, on the southern edge of the Ethiopian plateau, receives an average of 687 mm rain/yr. April is the wettest month with 186 mm, and more than 50 mm is received in both March and May, but there is a second rainy season in October-November, during which a further 185 mm is received. In the far northwest, Lodwar ($3^{\circ}07'N/35^{\circ}35'E$) is very dry. This centre is 506 m asl, 51 km west of Lake Turkana, and receives 166 mm rain/yr, with a single peak in April when 45 mm may fall. In central districts, in the valley of the Tana River, 128 m asl, Garissa ($0^{\circ}27'S/39^{\circ}39'E$) receives 301 mm rain/yr. Monthly falls in excess of 50 mm are recorded only in April, November and December. In the far south Voi ($3^{\circ}24'S/38^{\circ}35'E$), 560 m asl, receives 538 mm/yr. December is the wettest month, with an average receipt of 125 mm. March, April and November receive over 50 mm, but June, July and August are virtually rainless. Thus the eastern and northwestern interior is semi-desert. In the highlands, Meru ($0^{\circ}03'N/37^{\circ}40'E$), on the northeastern slopes of Mt. Kenya, 1570 m asl, receives 1370 mm rain/yr.

There are two distinct wet periods, peaking in April (275 mm) and November (320 mm), while no month between June and September receives more than 25 mm. The upper slopes of Mt. Kenya receive just over 2000 mm rain/yr and constitute the wettest part of the country. Nairobi ($1^{\circ}17'S/36^{\circ}49'E$), 1661 m asl, receives 907 mm/yr, with 200 mm in April, 140 mm in May and close to 100 mm in both October and November. Farther north, equidistant from the Aberdare Mountains and Mt. Kenya, Nyeri ($0^{\circ}25'S/36^{\circ}57'E$), 1829 m asl, receives 932 mm rain/yr with a very similar distribution, but Nanyuki ($0^{\circ}01'N/37^{\circ}05'E$), 1945 m asl, receives only 743 mm/yr but over 50 mm falls in all months except January and February. It is shielded from the influence of the SE winds by Mt. Kenya. In the southern Rift Valley, Magadi ($1^{\circ}54'S/36^{\circ}18'E$), 619 m asl, receives only 411 mm rain/yr. There is a reduced two peak pattern. March-April-May is the wettest period, each of these months receiving over 50 mm, with a minor wet season in November-December. Farther north and higher up, Nakuru

(0°17'S/36°05'E), 1850 m asl, receives 862 mm/yr, but here a rainy season extends from the beginning of April to the end of August. In the highlands west of the Rift Valley, Narok (1°07'S/35°52'E) is situated below the Mau Escarpment, 1890 m asl. It records an average of 729 mm rain/yr, with a single wet season between January and May. April is the wettest month with a mean receipt of 147 mm. Farther north, Eldoret (0°30'N/35°16'E), 2085 m asl, receives 1085 mm rain/yr, with a single wet season from April to August, with August the wettest month with a mean receipt of 175 mm.

Precipitation over the northern part of the Lake Victoria basin is comparatively high at lake level, and increases up the slopes towards the highlands along the western side of the Kenyan Rift Valley. There is no really dry season in the basin since all months receive more than 50 mm, but January and February are the driest months at all stations, while April and May are the wettest ones. Kisumu (0°04'S/34°45'E), 1157 m asl on the lakeshore, has a mean annual rainfall of 1295 mm with 200 mm in April. Kisii (0°40'S/ 34°45'E), at an altitude of 1768 m, receives 1767 mm rain/yr; Kericho (0°23'S/35°16'E) at 1981 m asl receives 1848 mm rain/yr; Kakamega (0°18'S/34°45'E), 1554 m asl, receives a mean annual total of 1923 mm. In these last three stations over 250 mm are received in April.

Temperatures are moderated by altitude inland, and by sea breezes at the coast. Thus the hottest parts of the country are the eastern slopes of the plateau along the Somalian border and the low northwestern part of the plateau around Lodwar. The mean annual temperature at Mombasa, on the coast, is 26.3°C, with a mean maximum of 30.3°C and a mean minimum of 22.4°C. Annual absolute maxima and minima for this place average 37.3 and 14.1°C. Corresponding figures for Garissa, at low altitude and away from the sea, are 28.4, 34.3 and 22.5°C, with absolute recordings of 46.1 and 13.9°C. At Lodwar in the NW the figures are 29.3, 34.8 and 23.7°C; at Magadi in the southern Rift Valley they are 29.0, 34.9 and 23.1°C. In the Highlands, the figures are 18.2, 26.4 and 10.0°C at Nakuru, and 16.6, 23.6 and 9.5°C at Eldoret. Frosts are seldom experienced below 2000 m, but occur regularly above 2500 m, and there is permanent snow on Mt. Kenya. Kisumu, on Lake Victoria, has a mean temperature of 23.2°C, with mean maxima and minima of 29.4 and 17°C and average annual absolute recordings of 36.9 and 11.0°C.

Mombasa experiences some 2900 hours of sunshine a year, while highland areas are cloudier and Lodwar in the northwest has close to 3600 hours sunshine/yr. Potential evaporation is about 1250 mm/yr at altitudes over 3000 m, but rises to a figure often well in excess of 2500 mm/yr below 300 m.

Vegetation

There is a strip of evergreen coastal forest, occupying the coastal plain in the south, and part of it in central districts. Otherwise the interior of the plain, the eastern slopes of the plateau and the northwestern interior are semi-desert areas, supporting deciduous scrub vegetation dominated by species of *Acacia* and *Cominiphora*. Above this, around the eastern slopes of the highlands, there is savanna country, while the highest areas support Afro-montane evergreen vegetation and Afro-alpine vegetation. The Rift Valley and shores of Lake Victoria support evergreen bushland, with a drier type of rain forest on the slopes leading up eastwards and northeastwards, from Lake Victoria to the rim of the Rift Valley.

Wetlands

Offshore the coast is fringed by coral reefs, and mangrove forests occur at several sites, notably in sheltered bays and estuaries. Many contain barren mudflat areas, often with peripheral saltmarsh vegetation. Floodplains occur on many rivers, and there are permanent swamps on the shores of lakes, and in numerous depressions along rivers. There are several lakes, including the endorheic soda lakes of the Rift Valley and the part of Lake Victoria situated in Kenya. High altitude bogs occur in the mountains.

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1. Tidal Wetlands

General: Mangrove swamps, containing almost the full spectrum of Equatorial East African species, are present in all sheltered sites, but are best developed in estuaries where fresh water influence is pronounced. The coast comprises Pleistocene deposits, raised coral reefs and associated lagoonal deposits, at altitudes below 30 m. North of the Galana River mouth and south of the Tana River mouth there are dunes, but they are limited in extent. The gradients of most rivers are very gentle over the lower coastal plain and tides penetrate the estuaries for tens of kilometres, although many small rivers reach the sea only in the rainy season.

The most northerly stretch of coast is aligned NE-SW and is protected by a series of islands, on the lee shores of which there are mangrove swamps and salt-marshes.

Immediately south of this several seasonal rivers reach the sea at Lamu, and here mangroves are well developed in Dodori and Mongoni Creeks, along Siyu Channel between Pate Island and the mainland, along Kipungani and Mto Wa Channels, and on the shores of Lamu and Manda Islands. The coast continues southwesterly from here, and is generally exposed and devoid of mangroves, until the Tana Delta is reached in Formosa Bay. The delta face has been moulded by strong longshore currents, but bays have developed at the northeastern end, near Kipini (2°32'S/40°32'E), where the main Tana River mouth is situated, and in the southwest, near Karawa (2°39'S/40°12'E), where two distributaries reach the sea. Both these bays support mangroves, which grade into fresh water swamp forests inland. Small mangrove stands then occur, with salt-marshes, in the series of bays leading southwards, and are moderately well developed in the bay at Ngomeni (3°00'S/40°11'E) sheltered by the Ngomeni Peninsula. Thereafter, in passing farther south, mangroves occur at the mouth of the Galana River just north of Malindi, and southwest of this in the large shallow bay at Mida Creek (3°19'-3°23'S/39°40'-39°51'E). Mangroves then occur in Kilifi Creek (3°35'-3°39'S/39°46'-39°51'E), Takaunga Creek (3°41'S/39°51'E), Shimo la Tewa Creek (3°54'-3°58'S/39°41'-39°46'E), Mombasa Harbour (3°58' - 4°08' S/39°32' -39°40' E), Maftaha Bay (4°26' S/39°31' E), Funzi Bay (4°31'-4°35'S/39°23'-39°27'E), and finally along the embayed stretch between Wasini and Vanga (4°31'- 4°40'S/39°14'-39°17'E) where the Mwena and Uмба Rivers reach the sea. In this latter sector the coast is protected by an almost continuous line of reefs and small offshore islands.

Flora & Fauna: The flora and fauna of the tidal swamps is described in the regional introduction. Sea grass beds are well developed in front of the mangroves in places, with species such as *Cyrtodocea ciliata*, *C. rotundata*, *Halodule wrightii*, *Syringodium isoetifolium* and *Thalassia hentprichii*. *Chelonia ntydas*, *Eretmochelys imbricata* and *Lepidochelys olivacea* are found along the coasts and may visit mangroves. *Dugong dugon* forages in mangrove creeks, and birds of the sand and mudflats backing the mangroves include *Calidris alba*, *C. ferruginea*, *Charadrius leschenaultii*, *Larus hemprichii*, *Pluvialis squatarola*, *Sterna saundersii* and *Thalasseus begalensis*. *Damaliscus lunatus* and *Tragelaphus imberbis* occasionally venture onto the mangrove fringes.

Human Impact & Utilisation: Mangroves have been extensively utilised for firewood during this century, and for poles and masts for Arab dhows for many centuries. *Rhizophora nzuconata* is the preferred species for poles, and large quantities were once shipped to Arabia for house construction, while *Heritiera littoralis* is used for masts. The latter species was once in great demand and has been almost completely cut out from many sites. In places mangrove swamps have been cleared for urban development and port facilities.

Conservation Status: Tidal swamps are protected in Lamu District, in the Dodori Coastal Reserve, NE of Lamu, and in the contiguous Kiunga National Marine Reserve, which includes both coastal and offshore island sectors. The coast between Malindi and Mida Creek is reef-fringed and is protected in the Malindi/Watamu Marine National Parks and National Marine Reserves. These include mangrove swamps and salt-marsh vegetation, best developed in Mida Creek. A further tidal area is protected in the Ras Tenewi Coastal Zone National Park, between the Tana River Delta and Lamu. In the south, an area from Kaya Kinondo to Chale Island, is to be protected in the proposed

Diani Marine National Park.

Wetland Name: The Lotikipi Plain

Country: Kenya

Coordinates: 3°52' -5°04'N/34°18' -35°27' E

Area: c. 720 000 ha (c. 500 000 ha in Kenya)

Altitude: c. 490-500 m asl

Nearest Towns: Eldoret (390 km S); Nairobi (630 km SSE)

General: The Lotikipi Plain, 90 km west of Lake Turkana, is a flat endorheic basin which slopes almost imperceptibly northwards into Sudan. It is situated in a semi-desert zone, with direct annual precipitation close to 250-500 mm. It receives water from several seasonal rivers, notably the Kotome, Narengor, Tarach, Napass, Natira and Nanam Rivers. The Kotome enters about half way along the eastern side of the plain, and drains the Murua Lokwana and Lorionetom Ranges to the northeast on the Sudan border. The Narengor drains the Pelekech Range in the south, and enters the southern end of the plain, as does the Tarach River which drains the Murua Nigithigerr and Mersuk Hills. The Napass, Natira and Nanam Rivers drain the highlands along the Uganda border in the west. These rivers overtop their banks after heavy rains and, in concert, may inundate an area of the plain 120 km long, and up to 120 km wide at the northern end in Sudan, with a total area of 720 000 ha. However, the rivers do not always flood together, and indeed may not flood at all in dry years. Thus the area of the plain that is inundated is usually far less than the maximum given. However, the Narengor and Tarach Rivers have definite courses across the plain from south to north as far as the Sudan border, anastomosing and diverging again before that point, and a zone of permanent swamps accompanies them across the lowest part of the plain. While the Kotome River is a tributary of the Narengor River, the western streams do not extend laterally across the plain to a discrete confluence with the Narengor/Tarach system.

Hydrology & Water Quality: The swamp is flooded during the rains to depths in excess of 1 m. The 9 rivers feeding it are seasonal but some retain pools of water in their beds during the dry season.

Flora & Fauna: Essentially it is a grassy floodplain with reeds and papyrus in the wettest sites, and scattered *Acacia* and *Balanites* trees. See regional introduction.

Human Impact & Utilisation: Apparently little utilised, but there is some hunting.

Conservation Status: Unprotected.

3. Riverine Swamps & Floodplains

Wetland Name: The Tana River

Country: Kenya

General: The Tana is the most important river of Kenya, with a mean annual discharge of 5.6 billion m³/yr, i.e. it has a mean annual flow rate of 178 m³/sec, but annual variations are large and total discharges in recent years have ranged from 2.7-10.2 billion m³. Evaporation over the delta is said to account for a loss of 700 million m³ (Haskoning, 1983). The river has three principal sources over 3000 m asl, on the eastern slopes of Mt.

Ilkinangop (0°37'S/36°42'E), which rises to 3906 m in the Aberdare Range. The three headwater tributaries join east of Fort Hall and below this the Tana receives the Thika on the right bank and the Thiba, which rises on Mt. Kenya, on the left, above Seven Forks Falls. Thereafter the river receives two right and two left bank tributaries above Grand Falls, and in this section is impounded to produce reservoirs at Kambuvu, Kindaruma, Gtaru and Masinga. Then flowing northeast and east, it receives several more tributaries. It descends below the 500 m contour at Usneni (0°09'S/38°12'E), and below the 200 m contour 160 km farther on at Mbalambala (0°03'S/39°03'E).

Below this point the Tana flows SE and then S and develops a floodplain which becomes broader towards the coast. In this sector the river supports a wide gallery forest backed by floodplain forest, and permanent swamps become more common downstream. The Tula, Hiraman, Galole, Kokani and Buna Rivers are seasonal streams which drain the lower eastern slopes of the interior plateau. They reach the Tana on its right bank when in flood, but in dry years, some, e.g. the Kokani, may dissipate their waters before they reach the Tana. Floodplains are well developed on the Kathua/Galole system (1°15' -1°25' S/38°55' -39°32' E) and on the Tiva/Kokani system (2°03' -2°25'S/ 38°38' -39°30'E). The Galole floodplain is 70 km long, and with widths of 7 km, occupies about 25 000 ha, while the Kokani floodplain is 112 km long, beginning just above Hidilathi Wells (2°25'S/38°38'E), and up to 10 km wide. It has a high water area of 55 000 ha and includes the Ndarapo Swamp, centred 2°07'S/39°18'E.

Direct precipitation increases downstream on the Tana, from about 250 mm/yr at Mbalambala (0°02'S/39°03'E) to about 1000 mm/yr over the delta. A flood plain extends 300 km downstream, from Mbalambala to the delta, varying in width from 1-9 km, with an area exceeding 150 000 ha. The river bifurcates (2°00'S/40°09'E) immediately below Mnazini, and from here, for 25 km, the two streams are accompanied by strips of high riverine forest backed by a broad floodplain forest with patches of swamp forest and numerous small lakes. At Hewani (2°14'S/40°12'E) another distributary leaves the main channel on the left bank and flanks the northern side of the delta to the sea. Below Lake Bilisa (2°13'S/40°08'E), at the head of the delta, the floodplain widens on the northeastern (left bank) side. There are extensive permanent swamps along the channels and around the lakes, among which Lake Shakabebo (2°17'S/40°11'E) is the largest. In the delta proper the floodplain soils are heavy clays, with numerous shallow depressions, while the prominent forested levees are sandy. The deposition of silt raises the delta surface by some 2 cm each year. As the sea is approached the swamp forests along channels merge into tidal forests on the open creeks. A triangular area, 42 km wide along the coast, and extending 33 km upstream, covering 69 000 ha, is subject to regular inundation. However, the area of the full delta has been estimated at 130 000 ha by Drijver & Marchand (1985), who say that as much as 90 000 ha may be inundated at the peak of the flood. The flood regime in the delta is bimodal, with a major flood in April-June, following rains over the catchments in March-May, and a minor flood in November to December.

Flora & Fauna: Galleries along the upper river and its tributaries contain *Acacia elatior*, *Apodytes dimidiata*, *Aspilia mossambicensis*, *Canthiunz schimperanum*, *Elaeodendron buchananii*, *Ficus eriocarpa*, *Hyphaene coriacea*, *Newtonia* sp., *Populus ilicifolia* and *Rhus natalensis* among others. In places papyrus and *Phragmites mauritianus* occur

beside the river. The flora and fauna of the lower Tana floodplain and its associated swamps, lakes and forests are essentially as described in the regional introduction. The floor of the delta floodplain supports grasses such as *Digitaria adscendens*, *Echinochloa haploclada* and *Sporobolus confinis*. The delta lakes contain dense aquatic vegetation, dominated by *Ceratophyllum demersum*, *Nymphaea caerulea* and *Pistia stratiotes*. Typical riverine swamp forest occurs in permanently wet, but less deeply inundated spots, and this is backed by floodplain forest.

Fish migrate upstream from the sea to spawn, and river fish leave the river to spawn in the swamps and pools of the floodplain in the wet season. *Chelonia mydas* occurs in the delta together with aquatic snakes and varanid lizards. 429 species of birds have been recorded from the delta, of which about 100 are aquatic birds (Ecosystems, 1983), many breeding in the delta. A rather different avifauna occurs in the galleries of the upper river, where among others, *Tockus erythrorhynchus* and *T. flavirostris* occur. *Crocodylus niloticus* and *Varanus niloticus* are common on the upper river, where also, the rare *Malacochersus tornieri* is found on the river banks. Most of the typical gallery forest snakes and mammals referred to in the regional introduction are present here. In the delta and on the lower river there is a rich primate fauna including the endemic subspecies *Cercocebus galeritus galeritus*, and *Cercopithecus aethiops johnstoni*, *C. albogularis*, *Colobus badius rufomitratu*, *Galago crassicaudatus*, *G. senegalensis* and *Papio cynocephalus cynocephalus*. Other mammals include *Canis aureus* (at the southern limit of its range), *Cephalophus natalensis*, *Damaliscus lunatus* (the most numerous large mammal on the floodplain), *Dugong dugon*, *Hippopotamus amphibius*, *Kobus ellipsiprymnus*, *Leptailurus serval*, *Loxodonta africana*, *Otocyon megalotis* and *Syncerus caffer*.

Human Impact & Utilisation: At present there are 4 reservoirs on the upper Tana, at Masinga, Kamburu, Gitaru and Kindaruma, with a total capacity of 1.743 billion m³, and a fifth is under construction at Kiambere. This will have a capacity of 350 million m³. A further 6 reservoirs are planned, to be built at Karura, Mutonga, Grand Falls, Usueni, Adamson's Falls and Kora Hills. It is believed that the upstream reservoirs will store sufficient water to irrigate large areas, and that further land can be converted for agriculture between Bura (1°05'S/39°58'E) and Galole (1°29'S/40°01'E). However, present development in the latter area is much smaller and includes the cultivation of some 6700 ha of cotton. Recently, small scale irrigation farming has been encouraged by the government in the 'Lower Tana Village Irrigation Program'. Major stock routes lead along the western side of the river from Garissa to Karawa, and thence down the coast to Mombasa. East of the river they run from Garissa to Bura, and then across country to Lamu, from where cattle are shipped to Mombasa. Cattle are grazed on the delta floodplains which are free from tsetse flies, and numbers treble during the dry seasons. Malaria is prevalent along the lower Tana River, with a six month transmission period and an incidence as high as that around Lake Victoria. Thus DDT has entered the floodplain foodchains. The river is fished by artisans, all the way to its delta, where freshwater prawns and typical floodplain genera (*Clarias*, *Protopterus*) contribute to the catch. The annual yield has not been reliably reported, but that from the delta is probably in the order of 2000 tonnes. Fish are an important source of protein for the 25 000 people who live in the delta. Whitehead (1960) gives an account of the lower Tana River fisheries, including names of the most important species. An extensive empoldering scheme for

the delta was proposed by consultants from the Netherlands in the early 1980's, details of which are given by Drijver & Marchand (1985).

The present impoundments reduce flooding at Garissa by 50% of what they were, but permit high floods to pass. This means that while the moderate floods, which were extremely beneficial to the people of the delta and lower river, are now suppressed, the damaging high floods still occur. Complete flood control, as envisaged, will prevent floodplain disasters but will alter the entire economy and ecology of the floodplain district. It is likely that savanna species of plants and animals, including tsetse flies, will invade the riverine area and possibly the delta. To date no clear picture has emerged of the new hydrological regime after all upstream projects are completed, but certainly irrigation schemes and impoundments will reduce the available discharge to the delta to about 30% of the current mean annual volume. Clearly this will have a drastic detrimental effect upon the floodplain ecology.

Conservation Status: The northern bank of the Kamburu Reservoir, a drowned section of the Tana, forms the boundary of the Mwea National Reserve. Part of the left bank of the river in its upper course is protected in Meru National Park, while the right bank forms the boundary of the contiguous North Kitui National Reserve. A further 80 km section of the right bank is protected in another contiguous reserve, the Kora National Reserve, 125 km east of Mt. Kenya. The southern boundary of this latter reserve is the Mwitamisyi River, a tributary of the Tana. Part of the floodplain with sandy river courses, but not the main river, is protected in the Arawale National Reserve, NE of the river in Garissa County. However, the most important reserve is the Tana River Primate Reserve, on the river north of Garsen between latitudes 1°45'-1°54'S. Here 50 km of the river channel with its sandy levees, adjacent black cotton soil floodplain, and numerous oxbows and sections of abandoned channel are protected. The delta is unprotected.

Wetland Name: The Athi/Tsavo/Galana System

Country: Kenya

General: The Athi has sources on the eastern rim of the Kenyan Rift Valley both north and south of Nairobi. The most southerly of these, the Sinya River, drains the Athi Plains and flows NE for 95 km, receiving headwater tributaries from the dip slopes of the Aberdare Mountains on its left bank, and others from the Kaputei Plains on its right bank, before rounding the flanks of 01 Doiyo Sapuk (2146 m asl). From here it flows SE for 250 km along the southwestern flank of the Yatta Plateau, a long flat-topped ridge aligned NW-SE. In this sector it receives many seasonal streams on its right bank, draining the slopes below Machakos, before reaching a confluence with the Kiboko River (2°09'S/37°54'E). Below this the river continues southeastwards to a confluence (2°59'S/38°31'E) with its principal tributary, the Tsavo River, near the town of that name. The river, then known as the Galana, veers east and after some 30 km, descends Lugard's Falls. It descends to the coastal lowlands some 45 km farther on, and crosses them with an ever decreasing gradient, to reach the sea through a swampy floodplain with numerous oxbows and other small lakes, north of Malindi. In its lower course it is often referred to as the Sabaki River.

The Kiboko also has sources on the plateau along the eastern rim of the Rift Valley, the

most important draining country to the north and south of Mt. Ile Melepu which rises to 2146 m asl (2°00'S/36°45'E). These several streams unite to form the O1 Keju which, with other tributaries, develops a more or less continuous floodplain of 25 000 ha above Merueshi, between longitudes 36°57' and 37°30'E,

The Tsavo has sources on the northern and eastern slopes of Mt. Kilimanjaro (5898 m asl in Tanzania). Many streams descend the mountain and feed endorheic swamps in the trough between Kilimanjaro and the NW-SE oriented Chiule Range (2174 m asl), 50 km distant in Kenya. Here the Namalog Swamps (2°41'-2°44'S/37°23'-37°34'E) are situated immediately west of the several sources of the Kikanet River. These swamps are part of the Lengurruahange Swamp Complex dealt with in section 2.5.4b, Lake Amboseli. At the confluence with its tributary from the Chiule Range, the Kikanet River has a floodplain (2°36'-2°44'S/37°38'-37°43'E) merging into an extensive permanent swamp zone (2°38'-2°46'S/37°40'-37°44'E), below which the river is called the Lolterish River. This receives the other tributaries from Mt. Kilimanjaro in another floodplain zone (2°51' -2°59' S/37°46'-37°53'E) before joining the Tsavo proper (3°01'S/38°00'E) below Kitane Lodge. In flowing east from here, to its confluence with the Athi, the Tsavo receives numerous seasonal affluents from the Serengeti Plains and Taita Hills in the south.

Flora & Fauna: The river and its tributaries support galleries of forest, stretches of which are subject to varying degrees of inundation. The permanent swamps in the upper reaches are predominantly papyrus swamps, but swamp forest occurs on the coastal plain. Very many of the species cited in the regional introduction for forested floodplains on equatorial rivers are present, but *Acacia elation* and *A. xanthophloea* also occur on the riverside and at Mzima Springs. Copley (1958) and Whitehead (1960) give some account of the fishes and fisheries of the lower reaches of the river. Important species include *Clarias* spp., *Clarotes* sp., *Labeo gregori* and *Oreochromis spirulus*. Freshwater prawns are common in the Sabaki, notably *Macrobrachium lepidactylus* (which grows to 40 g), *M. rude* and *M. scabrinsculum*, while *Caradina africana* and *C. nilotica* occur in the lakes of the floodplain. *Crocodylus niloticus* occurs in many pools and *Varanus niloticus* is common. Among birds, *Anastomus lamelligerus*, *Dendrocygna viduata*, *Egretta ardesiaca*, *Halcyon leucocephalus*, *Haliaeetus vocifer*, *Ispidina picta*, *Pandion haliaetus*, *Rhynchops flavirostris* and *Threskiornis aethiopicus* occur here. Among large mammals, *Hippopotamus amphibius*, *Kobus ellipsipryninus*, *Loxodonta africana*, *Panthera pardus* and *Syncerus caffer* occur in the wetlands.

Human Impact & Utilisation: Artisanal fisheries occur on the system, and much of the floodplain outside the protected areas is cultivated in the dry season. Water is carried by pipeline from Mzima Springs at the SE end of the Chiulu Range to Mombasa. The springs used to discharge southwards to the Tsavo River.

Conservation Status: A section of the upper Athi River is protected, where it flows through Nairobi National Park. About 120 km of the Tsavo and 230 km of the Athi/Galana Rivers are protected in the Tsavo East and West National Parks, but this does not include any of the important wetlands. Rather more than half (13 500 ha) of the floodplain on the Kiboko River is situated in the Amboseli National Park.

Wetland Name: The Ewaso Ngiro North

Country: Kenya

General: This river has 4 major sources on the western slopes of Mt. Kenya which unite with the Suguroi and Ewaso Narok Rivers from the Aberdare Mountains, on the high plateau east of the Rift Valley. The Ewaso Narok descends steeply northeastwards to the high plateau and then spreads its waters over the 50 000 ha expanse of the Ewaso Narok Swamp below Rumuruti (0°15'-0°23'N/36°33'-36°40'E). One of its headwater tributaries flows out of the mountains parallel with the Ewaso Narok, a few kilometres to the east, and spreads over Pesi Swamp (0°05'-0°10'N/36°36'E) on reaching the plateau. Some 40 km farther north this tributary joins the Ewaso Narok in the Narok Swamp. This latter swamp is 55 km long and 12 km wide. From here the river flows to its confluence with the Ewaso Ngiro North, after which the combined stream flows north and then east to Barasalinga (0°47'N/37°06'E), and then southeast and east to Archer's Post (0°38'N/37°40'E) where its mean flow is 740 million m³/yr or 23.5 m³/sec. Below Archer's Post the river crosses an undulating plateau eastwards, descends Chanler's Falls (0°46'N/38°04'E) and then flows ENE, spreading its waters near Sericho (1°08'N/ 39°06'E) into a vast swamp/floodplain. The upper swamp is generally called Lorian Swamp, but this narrows and continues southeast and east into Somalia. Here the river used to be known as the Lak or Lagh Dera, a variant of which name is still used in Somalia.

The swampy zone (0°11'-1°15'N/38°47'- 40°21'E) is 196 km long and 25 km wide at maximum, with a total area of 231 000 ha. A floodplain begins at longitude 40°21'E and continues, 2-5 km wide, as far as the Somalian border (41°00'E), becoming permanently swampy again at the border. The flow of the Ewaso Ngiro does not pass Lorian Swamp in dry cycles, but in addition to water arriving via the Ewaso Ngiro, the swamp is also fed by 15 wadis from the SW and 16 from the NE, and in wet years local precipitation makes a major contribution to the hydrological regime. Although mean annual rainfall over the swamp and local catchments is only 180-250 mm, annual totals are very variable; falls can be much greater than this in wet years and vice versa. The area inundated is thus subject to considerable expansion and contraction.

Flora & Fauna: Riverine forest accompanies the upper course of the river, containing *Acacia elatior* and *Hyphaene coriacea*, while saline grasslands adjacent to the upper river are dominated by *Sporobolus spicatus* with *Salvadora persica* bushes. Other briefly flooded areas support *Cynodon dactylon*. *Echinochloa* and *Setaria* spp. occur on flood-plains, while the swamps are freshwater riverine grass/sedge swamps. They are infested with malarial mosquitoes and species of *Biomphalaria* and *Bulinus* which are vectors of the causative organisms of bilharzia. *Crocodylus niloticus* is present all along the river, and *Cercopithecus aethiops* lives in the riverine woodland. Many of the large savanna mammals visit the floodplains, including *Loxodonta africana* and *Syncerus caffer*.

Human Impact & Utilisation: At present these swamps are little utilised.

Conservation Status: A 22 km section of the right (south) bank of the river is protected in the Buffalo Springs National Reserve 85 km north of Mt. Kenya (0°31'-0°39'N/ 7°31'-37°41'E), while a 32 km section of the left (north) bank forms the southern boundary of the Samburu National Reserve. 9 km farther downstream another 34 km of the south bank is protected in the Shaba National Reserve, situated some 70 km NNE of Mt. Kenya, and this reserve includes a large swamp. All these reserves are situated on the undulating plateau below the foothills of Mt. Kenya. Otherwise unprotected.

Wetland Name: The Ewaso Ngiro South

Country: Kenya

General: The Ewaso Ngiro rises as the Guaso Ngiro just south of Shabaltaragwa village (0°33'S/35°48'E), about 2550 m asl. It then flows southwards down the densely forested dip slopes of the Mau Escarpment in parallel with 21 affluents to the SW. These anastomose to form 3 major streams, the Ewaso Ngiro, Engare Narok and the Engare Siapei. The latter pair join the Ewaso Ngiro sequentially as that river descends a trough oriented NNW-SSE into the Rift Valley. It then flows southwards along the western side of the valley, under the Nkuruman Escarpment, passing 12 km west of Lake Magadi, to enter Lake Natron (610 m asl) in Tanzania through the Ngare Ngiro Swamp (2°01'-2°11'S/ 35°59'-36°09'E). The 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.

Flora & fauna: The lake is endorheic and highly saline and has no macrophyte flora, but the herb swamp in Kenya is a fresh water system with a typical spectrum of sedges and grasses. Stands of *Hyphaene coriacea* and *Raphia farinifera* have been reported here. There is a rich vertebrate fauna with an abundance of birds.

Human Impact & Utilisation: The swamp is virtually un-utilised.

Conservation Status: Unprotected.

Wetland Name: Southwestern Rivers

Country: Kenya

General: These rivers rise in the highlands and flow into Lake Victoria, contributing a mean total volume of 7.29 billion m³ water/yr. The most important ones are, from north to south, the Sio, which forms the border with Uganda, and the Nzoia, Yala, Nyando, Sondu and Gucha/Migori Rivers. Between them are many minor streams. The Sio rises on the southern slopes of Mt. Elgon, while the Nzoia, a much larger river, rises high in the Cherangany Hills, but receives 4 major affluents from Mt. Elgon and another from the highlands along the central western part of the Rift Valley. Of the tributaries from Mt. Elgon, the Sosio rises over 3500 m asl, and the Ewaso Rongai, Koitobos and Kuywa Rivers have sources near the 3000 m contour. The Yala drains the central highlands west of the Rift Valley, as does the Nyando, which has sources near Mt. Tinderet (0°06'S/35°21'E), 2640 m asl. The Sondu rises on the dip (western) slopes of the Mau Escarpment, while the Gucha and Migori Rivers drain Mts. Kijaur (0°45'S/34°58'E), 2166 m asl, and Moita (1°05'S/34°44'E), 2037 m asl.

All these rivers tend to flood in concert, having catchments in high rainfall zones with a prolonged summer wet season from April to October. Since in places, the lacustrine plains are very flat, several of these rivers form extensive swamps on the lakeshore. The Yala Swamps (0°07' N-0°01' S/33°58'-34°15' E) encompass the Nzoia Delta and all the lakeshore south to Ugowe Bay, and all the land east to Lake Kanyaboli. They also extend back up the Yala river in the south. In total they comprise 30 000 ha of wetland, including Lake Kanyaboli (1500 ha), and stretch 25 km from W-E and 15 km from N-S at the lakeshore. They also include several minor lakes. Another swamp (0°11' - 0°19'S/ 34°47'-34°57'E) is situated at the mouth of the Nyando River at Nyakach Bay, extending

back onto the Kano Plains, while another (0°18'- 0 °21'S/34°45'-34°48'E) occurs at the mouth of the Sondu River. The Nyando Swamp measures 15 km from W-E and some 6 km from N-S. Together the swamps on the Kano Plains occupy about 10 000 ha. To the south the Gucha Delta (0°54'- 0 °58'S/34°08'-34°11'E) is also swampy, while small swamps occur immediately south of the town of Kisumu and at the mouth of the Mogusi River (0°28'S/34°31'E) on Homa Bay.

Other small wetlands, including seasonally flooded areas and permanent swamps, occur on the upper courses of these rivers and their tributaries. The most important of these are found at the foot of the dip slopes on the west side of the Rift Valley, from the Cherangany Hills south to the equator. One such wetland, which includes both floodplain and permanent swamp, occurs on the Nzoia River (1°00'1°09 'N/34°57 '-35°05 'E) immediately north and east of Kitale. This wetland is 20 km long from NW-SE and 1-5 km wide and used to extend to about 6000 ha. A small permanent swamp, c. 1000 ha is situated (0°52'N/35°13'E) north of the Little Nzoia River. A seasonal floodplain occurs on the Kimandi River, a tributary of the Yala River (0° 12 ' - 0 °16'N/35°10'-35°16'E). This measures 12x6 km and covers 4800 ha.

Flora & Fauna: These are mixed grass and papyrus swamps, with scattered stands of arborescent swamp forest, as described in the regional introduction.

Human Impact & Utilisation: Both the Yala Swamp, and the Nyando and Sondu Swamps on the Kano Plains are being drained for agriculture. It is estimated that at least 14 000 ha of the Yala Swamp can be made productive, and by 1980, 380 ha had been converted for rice production. On the Kano Plains, 900 ha had been converted for rice and sugar cane.

Conservation Status: Unprotected.

4. Natural Lakes

Wetland Name: Lake Victoria

Country: Kenya

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

Area: 6 889 000 ha (c. 413 340 ha in Kenya)

Altitude: 1134 m asl

Nearest Towns: Kisumu (on lake); Nairobi (610 km E)

General: In terms of surface area, Lake Victoria is the 3rd largest lake in the world. 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 hydrology, water chemistry and biology of the lake are dealt with in some detail in

section 2.9 Tanzania, but a brief account of the lake is given here, as it relates to Kenya. The lake level rose by more than 2 m between 1961 and 1964 after a very long period of stability. Just 6% of the lake surface is Kenyan territory, but along the 550 km of Kenyan lakeshore, 6 major rivers discharge a mean average of 7.29 billion m³ water each year, while the contribution from the minor streams has not been properly assessed. However, a survey in 1969-70 indicated that the 10 small rivers entering Winam Gulf, the Kisyau, Muguruk, Luanda, Awach Seme, Nyandina, Obera, Awach Kibos, Awach Kaboun, Awach Tende and Olando, have an estimated mean average combined discharge of 473 million m³ of water each year, assuming run-off to be 18% of rainfall over the catchments. The principal swamps on the lakeshore have been mentioned in section 2.5.3e.

Over Winam Gulf the climate is similar to that cited in the introduction for Kisumu, with mean monthly air temperatures ranging from 21.9-24.3°C. February and March are the warmest months, while December and January are the coolest ones. Winam Gulf is comparatively shallow, having a maximum depth of 35 m and a mean depth of 6 m. Water temperatures range from 23.5-29.0°C, the absolute maximum reading having been made in June 1984. Secchi depths range from 35-155 cm. Generally the gulf is more turbid than the main body of the lake and its waters less productive. Water chemistry is not significantly different from that cited for the whole lake in section 2.5. It is normally well oxygenated throughout the water column, with concentrations ranging from 4.6-9.4 mg O₂/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 denziersunz* 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. The fish fauna is essentially nilotic, but there are many endemics. According to Greenwood (1965a) the lake contains 177 species of fish, of which 127 are cichlids. *Lates albertianus*, *Oreochromis leucosticta*, *O. niloticus* and *Tilapia zillii* had been introduced into the lake before 1962 and are now widely distributed. They certainly occur in all Kenyan waters. Certain species which are common in the lake are comparatively scarce in Winam Gulf, e.g. *Barbus altianalis*, *Labeo victorianus*, *Mormyrus kannume*, *Oreochromis esculentus* and *Schilbe mystus*. Many of the Equatorial East African animals cited in the regional introduction occur in, or on the shores, of the Kenyan part of Lake Victoria, including water turtles, aquatic snakes, monitor lizards, crocodiles, a wealth of birds, rodents, otters and *Hippopotamus amphibius*.

Human Impact & Utilisation: Apart from the swamp areas the Kenyan 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. There is some evidence to suggest that Winam Gulf is currently being overfished. The total annual catch recorded from Kenyan waters has risen steadily from 14 918 tonnes in 1971 to 60 958 tonnes in 1982, but with a sharp drop to about 30 000 tonnes in 1979-80. *Lates niloticus* comprised 54% of the catch by weight in 1982, most of which came from Winam Gulf. In decreasing order of importance *Lates* was followed by species of *Engraulicypris* 17%, *Bagrus* 4%, *Haplochromis* 4%, *Mormyrus* 4% and *Oreochromis* 4%. Kisumu is one of the largest

towns in Kenya, it is an important terminal for shipping services on the lake, and an industrial centre.

Conservation Status: Unprotected.

Wetland Name: Lake Amboseli

Country: Kenya

Coordinates: 2°33'-2°44'S/37°01'-37°15'E

Area: c. 10 000 ha

Altitude: 1189 m asl (lake bed)

Nearest Towns: Nairobi (140 km NNW); Voi (175 km SE)

General: Lake Amboseli is a temporary lake, dry for long periods, situated on the floor of a flat basin 20 km northwest of the massif of Mt. Kilimanjaro. The area subject to flooding is 30 km long, and 10 km wide at maximum, and aligned NE-SW. It extends 5 km into Tanzania at the southwestern end, where it is fed by two seasonal rivers, the Maiteri and Namanga, while the Ngatataik enters it in the northwest, in Kenya. Direct precipitation over the 'lake' averages 305 mm/yr. Several watercourses descend the flanks of Mt. Kilimanjaro toward the lake, but disappear underground before reaching the Amboseli Basin. However, their waters feed extensive, but discontinuous, swamps, between longitudes 37°17' and 37°33'E. A swampy belt therefore extends north of Mt. Kilimanjaro, between Lake Amboseli and the sources of the Kikarankot River (a tributary of the Tsavo). These swamps, of which the Longinye and Namalog Swamps are most important, are the only sources of permanent water in the district and are important watering points for animals.

Flora & Fauna: The basin is set in deciduous *Acacia-Commiphora* bushland, but moist drainage lines support *Acacia tortilis* and *A. xanthophloea*. Most of the floor is flat and alkaline, and supports *Salvadora persica* and *Suaeda monoica* bushes. The swamps contain *Cyperus papyrus* and several other sedges, together with some grasses, including *Aristida* sp., *Cynodon dactylon*, *Digitaria* sp., *Phragmites inauritianus* and *Sporobolus* spp. Over 420 species of birds have been recorded in the area, very many utilising the swamps or the temporary lake. Large mammals regularly present in the swamps include *Hippopotamus amphibius*, *Loxodonta africana*, *Panthera pardus*, *Papio cynocephalus* and *Syncerus caffer*.

Human Impact & Utilisation: Traditionally the wetlands have been of importance to pastoralists and the needs of these people were acknowledged, both when the area was first protected as part of a larger game reserve, and again when it became a National Reserve in 1948. However, the pastoralists agreed to leave when the National Park was created in 1977, in return for various concessions outside the park.

Conservation Status: Swamps and 'lake' protected in Amboseli National Park.

Wetland Name: Lake Magadi

Country: Kenya

Coordinates: 1°44'-2°00'S/36°12'-36°18'E

Area: 10 500 ha total wetland (9 700 ha 'lake' surface)

Altitude: 580 m asl

Nearest Towns: Magadi (on lake); Nairobi (85 km NE)

General: Lake Magadi is oriented almost due N-S, and the main basin is 29 km long and 4.5 km wide, with a NW arm, 12 km long and 2.5 km wide. It is situated on the floor of the Rift Valley and contains water only after heavy rain over local catchments when run-off reaches the northern end of the lake by three wadis. The 'lake' bed is a vast expanse of solid sodium carbonate (trona) and allied salts. However, shallow lagoons at both northern and southern extremities of the basin are perennial and are fed by very hot Spring 5i Water temperatures in the lagoon just ok9Y9 VC, salinities reach 40720, and pH values in the region of 10.5 are regularly obtained. Sodium, bicarbonate and carbonate are the principal ions.

Flora & Fauna: The lagoons support carpets of cyanophytes and swarms of a cichlid fish, *Oreochromis alcalicus*. The subspecies present, *Oreochromis alcalicus grahmi*, is endemic, but the species also occurs in Lakes Natron and Manyara farther south in Tanzania. These fish grow to 10 cm and are the only species present. Flamingoes visit the lake to feed after rains, but their numbers fluctuate greatly.

Human Impact & Utilisation: The sodium carbonate deposits of the lake bed are exploited commercially. Apart from this, the lake is virtually unutilised.

Conservation Status: Unprotected.

Wetland Name: Lake Naivasha

Country: Kenya

Coordinates: 0°42' - 0°50' S/36°16'-36°26'E

Area: 15 600 ha (including islands)

Altitude: 1884 m asl

Nearest Towns: Naivasha (2 km E); Nairobi (65 km SE)

General: Lake Naivasha is situated on the floor of the Rift Valley. It is roughly circular, measuring 14 km from north to south and 17 km from east to west. Crescent Island, actually joined to the eastern shore, is the rim of an old volcanic crater, and Lake Oloidien at the southwestern extremity becomes a discrete, but contiguous, basin at low water. Some 6000 - 13 000 years ago the lake was part of a much larger lake that encompassed the present lakes Elmenteita and Nakuru, and discharged down the Rift Valley southwards. This lake contracted rapidly after 6000 BP and reached present levels approximately 4200 BP, roughly coincident with the great contraction of the Saharan waterbodies.

Hydrology & Water Quality: Lake Naivasha is remarkable in that, although it is endorheic, it is a fresh water lake with a catchment of 2378 km². Wadis from Mt. Longonot, a volcano 2776 m asl, just 13 km south of the lake, do not reach the lake, but no doubt feed it beneath the surface. Other temporary watercourses descend the forested slopes of the (01 Doinyo Oporu) ridge, which extends eastwards from the Mau Escarpment, across the valley north of the lake. These approach to within 5 km of the shore, but again do not reach the lake on the surface. The principal water supply derives from the Aberdare mountains and an area of high plateau farther north along the eastern rim of the Rift Valley. Two rivers drain these areas and enter Lake Naivasha in parallel on the north shore. The easternmost stream, the Malewa, drains the western slopes of the nearby Aberdare Mountains by 9 major affluents, but rises close to the source of the western

river, the Gilgil, on the plateau some 55 km north of the lake. A third and shorter river, the Karati, enters the swamp from the Aberdare Range at the northeastern extremity. The Malewa has a catchment of 1730 km² and provides 90% of the inflow. The Gilgil, with a catchment of only 420 km², may dissipate its waters before they reach the lake, while the Karati flows to the lake only in the December-February period. Groundwater seepage, particularly along the N and NE shores is reputedly responsible for up to 16% of the total inflow. There is probably a subterranean drainage system, but this has not yet been verified. Water depth shows seasonal fluctuations of about 50 cm, but long term fluctuations are much greater and the surface has varied by 8 m over the past 50 years. Maximum depth was 7.3 m in 1973, and mean depth 4.6 m, but by 1979, these figures had increased to 10.0 m and 6.5 m respectively. Oxygen concentrations are of the order 6-9 mg/l, pH in the main lake is 8.5-9.0, but may reach 9.2 in the Oloidien basin. Secchi depths are 1-1.5 m in the main lake, but may be as high as 5.7 m in the basin secluded by Crescent Island and as low as 50 cm in the Oloidien basin. Total dissolved solids ranged from 230-750 mg/l over the period 1919-1974. Concentrations of the principal ions have been known to vary considerably over a five year interval, e.g. from 24-40 mg/l for sodium; 12-20 mg/l for potassium; 16-21 mg/l for calcium; 24-34 mg/l for silicate; 7-14 mg/l for chloride. Bicarbonate is the principal anion however, with concentrations exceeding 190 mg/l. The lake usually stratifies in the mornings, but this persists only for a few hours. Normally the lake is well mixed, even in the Crescent Island Crater basin.

Flora & Fauna: The lake is fringed by *Cyperus papyrus* and *Typha domingensis* along its eastern and northwestern shores, but there is a large floating papyrus swamp along the northern lakeshore, encompassing the mouths of the three affluent rivers. Narrow arms of this extend, more or less continuously around the eastern lakeshore, inside the rooted fringing swamp. These narrow strip swamps have been called papyrus 'reefs'. There is an abundant submerged macroflora in the main lake, including many typical species, e.g. *Ceratophyllum demersum*, *Najas pectinata* and *Potamogeton* spp. Water-lilies are locally abundant. However, the Oloidien basin is less well vegetated, and may support little more than a narrow strip of *Najas pectinata*. The phytoplankton is dominated by cyanophytes, but there are numerous diatoms and chlorophytes.

The density of the zooplankton shows bi-modal peaks, corresponding with the two rainy seasons. The American freshwater crayfish *Procambarus clarkii* was introduced and now forms the basis of a commercial enterprise, but at some cost to the traditional fishery. The only indigenous fish is *Aplocheilichthys antinorii*, but this may recently have become extinct in the lake. *Oreochromis leucostictus* was introduced accidentally and now provides the bulk of the commercial catch. *Oreochromis nigra*, which was deliberately introduced, seems to have died out. *Micropterus salmoides* and *Tilapia zillii* have both survived since their introduction, the former being popular with sport fishermen. Since the introduction of fish, the avifauna has diversified and now includes a number of piscivorous species. *Crocodylus niloticus* survives here, as does *Hippopotamus amphibius* (about a dozen individuals).

Gaudet (1976, 1977a,b) has written about the origin of the swamps and ecology of the lake.

Human Impact & Utilisation: The total annual fish catch on the lake is small, approximately 400 tonnes. The adjacent lands are irrigated from the lake, producing vegetables and flowers. The lake is a popular tourist resort, being just 2 km from the

town of Naivasha. Crayfish is exported to Europe.

Conservation Status: Unprotected.

Wetland Name: Lake Elmenteita

Country: Kenya

Coordinates: 0°27'S/36°15'E

Area: 1800 ha

Altitude: 1776 m asl

Nearest Towns: Nakuru (15 km NW); Nairobi (100 km SSE)

General: This is a shallow saline lake with a maximum depth of 1.9 m. It is situated close to the eastern side of the Rift Valley and is oriented N-S. Its southern end is set at the foot of a lava field which rises to 2128 m asl, while land at the northern end rises to 1950 m asl. It is fed by a small stream from the eastern plateau, which enters at the north end of the lake and there is no outlet. The water is highly saline (c. 40‰ with a mean pH of 9.4 and conductivities which range from 12 000-40 000 µSiemens/cm. Secchi depths vary between 10 and 20 cm. The concentrations of the principal ions vary depending upon the season and the amount of fresh water which has recently entered. However, typical concentrations are sodium 3700 mg/l; potassium 275 mg/l; chloride 1982 mg/l; silicate 200 mg/l; sulphate 140 mg/l; and phosphate 3 mg/l. Little is known of the biology of the lake, but cyanophytes are present, and some copepods have been detected but so far not identified. Large numbers of flamingoes are sometimes present. The lake is little used and unprotected.

Wetland Name: Lake Nakuru

Country: Kenya

Coordinates: 0°19'- 0 °24'S/36°04'-36°07'E

Area: c. 4900 ha

Altitude: 1758 m asl

Nearest Towns: Nakuru (2 km N); Nairobi (120 km SSE)

General: The lake is 9 km long and 5.5 km wide at maximum. It is a soda lake with a mean salinity of 45‰. It is bordered by a scarp of the Rift Valley on the west and a salt-dome hill in the east. The blue-green colour of the water is due to high densities of the cyanophyte *Spirulina platensis*. There are swamps around the lake and alkaline mudflats are exposed around the shores at low water. The open surface normally varies between 3500-4900 ha, depending upon water level fluctuations over cycles of a few years, but the lake has been known to dry completely. It was once, 6000 -13 000 years BP, part of a larger lake which discharged southwards and encompassed lakes Elmenteita and Naivasha. The climate is bi-modal, with two wet and two dry seasons. The mean annual rainfall over the lake is 876 mm, but with substantial annual variations. The lake is set on the floor of the Rift Valley, surrounded by *Acacia* woodland or grasslands with occasional *Acacia* trees, but hills come close to the lake in the east and southwest. Vareschi (1978) gives an account of the ecology of the lake.

Hydrology & Water Quality: The lake is shallow with a maximum depth of 4.5 m and a mean depth of 3.5 m at high water. There are two perennial affluents, the Nderit and

Njoro Rivers and three intermittent affluents, but no effluent. Most of the run-off comes from the western side of the Rift Valley, as all but one affluent originates on the Mau Escarpment, but there are alkaline springs along the north, northeastern and eastern shores. It is believed that evaporation roughly balances inflow. The surface water temperature varies between 25-30°C, but readings of 38°C have been obtained. The pH is 10.5 with little variation, but by contrast conductivity is extremely variable, and readings of 9500 - 165 000 $\mu\text{S/cm}$ have been made. Changes in conductivity do not reflect changes in chemical composition which is homogeneous and stable. Oxygen concentrations approach 1 mg/l at the bottom of the lake, and the lake is generally well mixed. Stratification seldom persists for more than 4 hours/day, if it occurs.

Flora & Fauna: Cyanophytes dominate the phytoplankton, but diatoms and chlorophytes also occur here. There are no macrophytes in the lake. *Cyperus laevigatus* occurs around the margins, at the fringes of the mudflats, with *Sporobolus spicatus* swards behind this. *Typha domingensis* is found at the mouths of the affluent streams. The zooplankton is dominated by a single species of copepod, *Paradiaptomus africana*, but rotifers are present, notably *Brachionus* spp. Chironomid larvae occur in the benthos. There are no indigenous fish, but *Oreochromis alcalicus grahami* has been introduced from Lake Magadi on several occasions for mosquito control. The last introductions were made in 1962, when the lake had recovered from having dried completely. *Oreochromis alcalicus* is herbivorous and has flourished, attracting large numbers of piscivorous birds to the lake. The lake is famous for the great concentrations of *Phoenicopterus ruber* and *Phoeniconaias minor* which gather to feed there, the latter sometimes numbering 1.5 million birds. In addition, a further 117 species are closely associated with the lake, the most numerous of these being *Pelecanus onocrotalus roseus* and *Phalacrocorax carbo*. Others are *Anas capensis*, *Nycticorax nycticorax* and *Platalea alba*. *Hippopotamus amphibius* still survives on the lake in small numbers, while *Aonyx capensis*, *Kobus ellipsiprymnus*, *Redunca arundinum* and *Syncerus caffer* frequent the affluent watercourses and their galleries, together with frogs, crocodiles, monitors, snakes, rodents, otters and monkeys.

Human Impact & Utilisation: The lake is a popular tourist attraction, with over 72 000 visitors in 1979. The manufacturing town of Nakuru (pop. 60 000) is just 2 km distant and sewage is processed on the north shore of the lake and on one of the effluent streams. A substantial proportion, perhaps 45 %, of the land in the catchment is cultivated or grazed.

Conservation Status: The entire lake and its immediate surrounds have been protected in the Nakuru National Park since 1964, and the area of the park was increased to 16 000 ha in 1973.

Wetland Name: Lake Bogoria

Country: Kenya

Coordinates: 0°11' - 0°20' N/36°07' E

Area: 4250 ha (high water)

Altitude: 963 m asl (mean)

Nearest Towns: Nakuru (50 km SSW); Nairobi (175 km SSE)

General: This lake was formerly known as Lake Hannington. It lies on the floor of the

Rift Valley and is 17 km long and has a maximum width of 4.5 km at high water, but both its depth and area vary considerably from year to year. It has a mean lake surface of about 3000 ha. It is an endorheic alkaline soda lake, with hot springs, geysers and fumaroles along its shore. It is fed by these, and by the Waseges River which enters at the northern end. This stream rises south of the lake on the Rift Valley slopes of the Nyandarua Plateau at the foot of the Aberdare Mountains. It flows north, passing the lake to the east, but then turns through 180° to enter the north end of the lake through a swamp. The maximum recorded depth is 8.5 m. Salinity is generally about 35‰, the water temperature is about 24°C, Secchi depths vary from 28-43 cm, conductivities are 10 000-70 000 $\mu\text{S/cm}$, and the pH range is 9.8-10.3. The lake is often the feeding ground for large numbers of flamingoes, and as many as 2 million have been determined. The phytoplankton is dominated by cyanophytes, often by *Spirulina platensis*, yet on occasions this species has been almost absent. There are no macrophytes in the lake, but the lakeshore grassland is dominated by *Sporobolus spicatus*, and the galleries on the affluent stream by *Acacia tortilis*. The zooplankton is relatively abundant and the benthos mainly comprises chironomid larvae. The lake is not utilised and is protected in the Lake Bogoria National Reserve.

Wetland Name: Lake Baringo

Country: Kenya

Coordinates: 0°32'-0°44'N/36°02'-36°08'E

Area: 13 000 ha

Altitude: 975 m asl

Nearest Towns: Nakuru (88 km S); Nairobi (202 km SSE)

General: The lake is set amongst dry *Acacia* scrub on the floor of the Rift Valley north of Lake Bogoria. It is 22 km long, up to 10 km wide, and reaches a maximum depth of about 8 m. There are several small islands in the lake, and the large volcanic O1 Kokwa Island in the centre, on which there are hot springs which discharge into the lake. Mt. Karosi (1448 m asl) is situated at the end of a trough delimited by steep scarps 5 km apart which runs NNE from the head of the lake, while a low watershed in the south separates the Baringo basin from that of Lake Bogoria.

Hydrology & Water Quality: The lake is fed by 6 rivers. The Ndau and an un-named stream drain the nearby Amasya and Thugen Hills and enter the lake in the southwest. The largest affluent, the Molo, has many tributaries with which it drains the northern end of the Mau Escarpment and Mts. Lodiani (0°07'S/35°42'E), 3009 m asl, and Gea (0°03'N/35°26'E), 2772 m asl. It enters the lake through an extensive swamp belt in the south. The Ngusero/O1 Arabel system drains the northern extremity of the Aberdare Range and enters the lake in the southeast, while the Tangelbei and another un-named stream rise on the Laikipia Plateau east of the Rift Valley and also enter the lake in the southeast. The lake is fresh despite the fact that the springs which discharge into it are highly saline, and there is no surface outflow. However, Gregory, who discovered it in 1893, reported that its waters escaped freely under the lava at the northern end, and it cannot be seriously doubted that there is a subterranean effluent.

The lake is well oxygenated, but turbid, with Secchi depths as low as 10 cm having been recorded. The pH range is 8-9, and conductivity is low, c. 420 $\mu\text{S/cm}$.

Flora & Fauna: The Molo Swamps at the southern end of the lake are dominated by *Cyperus papyrus*. *Pistia stratiotes* and *Nymphaea caerulea* float on the surfaces of small bays and along the lakeward faces of the papyrus. There are beds of submerged aquatics, and the phytoplankton is dominated by cyanophytes, notably *Anabaena circinalis* and *Microcystis aeruginosa*. Rotifers are plentiful in the zooplankton, especially *Branchionus calyciflorus* and *Keratella tropica*, together with cladocerans and copepods. *Barbus gregori*, *Clarias mossambicus*, *Labeo cylindricus* and *Oreochromis niloticus* are common fishes. Some 300 species of birds have been identified at the lake, with many piscivores, including *Anhinga rufa*, *Ardea goliath*, *Haliaeetus vocifer* and *Nycticorax nycticorax*. There is an abundant small mammal fauna.

Human Impact & Utilisation: There are no towns in the area, but about 10% of the catchment is cultivated. However, increased erosion in recent years has led to increased siltation and turbidity in the lake. The waters are as yet unpolluted by pesticides and insecticides. There is a fishery with an estimated maximum sustainable yield of 1500 tonnes/yr. Yields in the 1960s were of the order of 600 tonnes/yr, but had declined to less than 450 tonnes/yr by the early 1980s. Tourism is increasing. There are hotels on the western shore and on the large island.

Conservation Status: Unprotected.

Wetland Name: Lake Turkana

Country: Kenya

Coordinates: 2°23'- 4 °35'N/35°50'-36°42'E

Area: 756 000 ha

Altitude: 375 m asl

Nearest Towns: Nairobi (405 km S); Eldoret (252 km SW)

General: This lake was formerly known as Lake Rudolph. It is set in hot barren desert country, much of which receives less than 200 mm rain/yr, in the extreme northwest of Kenya. Mean maximum air temperatures range from 31-33°C, and the climate is remarkably constant. Such rain as does fall may fall at any time of the year. The lake extends 249 km from north to south (265 km along its axis) and has a maximum width • of 48 km. There are three islands, North, Central and South Islands, of which the latter is the largest, measuring some 1 1 x4.5 km. The delta of the Omo River at the north is situated in Ethiopia. The lake is famous for the colour of its water which is largely due to the presence of blue-green algae in the phytoplankton. The maximum depth, 114 m, occurs in a depression of the lake bed close to the southern end, otherwise the deepest part is along the axis, reaching 84 m off Alia Bay on the eastern shore. There are extensive seasonal floodplains in the Omo Delta and in places around the lakeshore. The lake has been in existence since at least early Miocene times, but has varied greatly in size. It was greatly expanded between 9000 and 7500 BP, when it covered the Lotikipi Plains to the west and discharged from them to the Nile. It was this temporary connection that permitted the ingress of a nilotic fauna. The lake level was then 80 m above the present level, and at this time it also received overspill from Lake Ch'ew Bahir, in Ethiopia. The level is still very variable, having been 15 m higher than the current level in 1895 and 5 metres lower in the 1950s. The Omo Delta has been forested in the past, and the remains of a forest, destroyed by recent high water levels, are evident. The floodplains of the delta and the western shore are littered with the remains of contemporary fishes and molluscs. Hopson

(1978) provides a comprehensive survey of the lake.

Hydrology & Water Quality: The lake is fed by 12 principal rivers, while a thirteenth, the Suguta, peters out 36 km south of the lake. The largest affluent is the Omo River which flows south down the Rift Valley from Ethiopia to enter the northern extremity of the lake through a large and swampy delta. The Omo contributes some 18.6 billion m³ of water each year, which is more than 98% of the total riverine inflow (Beadle, 1981), although its catchment represents only 38% of the total lake catchment. This inflow represents a mean discharge rate of 591.4 m³/sec. Thus it is clear that it is rainfall over SW Ethiopia which determines the seasonal, annual, and long term fluctuations of the lake level. The Omo Delta is also joined on its eastern side by the small Macho Alas River and an un-named stream, both of which drain the Hummer Range (2049 m asl in southern Ethiopia). The only affluents on the eastern shore are two un-named temporary watercourses which reach the lake in dry wadis. They may not flow in some years, and in general never discharge water into the lake for more than a few hours in any one year. The western shore affluents are, from north to south, the Loburin, Katabai, Kanukurdio, Kalakol, Turkwell, Lokichar and Kerio Rivers. Of these, only the Turkwell and Kerio are important, between them contributing about 98% of the riverine inflow.

The Kerio drains the Amasya Hills west of Lake Bogoria, the Elgeyo Escarpment along the western side of the Rift Valley and the eastern slopes of the Cherangany Hills. It flows northwards, often deeply entrenched, and in places occupying the floor of a canyon, to enter the lake through a delta. Immediately north, and almost contiguous is another delta formed by the Turkwell and Lokichar Rivers. The Turkwell has sources in the Cherangany Hills which unite on the Suk Plains in the Rift Valley. This river then flows north across the Lebatin Plains to Lodwar, where it swings through 90° to flow east to the lake. Neither the Kerio nor Turkwell Rivers are perennial in their lower courses, but both usually discharge to the lake for a few months each year.

Seasonal water level fluctuations are of the order of 50 -100 cm, but annual variations may be larger. The salinity of the lake has varied between 1.7 and 2.7‰ in recent years. The northern end tends to be less saline and more productive than the southern end. The lake is well oxygenated and well mixed, due to strong, often violent, winds which blow over the lake every morning. However, regional differences in water chemistry do occur, and shallow bays and sheltered inlets may be atypical.

Flora & Fauna: The phytoplankton is dominated by cyanophytes, chiefly *Microcystis aeruginosa*, but with many other species. *Anabaena circinalis* and *Botryococcus braunii* are most important in Ferguson's Gulf on the middle western shore which is very shallow, c. 1.7 m. Papyrus is apparently absent from the lake, as it is from the lower Omo River and Lakes Abaya and Cha'amo. Thus, the salinity in the lake cannot be accepted as the reason for its absence. The principal emergent macrophytes are the grasses *Paspalidium geminatum* and *Sporobolus spicatus* which cover the seasonally exposed shallows, and provide important nurseries for fish. There are extensive *Potamogeton* beds in the shallow bays. *Salvadora persica* forms a bushland on Central and South Islands. Galleries of forest occur along the affluent watercourses, being characterised by *Acacia elatior*, *Balanites aegyptiaca* and *Hyphaene coriacea*.

The zooplankton is dominated by protozoans in terms of numbers, but by crustaceans in terms of biomass. There are 5 gastropod molluscs, *Bellamyia unicolor*, *Ceratophallus natalensis*, *Cleopatra pirothi*, *Gabbiella rosea* and *Melanoides tuberculata*, and two shrimps, *Caradina nilotica* and *Macrobrachium niloticum*. Some 48 species of fish have been identified in the lake, of which 30 are widespread Soudanian types, 8 have restricted distributions and 10 are endemic. Common species include *Alestes baremose*, *A. dentex*, *Bagrus bayad*, *Barbus bynni*, *Citharinus citharus*, *Clarias lazera*, *Haplochromis rudolfianus*, *Hydrocynus forskalii*, *Lates longispinis* (endemic), *L. niloticus*, *Oreochromis galilaeus*, *O. niloticus*, *Synodontis schall* and *Tilapia zillii*. Less common species are *Gynznarchus niloticus* which is confined to the Omo Delta, and *Hyperopisus bebe* and *Mormyrus kannume* which live in affluent streams and venture short distances into the lake when their home streams are in flood. *Malapterus electricus* has been found in the lake but is rare. Several species occur in the crater lake on Central Island which has been isolated from the main lake for about 75 years, and which is three times more saline than Lake Turkana. *Crocodylus niloticus* and *Varanus niloticus* are common, and over 350 birds have been recorded from the lake and its environs. Among them *Alopochen aegyptiacus*, *Calidris nzinuta*, *Hitnantopus hiinantopus*, *Mycteria ibis*, *Plegadis falcinellus*, *Pterocles exustus*, *P. lichtensteinii* and *Threskiornis aethiopicus*. Several large mammals visit the lakeshores including *Acinonyx jubatus*, *Alselaphus buselaphus*, *Damaliscus lunatus* and *Panthera leo*.

Human Impact & Utilisation: There are fisheries on the lake, despite its isolation, and there have been attempts to develop them in recent years as the commercial potential seems great. Hopson (1978) gives a comprehensive survey of the fisheries. There are three hotels on the lakeshore and there is now some tourism.

Conservation Status: Mostly unprotected but an area of the eastern lakeshore and Central Island with its crater lake are protected in the Sibiloi National Park, established in 1972 as a wilderness reserve. There is a crocodile colony with some 12 000 individuals on the Central Island. Early hominid remains, c. 2 million years old, have been found at Koobi Fora, north of Alia Bay, together with evidence of a lush forest climate. Itinerant fishermen call at Central Island and have cut a lot of the *Salvadora persica* bush for firewood, despite efforts to maintain the island as a sanctuary. The southeastern section of the lake is also protected in the Mount Kulal Biosphere Reserve, approved in 1978. This includes the South Island National Park of 3880 ha. Part of the gorge section of the Turkwell River is protected in the Nasolot National Reserve, and a 25 km section of the left bank of the Kerio River is situated in the South Turkana National Reserve, 100 km north of Kitale.

5. Isolated Swamps & Pans

General: A large area subject to shallow seasonal inundation occurs between the Kokani and Galana/Sabaki Rivers in a low rainfall zone of the coastal lowlands (2°19'-2°39'S/39°27'-39°38'E). This measures 32 km from N-S and 21 km from E-W at maximum. It has an area of 34 000 ha and lies inland, 90 km due west of Formosa Bay. It is fed by direct precipitation, peripheral run-off, and several ephemeral streams from the west. Another similar area, containing several separate pans with a total area approaching 16 000 ha, is

situated farther north between the Kokani and Galole Rivers (1°40'-1°52'S/ 39°16'-39°32'E). Direct precipitation over these pans is 300-500 mm/yr.

Temporary wetlands occur in the Boni National Reserve just inland from the sea, west of the Mundane Hills, on the Kenya/Somalia border. The Dodori River traverses this area and a number of wadis lead down westwards from the hills towards it. On the very flat plain at the bottom of the hills, depressions in two large pans (ziwas) may be flooded to a depth of 2 m. Patches of groundwater forest occur on the plain, sustaining *Chlorophora excelsa*, *Memecylon* sp. and *Sterculia africana* among other species.

In northeastern Kenya, south of the village of Wajir (1°45'N/40°03'E), and west of the Somali border, a great many wadis, descending gentle slopes from the north, west and southwest, reach a flat area where they terminate in pans and swamps. This area is traversed from west to east by the Ewaso Ngiro/Lagh Dera system, which usually dissipates its waters here, in the Lorian Swamp, described in section 2.5.3c. Most wadis do not carry water this far and thus a collection of pans and swamps occurs north and south of the river bed. They are all isolated from the river for years on end, but dry watercourses below some indicate an overflow, to, or towards the Ewaso Ngiro in wet cycles. Direct precipitation over this region is approximately 200-250 mm/yr.

The largest of these isolated wetlands is the swampy Boji Plain, an oval area 62 km long and 19 km wide, about 160 m asl. This is oriented NW-SE and lies immediately north of Lagh Bogal (1°07' - 1°31'N/39°41'-40°07' E). It contains 61 000 ha of hydromorphic soil, and is at least partially waterlogged for long periods. In wet cycles it is flooded. Fifty-five kilometres southeast of this, south of the Bogal, at the upper end of the Bun Plains, about 130 m asl, there is another endorheic wetland (0°40'-0°59'N/ 40°28'-40°37'E), comprising a permanent swamp and a floodplain fed by a dozen temporary streams from the NE. This measures 28 km from SW-NE and is 7 km wide in the swamps at its southwestern end, while the northeastern end comprises a floodplain which drains to the swamps. Closer to the Ewaso Ngiro is the Maiti Swamp, 43 km long and 5 km wide, about 115 m asl, and also oriented NW-SE (0°31'-0°51'N/39°53'-40°05'E). Immediately south of this, south of the Ewaso Ngiro, is an oval swamp (0°07'N-0°07'S/ 39°53'-40°01'E), measuring 30x15 km, which receives drainage from the SW. This also is flooded in wet cycles, and is semi-permanently waterlogged.

West and northwest of Lorian Swamp there are lava fields, but another semi-permanent swamp (0°45'-1°01'N/38°30'-38°49'E) is situated 367 m asl, at the foot of a lava massif 40 km west of Lorian Swamp. This covers 24 000 ha and may discharge northwestwards by a series of minor wadis to the Ewaso Ngiro in wet years. The most northerly of these isolated swamps is situated another 100 km north. This is a seasonally inundated wetland and covers 26 000 ha (1°54'-2°11'N/38°21' -38°37'E), 1050 m asl. It is set against the southern flank of a large lava field, and is fed by run-off from the NE, some of which emanates from the Marsabit Range about 40 km away. In wet years this swampy pan drains by a wadi from the southwestern tip towards the Ewaso Ngiro which is 85 km distant.

Another large pan occurs on the Milgis River which has sources in the Karisia Hills on the eastern rim of the Rift Valley. These hills rise to 2531 m asl (1°15'N/36°40'E) near Maralal.

The Milgis River flows northeast from its sources and cuts through the 01 Doiyo Lengeyo Hills, thereafter descending to the semi-desert zone where it terminates in a swampy pan 45 km long and 15 km wide (1°34'-1°50'N/38°06'-38°24'E) at an altitude of about 400 m. In wet years some 40 000 ha may be inundated.

Other permanent swamps and seasonally inundated pans occur on the floor of the Rift Valley. Large seasonal wetlands are situated about the base of Mt. Susua (2357 m asl), in a comparatively high rainfall zone. Numerous watercourses drain the mountain in radial fashion, and discharge into pans to the north and south. The southern system (1°14' -1°21' S/36°15' -36°25' E) is not continuous, but comprises three separate areas, while the northern wetland (0°58'-1°05' S/36°15' -36°23'E) is an integral, although much branched, pan. This is situated between Mt. Susua and Mt. Longonot (2776 m asl), from the southern slopes of which it also receives run-off. To the south, west of Lake Magadi, is the En Doiyo Ngiro system, a small seasonally inundated plain with areas of permanent swamp (1°45'S/36°11' E). This is fed by temporary watercourses rising on Mt. Kisamis (990 m asp 10 km to the north).

Flora & Fauna: *Phragmites*, *Typha* and papyrus are present in the wettest sites, and there are numerous halophytic species including *Cyperus laevigatus*, *Salvadora persica*, *Scirpus littoralis*, *Sporobolus spicatus* and *Suaeda monoica* on the fringes of the most saline, and *Hyphaene coriacea* and stunted figs grow along some watercourses. *Echinochloa* and *Setaria* spp. are common floodplain grasses. Many animals visit these wetlands for water. Species of *Chlorophora*, *Memecylon* and *Sterculia* occur in groundwater forests around some coastal pans. *Crocodylus niloticus* survives in Lorian Swamp, and amphibians, snakes and *Varanus niloticus* are widespread. The avifauna is often prolific and includes flamingoes, herons, weavers and warblers.

Human Impact & Utilisation: All these wetlands are situated in very sparsely populated areas and none is intensively utilised.

Conservation Status: Unprotected.

6. Minor Lakes

General: There are a large number of glacial tarns (small lakes) in the high mountains, for example on Mts. Kenya and Elgon, and in the Aberdare Range and the Cherangany Hills. A number of these are protected in the Mt. Kenya National Park, at altitudes of 3950-4800 m. Some small isolated lakes occur in the Rift Valley. In the far north, Lake Logipi (2°13'N/36°24'E) is situated 15 km south of Lake Turkana in the Suguta Valley. In the far south, Lakes Kwenia (1°47'S/36°30'E) and Kabongo (2°05'S/36°24'E) are situated east and southeast of Lake Magadi respectively. Lake Kwenia is 4 km long and 2 km wide, with a 6 km floodplain at its northern end, in total providing a maximum of 1600 ha of wetland. Lake Kabongo appears to be fed by underground water. In the central part of the Rift Valley, Lake Ilpolosat (0°10'S/36°26'E) is situated on the Nyandarua Plateau at the foot of the Aberdare Mountains. It is about 5 km long and a few hundred metres wide, with an extensive permanent swamp 10 km long on its eastern side, joined by a tract of seasonally inundated land in the south to the Wanjohi River, a tributary of the Malewa River which feeds Lake Naivasha.

Along the southern border with Tanzania there are two more small lakes, Lake Chala (3°19'S/37°42'E) and Lake Jipe (3°31'-3°40'S/37°45'E). The national boundary passes through both lakes, which are approximately half in Kenya and half in Tanzania. Lake Chala occupies about 600 ha and is 20 km east of the Kilimanjaro Massif. Lake Jipe is farther east and receives drainage from Mt. Kilimanjaro and the North Pare Mountains in Tanzania. It has a swampy littoral, and a belt of permanent swampland extends along the border for 30 km west of the lake, occupying some 7500 ha. Another, smaller swamp extends southeastwards from the other end of the lake.

At the coast Lake Mukunguya (2°25'S/40°41'E) is set in an extensive but broken zone of swamps which extends alongshore between Formosa Bay and Lamu Bay. Farther inland, but in the same district, there are a number of temporary lakes or ziwias. The largest of these are Ziwa Roka (2°05'S/40°44'E), Ziwa Shalu (2°08'S/40°27'E), Ziwa Gambi (2°11'S/40°27'E), Ziwa Kiboko (2°15'8/40°24'E) and Ziwa Kambe (2°17'5/40°34'E).

7. Artificial Impoundments

General: The only major impoundments are those constructed or proposed on the Tana River and dealt with in section 2.5.3a