2.4 ETHIOPIA

Introduction

Ethiopia is a mountainous country bounded by Sudan in the north and west, by Kenya and Somalia in the south, and by Somalia, Djibouti and the Red Sea in the east and northeast. It has an area of 1 023 050 km^2, a population of 33 680 000 (1983), and thus a mean population density of 32.9 persons/km^2. It stretches approximately 1645 km from north to south between latitudes 3°25' and 18°00'N, and 1615 km from west to east between longitudes 33°03' and 48°00'E.

The western half of the country, to longitude 40°E, is almost completely occupied by the Ethiopian Massif. The southern part of the massif is split by the Eastern Rift Valley which, running SW-NE, divides it into a large northwestern block and a small southeastern block. Active volcanoes occur in the rift valley, right through to the Djibouti border. In the northwestern highlands, Mt. Ras Dashen (13°12'N/38°25'E) rises to 4620 m asl, and there are five other peaks above 4000 m, while in the southeastern highlands Mt. Batu (6°56'N/39°47'E) rises to 4307 m asl and two other peaks exceed 4000 m.

The eastern half of the country is a plateau, 500-1000 m asl, divided into southern and northern halves at a latitude of 9°N, by an E-W oriented extension of the great massif. Mountains along the southern arm of the Eastern Rift Valley provide this extension, and in this range, 7 peaks exceed 3000 m asl. The southeastern quadrant of the country slopes into Somalia and Kenya, while the northeastern quadrant slopes towards the Red Sea. However, at its northern end it descends to more than 116 m below sea level in the Afar Depression, separated from the Red Sea by the Eritrean Mountains which are aligned parallel to the coast. Active volcanoes occur on the floor of the depression and to the south of it.

The western slopes of the Ethiopian Massif drain to the Nile, while the southern and southeastern slopes drain to the Indian Ocean by rivers which cross Somalia and Kenya. The slopes facing the Rift Valley drain to a series of endorheic lakes on the valley floor, and both the northeastern slopes of the massif and the western slopes of the Eritrean Mountains drain to lakes in the Afar Depression. The Eastern slopes of the Eritrean Mountains drain to the Red Sea.

Climate

In winter, the Ethiopian coast is in a zone of convergence between dry NW winds and moist SE winds, and some rain falls. This is greatest at Mits'iwa (15°38'N/39°25'E) where mean annual precipitation is 165 mm, but this decreases northwards to 100 mm/yr at the Sudanian border, and southwards to 104 mm/yr at T'i'o (14°41'N/40°55'E) and 27 mm/yr at Aseb (13°02'N/42°47'E). Rain may fall over coastal districts at any time of the year but it is always concentrated in the October-February period. For example, Mits'iwa has an average receipt of 120 mm for these five months, i.e. 72% of the mean annual total. Annual variations along the coast may be very great, for example, Karora (17°42'N/38°22'E), 34 km inland at an altitude of 244 m, once had an annual receipt of 321 mm, but it normally receives less than a

third of this. Further, there are regional vagaries, thus Damas (15°28'N/39°13'E) which lies 26 km inland of Mits'iwa, had a mean annual rainfall of 645 mm/yr between 1926 and 1948.

In summer the intertropical convergence between the SW Monsoon and the NW Trade Winds lies over the Ethiopian Massif, reaching its most northerly position, about 19°N in Sudan, during July-August. While the monsoon brings heavy rain to the western mountains it does not usually extend far east of the mountains, so that the eastern half of the country remains dry. Falls on the high mountains reach 2000 mm/yr locally, but are lower in the valleys and plateaux, and tend to decrease from SW to NE. Thus mean annual receipts are 1302 mm at Adis Abeba (9°03'N/38°42'E), 1118 mm at Dese (11°05'N/39°40'E) and 730 mm at Adi Ugri (14°47'N/38°50'E), all between 2000 and 2440 m asl. The floor of the Rift Valley, in rainshadow, is very dry, while falls along the western foothills range from 800-1100 mm/yr.

At Mits'iwa the mean annual temperature is close to 30°C, occasioned more by warm winters than by exceptionally hot summers. July and August are the warmest months when the mean temperature is 34.7°C, while February is the coldest month with a mean temperature of 25°C, and the average diurnal range is 7°C throughout the year. Extremes of temperature occur inland in the east of the country, with colder winters and warmer summers, during which recordings above 50°C have been made in the Danakil Depression. The climate of western Ethiopia is moderated by altitude, as indicated by the mean temperatures at Adis Abeba (16°C-2440 m), Dese (18.6°C-2220 m) and Adi Ugri (19.3°C-2022 m).

Vegetation

The Ethiopian Massif supports Afro-montane vegetation at the highest levels, giving way below to evergreen bush and woodland, and this in its turn to Ethiopian savannas along the western flanks of the massif. The Rift Valley supports deciduous bushland, the eastern plateaux semi-desert scrub, while an area of Red Sea coastal desert occupies the southern half of the Eritrean coastal plain. The Danakil (Afar) Depression is largely barren, being covered in part by lava flows, and having vegetation almost confined to wadis.

Wetlands

Tidal wetlands occur along the coast including isolated mangrove stands, reed swamps at the mouths of wadis, and extensive saltmarshes. Most rivers draining the mountains have seasonal floodplains because of the seasonality of rainfall over their catchments, and many valley floors are covered by deep fertile alluvia. Some rivers traverse lakes and permanent swamps on the plateaux. There are a number of endorheic lakes in the Rift Valley, in the Danakil (Afar) Depression, on the Danakil Plateau, and in the mountains. Montane lakes range from large deep lakes like Lake Tana, through small but deep crater lakes, to myriad alpine tarns. In addition some rivers have been impounded to create artificial lakes in the mountains.

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1. Tidal & Coastal Wetlands

General: In the north the coast consists of raised coral reefs which end abruptly with a low shelf about 1.5 m above high tide mark. Generally these are overlaid either by coralline or quartz sands, and at wadi mouths by pale brown alluvium. In the south the fossil reefs are lower and sand beaches reach the sea. Living reefs line the coast almost continuously, being especially well developed in the island studded bay at Aseb. In places small bays have been eroded into the fossil reefs, often where the discharges from wadis have facilitated erosion, and these bays are the sites of small mangrove stands, with *Avicennia marina* dominant. Many gnarled old trees are present, some 8-10 m high. Mangroves also occur on the islands of the Dahlak Archipelago, where *Ceriops tagal* and *Rhizophora mucronata* have been reported in addition to *Avicennia marina.* A Marine National Park has been proposed for this area which will protect some mangrove stands. Mangroves

also occur on infrequently flooded areas, separated from the sea by low dune ridges, e.g. at 17°40'N/38°44'E some 13 km south of Lake Mandalum. Other prominent mangrove stands occur at Mersa Deresa (17°55'N/38°35'E) and Mersa Mubarec (16°31'N/39°08'E) in the north, and in Aseb Bay in the south.

Salt-marshes, many of which are only irregularly tidal, are often found adjacent to mangroves, and are dominated by *Arthrocnemum glaucum, Halopeplis perfoliata* and *Suaeda monoica,* grading inland into areas of *Aeluropus lagopoides, Cenchrus ciliaris* and *Sporobolus spicatus.* Maximum tidal amplitudes vary between 1-1.5 m along this coast.

The coastal plain is narrow, 10-30 km in width, and from it hills rise to heights of 800-2100 m over distances of 5-15 km. These hills are deeply gullied, but many rivers divide on reaching the coastal plain, into a network of streams which periodically flood substantial areas. Most wadis flow only for a few hours after storms in the hills, and do not extend to the sea, their waters always being absorbed by the soils of the coastal plain. However, a few larger wadis do reach the sea and regularly flow throughout their courses, e.g. Wadi Falcat which drains the northern end of the Ethiopian Massif. It has a mouth in the far north of the country (17°36'N/38°47'E) and has deposited alluvium over a raised beach which supports large bushes of *Suaeda monoica.* In favourable years these flooded lands (inland deltas) on the coastal plain are cultivated for bulrush-millet *(Pennisetum typhoideum)* and cotton. Inland many wadis are dammed with sand, both to contain flood water, and to direct it and the alluvium it carries onto the banks for the cultivation of crops, but all floods eventually breach these dams.
In some places, near the mouths of large wadis, drainage to the sea is impeded by dunes, and in these areas pans develop, supporting the grasses *Aeluropus lagopoides, Eleusine compressa* and *Sporobolus spicatus,* together with *Pulicaria schimperi* and *Tavernieria lappacea.* In these sites vegetational cover may be nearly complete, but vegetation in the wadis is scant. *Tamarix orientalis,* often reaching 10 m in height, occurs on the banks of wadis, and on islands in the wadi beds, often with *Salvadora persica* and sometimes with *Cadaba rotundifolia* or *Ziziphus spinachristi.* In the hills these species may be joined by *Acacia tortilis* and *Delonix elata. Acacia nubica* often covers depressions in backwaters along wadis which are subject to periodic flooding but not to heavy scouring. No coastal wetlands are currently protected.

Wetland Name: Lake Tana
Country: Ethiopia
Coordinates: 11°35'-12°18'N/37°01'-37°35'E
Area: 315 600 ha
Altitude: 1829 m asl
Nearest Towns: Adis Abeba (310 km SE); Gonder (37 km N)
General: The lake is 73 km long with a maximum width of 67.7 km and contains several minor and two major islands. These latter, Daga and Dek Islands in the southern part of the lake, are volcanic cones. Small swampy and seasonally flooded alluvial plains border the lake to the north, east and west and in these regions the lakeshore is flat; elsewhere it is steep and rocky. The lake area enjoys some 2660 hours of sunshine each year, with a mean

maximum of 288 hours in January and a mean minimum of 114 hours in July. Winds are generally light.

Hydrology & Water Quality: The lake is fed by 61 small streams, all very seasonal in the volume of water they carry. They drain a basin of 16 500 km^2 and the longest of them, the Abbai, is considered to be the source of the Blue Nile. This river carries the overspill of the lake from its southern extremity. Maximum outflow is of the order of 400 m^3/sec in September and the annual overspill is estimated at 3.9 billion m3. Precipitation averages 1320 mm/yr over the lake, with a monthly maximum of 475 mm in July, but by contrast the December-April period is virtually rainless. Rainfall over the upper catchments may reach 2000 mm/yr while evaporation from the lake margins has been determined as 1836 mm/yr. The lake has a maximum known depth of 14.1 m, a mean depth of 8.5 m and an estimated capacity of 28 billion m^3. The surface level has varied by nearly 2 m during the past 20 years. Mean annual surface water temperatures are beteen 21.5 and 22.0°C depending upon locality, and the waters are generally well mixed and well oxygenated. Total dissolved solids range from 151-174 mg/l and the pH range is 7.5-8.4. Calcium is the most abundant cation, and bicarbonate the most common anion.

Flora & Fauna: Emergent macrophytes fringe the flat swampy parts of the shoreline, the dominant species being *Cyperus papyrus,* with *Echinochloa pyramidalis, E. stagnina, Polygonum barbatum, P. senegalense* and *Typha doiningensis.* Floating leaved aquatics include *Nymphaea caerulea, N. lotus* and *Pistia stratiotes,* while the most important submerged species are *Ceratophyllum demersunt* and *Vallisneria spiralis.* Among the fishes, cyprinids are best represented, with 14 species of *Barbus* (of which *B. affinis* and *B. intermedius* are the most numerous), *Discognathus quadriinaculatus* and *Varicorhinus beso.* There are three clariids, *Clarias anguillaris, C. mossanzbicus* and the endemic *C. tsanensis. Oreochromis niloticus* is the only cichlid. The lake is not very productive and the fish biomass is comparatively low. A wide spectrum of aquatic birds is found here with *Alopochen aegyptiaca, Bubulcus ibis, Egretta internzedia, Larus ichthyaetus, Plectropterus gambensis, Sarkidiornis melanota* and *Threskiornis aethiopica* among the most numerous. Small mammals include otters and rodents.

Human Impact & Utilisation: There are artisanal fisheries on the lake, with *Barbus* and *Clarias* spp. contributing 90% of the catch. Parts of the lakeshore are cultivated, but the lake is little interfered with. There is an hotel at Bahr Dar on the lakeshore and the lake is used for recreational purposes.

Conservation Status: Unprotected.

Wetland Name: Wetlands of the Bale Mountains
Country: Ethiopia
Coordinates: 6°30'-7°20'N/39°00'-41°00'E
Area: c. 10 500 ha (500 ha permanent open water)
Altitude: 4000-4200 m as1
Nearest Towns: Adis Abeba (275 km NNW); Yirga'Alem (75 km W)

General: About 100 small lakes, each a few hectares in area, and many bogs are set in the (?uarternarr basalt of the Goba Plateau well above tree line in the Monts Bale. This is a glaciated area and most lakes occupy depressions carved out by ice. Others have been filled in, but retain water permanently and support wetland vegetation. There tend to be two wet seasons here, the principal summer one, when the SW Monsoon blows, and a

minor winter one, when SE winds reach the eastern edge of the Ethiopian Massif from the Indian Ocean. Precipitation exceeds 2000 mm/yr, and there are frequent frosts. The mean temperature is in the vicinity of 2°C. Ultimately these tarns drain either to the Shebele or Genale Rivers.

The Garba Gurastch and Hora Orgona lakes are the best known. The former is situated 15 km south of Goba (7°01'N/39°59'E) and covers about 12 ha and has a maximum depth of 5 m, while water levels fluctuate by some 40 cm/yr. There is an outflow, to an affluent of the Genale River, and the water is clear, with a Secchi depth of 5 m. Water temperatures range from 11-12°C in summer and the pH is close to 7.5. The concentrations of the commonest ions are sodium 0.38 mg/1, calcium 0.23 mg/1, sulphate 0.15 mg/1 and chloride 0.1 mg/l. The Hora Orgona is larger, but variable in area, less deep, more turbid, more alkaline (pH 8.4) and has higher concentrations of dissolved solids (sodium 3 mg/1; calcium 4 mg/1; magnesium 3.5 mg/1; chloride 4 mg/1 and sulphate 1 mg/1). It is situated a few kilometres southwest of Garba Gurastch and does not have a perennial effluent.
The biology of these lakes is not known in any detail, but the plankton includes palearctic species. The benthic fauna includes cladocerans, copepods and ostracods, but neither amphibians nor fish have been recorded. The avifauna is comparatively rich, with *Bostrychia carunculata, Cyanochen cyanoptera, Pallus rougetti* and *Tadorna ferruginea* the most numerous species. *Canis sintensis* and a species of *Otontys* occur in these wetlands. The lakes are little used and are, ostensibly at least, protected in the Bale Mountain National Park, proclaimed in 1970, but not yet gazetted.

Wetland Name: Lakes of Bishoftu
Country: Ethiopia
General: A chain of volcanoes, containing 5 crater lakes, runs roughly SW-NE near Debre Zeyit (8°47'N/39°01'E) some 45 km SE of Adis Abeba. Lake Biete Mengest is 1850 m asl, while the others are all higher, Bishoftu (1870 m), Pawlo (1870 m), Aranguadi (1900 m) and Kilotes (2000 m). The maximum recorded depths and mean depths of these lakes are Bishoftu 87 m and 55 m, Pawlo 65 m and 38 m, Biete Mengest 38 m and 17 m, Aranguadi 32 m and 19 m, while Kilote is only 6.5 m deep with a mean depth of just 2.6 m. The crater walls around Lake Kilotes have been heavily eroded, accounting for much infill and the shallow depth of this lake, but those around the other lakes are well preserved. The lakes are all about 7000 years old. Lake Biete Mengest covers 103 ha, while the others are smaller; Bishoftu (93 ha); Kilotes (77 ha); Pawlo (58 ha) and Aranguadi (54 ha). Mean annual temperatures in the area are 17-18°C, precipitation is 800-900 mm/yr, and maximum wind speeds range from 11 km/hr in the summer wet season to 30 km/hr in the winter dry season. The lakes are fed by direct precipitation and local run-off and are apparently endorheic, although some may have underground effluents. Mean surface water temperatures range from 25°C in Lake Kiloti to 19°C in Lake Aranguadi. All lakes are alkaline; Bishoftu, Pawlo and Biete Mengest have mean pH values of 9.2, while Kilotes has a mean value of 9.6 and Aranguadi 10.3, but there are seasonal variations. In all lakes sodium is the most abundant cation and bicarbonate and silicate the most abundant anions.
Productivity is generally high, especially in the most alkaline lakes, Aranguadi and Kilotes. *Microcystis aeruginosa* is the dominant species in the phytoplankton of all lakes and occasionally forms blooms, while *Spirulina platensis may* also reach very high densities

in the two highly alkaline lakes. The fauna of the lakes has not been studied. The lakes are fished but are not protected. The area is an important recreation area for citizens of Adis Ababa and there are several hotels.

Wetland Name: Lakes of the SW Rift Valley
Country: Ethiopia
General: The Ethiopian Rift Valley, aligned SW-NE, is an extension of the Eastern Rift Valley of Equatorial Africa. It is a trench limited by faulting and its development has been characterised by predominantly acid volcanism. Much of the floor is covered by recent, still barren lavas, and by deposits of pumice. Since the development of the major escarpments 1.8-1.6 million years ago, volcanic activity has been confined to the Wonj Fault Belt, a zone of normal faults 5-15 km wide, oriented NNE-SSW, and arranged in stepped fashion along the rift. In the southwestern part of the rift four topographic basins have developed, separated by volcanic sills and these now contain, from N-S, Lakes Ziway, Abiyata, Langano and Shala. Lake Shala occupies a deep caldera of Pliocene age, while the others are set in younger shallow depressions. Lakes Ziway and Langano have surface drainage towards Lake Abiyata, which is endorheic. Lake Shala does not presently overflow, although it clearly did in the past. During past pluvial periods of the Quaternary these four lakes were continuous, at an altitude of 1670 m, and then overflowed northwards to the Awash River.
Farther to the southwest is the basin of Lake Awasa, separated from the Shala-Ziway complex by Caldera Corbetti. Yet farther, and some 400 m lower, is another basin containing Lakes Abaya and Ch'amo. They are linked by a watercourse and they too formed a single lake in the past. In the far southwest, close to the Kenyan border is Lake Bahir, within the giant pan of Ch'ew Bahir, which is most often dry but is sometimes flooded over very large areas.
The Ethiopian Rift Valey is arid, with mean annual rainfalls in the vicinity of 600 mm, and with annual variations in the range 400-900 mm. At least 50% of the rain falls in the three months from July to September, and this is comparatively reliable, but the remainder which falls between October and January is very unreliable. February-June are generally rainless months. The dry season may thus persist for 9 months in some years. Wind speeds do not vary much throughout the year, with mean velocities in the vicinity of 4 km/hr. Mean annual evaporation reaches or exceeds 2000 mm throughout the valley. Mean annual temperatures range from 19-20°C, but in winter temperatures as low as 4°C have been recorded near Lake Ziway.

Wetland Name: Lake Ziway (Zwai)
Country: Ethiopia
Coordinates: 7°51'-8°07'N/38°43'-38°56'E
Area: 65 400 ha
Altitude: 1636 m asl
Nearest Towns: Adis Abeba (105 km N); Yirga'Alem (135 km SSW)
General: The lake has flat swampy margins on all sides except the south and southeast. It is fed by a number of streams, the most important of which are the Katar River, which drains the Arsi Mountains to the east, and the Me'ki River, which drains part of the Western Highlands. The lake has a catchment of 7025 km^2 and its overspill is carried to Lake Abiyata by the Bulbula River. Seasonal variations in the surface level are within the

range 50-120 cm, with high water in September and low water from February-May, while annual variations are equally great. Exeptionally high levels in 1969-70 were followed by unusually low levels in 1973-74. The lake is almost 29 km long and 20 km wide. It has a maximum depth of 8 m at high water and a mean depth of 2.5 m, and is estimated to contain 1.1 billion m^3 of water. Water temperatures range from 21-27°C and pH from 7.9-8.7. Mean dissolved oxygen concentration is 6 mg/l, while that of total dissolved solids is 350 mg/l. Sodium, magnesium and calcium are the principal cations, in that order of abundance, and bicarbonate the principal anion.

Flora & Fauna: Primary production is moderately high and the phytoplankton is seasonally dense, being dominated by *Microcystisflos-aquae* and species of *Aphanotheca, Chroococcus, Gleotrichia, Mesrimopedia,* and *Spirulina*. The distribution of emergent vegetation along the banks are determined by fluctuations in lake level and the distribution of plants may alter substantially over a period of a few years. *Cyperus papyrus, Phragmites mauritianus* and *Typha domingensis* are the dominant species, with *Aeschynonzene elaphroxylon* on areas inundated only periodically and along the banks of the Bulbula River. There are dense beds of submerged macrophytes. The zooplankton is dominated by rotifers, with species of *Brachionus* most numerous and molluscs are abundant amongst the vegetation. Among gastropods, *Anisus natalensis, Biomphalaria sudanica, Bulinus forskali, B. truncatus, Lymnea natalensis* and *Melanoides tuberculata* are most common. Only 8 species of fish are known, belonging either to Cichlidae or Cyprinidae. These include 0 *reochromis niloticus , Discognathus* sp. and several barbels, one of which, *Barbus zwaicus,* is probably endemic. Remarkably, *Clarias* is absent. There are several species of snake, but crocodiles are reputedly absent. The avifauna is quite rich. *Anas crecca, Anhinga rufa, Bubulcus ibis, Egretta garzetta, Larus fuscus, Pelecanus onocrotalus, Phalacrocorax carbo, Plegadis falcinellus* and *Threskiornis aethiopicus* are common species and *Merops nubicus* is abundant along the River Bulbula. *Hippopotamus amphibius* is present, as are several small semi-aquatic mammals.

Human Impact & Utilisation: There is a commercial fishery currently producing about 1500 tonnes/yr, but with an estimated sustainable yield of 3000 tonnes/yr. The catch is exported to Adis Abeba by refrigerated trucks. Dense vegetation along the shore makes access to the lake difficult and most fishing is carried out from canoes. It is planned that an area of 5500 ha near the lake will be cultivated, using water pumped from the lake for irrigation. This scheme will involve the construction of sluice-gates on the Bulbula River where it leaves the lake.

Conservation Status: Unprotected.

Wetland Name: Lake Langano
Country: Ethiopia
Coordinates: 7°32'-7°43'N/38°42'-38°50'E
Area: 24 000 ha
Altitude: 1582 m asl
Nearest Towns: Yirga 'Alem (95 km SSW); Adis Abeba (150 km N)

General: This lake receives drainage from the Arsi Mountains at the southern end and discharges from the northern end via the River Hora Kallo to Lake Abiyata. It has a

catchment of approximately 1600 km^2. Direct precipitation accounts for about 20% of the annual input. The lake is 23 km long and has a maximum width of 16 km. It has a maximum depth of 46 m and a mean depth of 20 m and is estimated to contain 3.8 billion m^3 of water. The shores are rocky in places, particularly on the eastern side, but there are a number of swampy bays in the south. The water is usually a reddish-brown colour. Water temperatures range from 22-26.5°C and pH is generally close to 9.1. The principal ions are sodium and bicarbonate. The concentrations of total dissolved solids ranges from 1250-1650 mg/l, while mean dissolved oxygen concentration is 4 mg/l. The level of the lake surface has varied by 1.7 m over the past 25 years, with a maximum level in 1969 and a minimum in 1974. Seasonal variations in level are generally less than 1 m.

Flora & Fauna: Species of *Juncus* and *Scirpus* fringe some of the lake and form extensive swards in the small swampy bays, but much of the shoreline is a rock or pebble beach largely devoid of vegetation. *Ceratophyllum demersum* and *Potamogeton* spp. are important submerged aquatics. The phytoplankton is quite diverse and the diatomaceous flora is characteristic of East African alkaline lakes. Primary production is moderate. Crustaceans dominate the zooplankton, and a number of molluscs are present including *Corbicula pusilla, C. saharica* and *Melanoides tunerculata.* The lake is rich in cichlid and cyprinid fish. There are a number of amphibians, reputedly no crocodiles, but an abundance of birds, including *Alopochen aegyptiacus, Anhinga rufa* and *Phalacrocorax carbo.*

Human Impact & Utilisation: There is an artisanal fishery, mainly exploiting *Oreochromis niloticus,* and an hotel which largely serves the adjacent Rift Valley National Park.

Conservation Status: Unprotected.

Wetland Name: Lake Abiyata
Country: Ethiopia
Coordinates: 7°33'-7°43'N/38°27'-38°40'E
Area: 17 600 ha
Altitude: 1578 m as1
Nearest Towns: Yirga 'Alem (95 km S); Adis Abeba (150 km N)

General: Lake Abiyata is an endorheic alkaline lake set in flat *Acacia* savanna country, with large areas of seasonally or periodically flooded alkaline mudflats. It is a shallow lake covering some 20 000 ha with a maximum recorded depth of 14 m and a mean depth of 7.6 m. Seasonal variations in water level are of the order of 50 -100 cm, but interannual variations may be greater than this. Over the past 25 years the lake surface has varied by 5 m, and the area has correspondingly changed from 14 200 ha to 18 100 ha. Surface water temperatures may approach 27°C in April and the pH range is 9.3-9.5. Mean oxygen concentration is 5.8 mg/1, and total dissolved solids amount to some 8200 mg/l. In addition to direct precipitation, which accounts for some 21% of of the annual influx, inputs are from Lake Ziway via the Bulbula River, from Lake Langano via the Hora Kolla River, and from the Gogesa River. The lake is estimated to contain 1.6 billion m3 of water.

Flora & Fauna: The mudflats support little more than clumps of *Juncus* and occasional sedges, usually *Scirpus littoralis.* There is a dense submerged vegetation in places and

productivity is relatively high. The diatom flora is typical of East African alkaline lakes with species such as *Navicula elkab, Nitzschia* spp., and *Thalassiosira rudolfi*. Both rotifers and crustaceans are important in the zooplankton, with species of *Brachionus* and *Cyclops* dominant. The benthic fauna is very scant, save for chironomid larvae and a few molluscs, e.g. *Bellamya unicolor* and *Helicarion ruppellianum.* Cichlids are numerous but *Barbus gregorii* is the dominant fish. The abundance of piscivorous birds suggests that fish production is high, and it has been estimated that the resident population of white pelicans consume some 3000-5000 tonnes fish/yr. The avifauna includes *Anas crecca, Anhinga rufa, Ephippiorrhynchus senegalensis, Pelecanus onocrotalus, Phalacrocorax carbo* and *Phoeniconaias minor.* There are no crocodiles and no large aquatic mammals, but otters and rodents are present.
Human Impact & Utilisation: Virtually none as the area is protected.
Conservation Status: Entirely situated within the Abiyata-Shala National Park, otherwise known as the Rift Valley National Park. This includes plains and two hills between the lakes and six rivers which flow into the lakes.

Wetland Name: Lake Shala
Country: Ethiopia
Coordinates: 7°24'-7°33'N/38°23'-38°39'E
Area: c. 32 900 ha
Altitude: 1558 m asl
Nearest Towns: Yirga 'Alem (75 km S); Adis Abeba (370 km N)
General: Lake Shala is set with its long axis (27 km) across the rift valley and reaches a maximum width of 17 km. It has a maximum depth of 266 m and a mean depth of 86 m and is estimated to contain 37 billion m^3 of water. Surface water temperatures range from 21-27°C and pH from 9.7-10.1, while mean oxygen concentration is 6.4 mg/l. Sodium is the principal cation and bicarbonate the chief anion, and the concentration of total dissolved solids is frequently in excess of 16 500 mg/l. For the most part the banks are steep, but locally there are mudflats, and hot springs on the Lakeshore.
Flora & Fauna: Little known. Both phytoplankton and zooplankton are poorly developed and productivity is low. *Oreochromis niloticus* occurs in the lake, but fish production is low and it is therefore surprising that it supports a rich avifauna, including a large breeding colony of *Pelecanus onocrotalus* on a volcanic island.
Human Impact & Utilisation: There used to be a commercial fishery but this has ceased. Some artisanal fishing still occurs.
Conservation Status: Entirely protected, together with an area of peripheral land, in the Abiyata-Shala National Park.

Wetland Name: Lake Awasa
Country: Ethiopia
Coordinates: 6°58 ' -7°07 'N/38°22 ' -38°29 'E
Area: c. 12 000 ha
Altitude: 1680 m asl
Nearest Towns: Yirga 'Alem (25 km S); Adis Abeba (220 km N)

General: The lake is apparently endorheic, 17 km long, and up to 11 km wide with a perimeter of 53 km. It has a maximum recorded depth of 21.6 m and a mean depth of 10.7 m. It has a catchment of 52.5 km^2 and is estimated to contain 1.3 billion m3/water. Sodium and bicarbonate are the dominant ions and total dissoved solids amount to some 650 mg/l. The water temperature ranges from 21-26°C and has a pH close to 8.4. It is fed by a river which drains the highlands to the east of the Rift Valley, with a total catchment of 1250 km^2. The affluent stream flows through an extensive area of swam-pland, containing papyrus and *Phragmites,* and also swamp forest en route to the lake which has extensive fringing marshes and areas of wet grassland. The possibility that the lake loses water underground is not ruled out. A dormant volcano is situated in Caldera Corbetti immediately to the north of the lake.
Flora & Fauna: There are dense beds of submerged aquatics in the lake and the peripheral vegetation includes *Cyperus papyrus, Nymphaea caerulea, Phragmites mauritianus, Polygonum senegalense, Scirpus littoralis* and *Typha domingensis.* It is an important habitat for birds and supports comparatively large numbers of *Actophilornis africana, Ardea melanocephala, Ardeola ralloides, Bubulcus ibis, Chlidonias leucoptera, Dendrocygna viduata, Larus ridibundus, Leptoptilos crunieniferus, Pelecanus onocrotalus, P. rufescens, Scopus umbretta, Threskiornis aethiopica,* and is visited by the normal spectrum of small mammals.
Human Impact & Utilisation: There is an artisanal fishery and a fish market on the lakeshore, and concentrations of tame piscivorous birds, including pelicans, are a tourist attraction. The area is beginning to be important for recreation and tourism and there is an hotel between this lake and Lake Ch'amo.
Conservation Status: Mostly unprotected, but the southern end of the lake is included in the Nechisar National Forest, a game reserve.

Wetland Name: Lake Abaya (Margherita)
Country: Ethiopia
Coordinates: 6°02'-6°37'N/37°40'-38°06'E
Area: 107 100 ha
Altitude: 1285 m asl
Nearest Towns: Yirga 'Alem (50 km NE); Adis Abeba (275 km NNE)
General: This lake is 70 km long, 29 km wide at maximum, and is oriented SW-NE along the axis of the Rift Valley. It has a maximum recorded depth of 13.1 m and an estimated mean depth of 7 m. Surface water temperatures range from 22-28°C, mean oxygen concentration is 5.7 mg/l, and pH is close to 8.0. Sodium and bicarbonate are the principal ions and the concentration of total dissolved solids is 515 mg/l. The lake is fed by 5 major rivers, the most important of which is the Bilate, and a number of small streams which drain a catchment of 17 300 km^2. Overspill is carried by the Ualo River to Lake Ch'amo, with which it was united during pluvial phases of the Pleistocene. Lake Abaya is estimated to contain 8.2 billion m^3/water. The large islands of Sacchi and Bottego are situated in the northeastern part of the lake and there are many small islands. Great areas of the shores are flat with swampy woodlands and extensive marshes, especially in the northeast, but there are a number of rocky promontories. Luxuriant riverine woodland occurs between this lake and Lake Ch'amo in the south.

Flora & Fauna: Areas of swampy savanna forest occur on the lake margins, containing species of *Acacia* and *Ficus,* while *Aeschynomene elaphroxylon, Juncus* sp., *Phragmites mauritianus* and *Typha domingensis* are present in places along the lake shores together with the scandent *Ipomoea fragrans. Juncellus* sp., *Leersia hexandra, Ludwigia adscendens, Oenanthe* sp., *Paspalidiunz genzinatum, Panicunz* spp. and *Sphaeranthus* sp. are common on the lake margins. In the lake, *Ceratophyllum demersum, Hydrocotyle* sp., and *Potamogeton* spp. are important submerged aquatics, while *Azolla nilotica, Lemna gibba, Nymphaea* spp., *Ottelia ulvifolia* and *Pistia stratiotes* are floating plants. The phytoplankton is dominated by cyanophytes but the diatoms are very diverse. Papyrus is reputedly absent.

In the zooplankton rotifers are abundant, notably *Brachionus militaris* and *Keratella quadrata.* In addition there are numerous cladocerans, copepods and chironomids. Among molluscs, *Anisus natalensis, Biomphalaria sudanica, Bulinus forskali, B. truncatus, B. ugandae* and *Lymnea natalensis* are the most numerous.

28 species of fish have so far been identified including Bagridae *(Bagrus docmac),* Centropomidae *(Lates niloticus),* Characidae, Cichlidae *(Oreochromis niloticus, Tilapia zillii),* Clariidae, Cyprinidae (10 species of *Barbus* and 3 species of *Labeo),* Mormyridae (3 species), Schilbidae *(Schilbe mystus)* and Synodontidae (4 species). The most numerous species are *Barbus gregorii, Clarias mossambicus* and *Oreochromis niloticus.*

Amphibians and reptiles are present, including crocodiles, monitors, snakes and terrapins. There is a diverse avifauna which includes *Anhinga rufa, Bubulcus ibis, Casnzerodius albus, Egretta garzetta, Haliaeetus vocifer* and *Scotopelia peli.* The spectrum of mammals includes *Hippopotamus amphibius* together with many others listed in the regional introduction.

Human Impact & Utilisation: There are artisanal fisheries, which take mainly *Lates niloticus,* but it is anticipated that a commercial fishery will soon be started with a production of some 7000 tonnes/yr, comprising about 3000 tonnes of *Lates* and 4000 tonnes of other fish. Some cultivation occurs on the lake shores.

Conservation Status: Unprotected.

Wetland Name: Lake Ch'amo

Country: Ethiopia

Coordinates: 5°43'-5°59'N/37°32'-37°45'E

Area: c. 45 000 ha

Altitude: 1233 m asl

Nearest Towns: Gidole (19 km SW); Adis Abeba (350 km N)

General: This is a large lake with fringing beds of *Typha* in places and some extensive lakeshore marshes, swampy woodlands and wet grasslands. The lake is 36 km long and nearly 23 km wide at maximum. It has a maximum known depth of 12.7 m and the surface water temperature range is 22-28°C. Mean oxygen concentration is 4 mg/l. Sodium and bicarbonate are the dominant ions in solution and pH is always close to 8.6. The concentration of total dissolved solids is 651 mg/l. The lake receives drainage from several small streams with a catchment of approximately 2220 km^2, and receives the overflow from Lake Abaya (with which it was once united) via the Ualo River. It has no outlet at the surface but there appears to be a substantial loss of salts by infiltration.

Flora & Fauna: There are extensive beds of submerged aquatics and productivity is moderately high. The phytoplankton is dominated by cyanophytes and the zooplankton by rotifers and crustaceans. *Aetheria elliptica, Aspatharia rubens, Corbicula pusilla, Limicolaria barderensis* and *Planorbis herbini* are molluscs. Among fishes, *Bagrus docmac* and *Lates niloticus* are most numerous. There are large populations of *Crocdylus niloticus* and some *Hippopotamus amphibius,* together with a large proportion of the small mammals cited in the regional introduction as being associated with East African wetlands. There is a rich avifauna.
Human Impact & Utilisation: There is an important local fishery and tourism and recreation are developing in the area. There is an hotel between this lake and Lake Abaya.
Conservation Status: Unprotected.

Wetland Name: Lake Chew Bahir
Country: Ethiopia
Coordinates: 4°27 ' -4°59 ' N/36°41 ' -37°00 ' E
Area: 112 500 ha
Altitude: 520 m asl
Nearest Towns: Gidole (100 km NNE); Adis Abeba (485 km NNE)
General: This is a temporary endorheic saline lake situated in the far south of Ethiopia, indeed the tip of the lake crosses the border into Kenya. It is 45 km long and 30 km wide at maximum. The lake is often dry, but the lowest part in the northeast is always moist. The lake is fed by the Dulei River from the north and by two temporary rivers from Kenya which enter the southern end. It is set in *Acacia-Combretum* scrub country with a mean annual rainfall over the lake of 500-600 mm/yr, while evaporation exceeds 2000 mm/yr. Sodium and chloride are the most abundant ions in solution when there is water in the lake and there is a sparse halophytic flora over most of the basin, with reeds, sedges and rushes in the more permanently moist sites. Only in very wet years is the basin deeply flooded. The detailed biology of the lake is not known, however, in wet years it is visited by large numbers of flamingoes and it is important to many large mammal species. The entire lake is situated within the Ch'ew Bahir Wildlife Reserve.

Wetland Name: Lake Turkana (Rudolph
Country: Ethiopia
General: The northern edge of Lake Turkana intrudes a few kilometres into Ethiopia, but is dealt with in section 2.5 Kenya. The Ethiopian shoreline is 52 km long, and the Omo River enters the lake from Ethiopia in a large swampy delta which includes two lakes. Upstream of this there is an extensive floodplain. The combined wetland (4°28'-5°13'N/35°44'-36°13'E) covers 120 000 ha, and the river discharges 18.6 billion m^3 of water into Lake Turkana each year. The river carries levee forest and the delta was forested in comparatively recent times. The lake level has fluctuated by 20 m over the past 75 years and the delta forest, remains of which are still apparent, was drowned when the level was higher. Fishing and hunting take place in the delta and no part of the system is protected. Papyrus is absent.

Wetland Name: Lakes & Swamps of the Awash River System
Country: Ethiopia
General: The Awash drains the highlands on either side of the northeastern part of the Ethiopian Rift Valley and then flows out into the Danakil Desert. The temperate headwater basin receives between 1600-2000 mm of rain/yr, but the Rift Valley is warm and arid. Mean annual rainfall at the feet of the escarpments is 500-900 mm, and on the plain of Danakil it is generally less than 200 mm. Rain in the Rift Valley is a summer phenomenon, but in central and southern Danakil there are two 'rainy' seasons, one in April, the other in July/August. Potential evaporation along the course of the Awash increases with the thermal gradient, generally from west to east, rising from 2000 mm/yr to over 4500 mm/yr.

Wetland Name: The Upper Awash Valley
Country: Ethiopia
General: The river has a drainage basin of some 76 000 km^2 and is approximately 1200 km long. It has four sources (8°29'N/38°12'E; 8°47'N/38°04'E; 9°01'N/38°06'E and 9°10'N/38°28'E) high above the Rift Valley on the western side, at altitudes close to 3000 m. These, and their several tributaries, traverse a broad headwater valley, 100 x 60 km, containing large areas of permanent swamp and floodplain before a final confluence at about 2100 m asl. From this point the combined stream flows SE, entering a deep valley in which it descends to the floor of the Rift Valley where it is impounded to form Lake K 'ok'a (dealt with in section 2.4.9). This lake is also fed by other rivers, principally from the western highlands, and one of which enters the northern end of the lake over Menelik Falls.
The Awash then descends the Rift Valley, at first flowing northeastwards past Lake Beseka (8°53'N/39°52'E) near the village of Metehara. This lake has an area of about 600 ha and is a volcanic lake containing highly mineralised water. It is fed by thermal sources, at least in part, and is nearly 10 km distant from the Awash and not strictly a part of the Awash system. Downstream of this the Awash skirts another small lake with a swampy marginal floodplain (8°51'N/39°52'E) about 5 km above the town of Awash (8°59'N/40°09'E). The lake has a mean open water surface of about 400 ha and the floodplain, with its swamps, extends to an additional 2800 ha and appears to have tenuous connection with the Awash.

Wetland Name: Lake & Pans of Southern Wadis
Country: Ethiopia
General: Below the town of Awash the river flows northwards onto the plains of Danakil (Afar). On its eastern side a number of wadis descend from the Ahmar Mountains, an extension of the southern margin of the Rift Valley, and on reaching the plain they flow roughly northwards, parallel with the Awash. These are not effectively part of the Awash system, since their waters seldom reach that river, being absorbed or evaporated on minor floodplains tens of kilometres distant. One stream forms a temporary lake at a point 9°28'N/40°25'E, which may cover 3000 ha in a wet year when it may have a maximum

length of 11 km and a width of up to 3 km. The stream often continues below this shallow `lake' to a confluence with the Mi'eso Stream on which another floodplain and temporary lake forms at a point 9°51'N/40°42'E, again covering 3000 ha in a wet year. Still farther north (9°55'N/40°47'E) another small floodplain (1000 ha) is inundated by an unnamed stream which flows to the east of the Mi'eso, and parallel to it.

Wetland Name: The Lake Beda Sector
Country: Ethiopia
Coordinates: 9°52 '-9°55 'N/40°22 '- 40°24'E (Lake Beda)
Area: 1800 ha
Altitude: 609 m asl
Nearest Towns: Adis Abeba (200 km SW); Harer (205 km ESE)
General: The Awash skirts the eastern side of a barren lava field between latitudes 9°30'-9°41'N, and this contains two small crater lakes (9°31'N/40°12'E and 9°33'N/ 40°12'E) fed by subterranean waters. Below this the Awash receives a number of tributary streams on the right bank, all rising on the eastern flanks of the Western Highlands. Perhaps the most important of these is the Hawadi River which has a confluence with the Awash at a point 9°51'N/40°15'E. The river then skirts the northern tip of another vast lava field at 9°55'N, and receives below this, the overspill from Lake Beda, which lies at an altitude of 609 m under the northern face of the lava and 5 km distant from the river. This lake also has highly mineralised water and its pH rises above 11.0. It is fed by subterranean sources but is connected to the Awash via swamps, through which its overspill drains.

Wetland Name: The Gewane Lake/Swamp Complex
Country: Ethiopia
Coordinates: 9°57 ' -10°35 'N/40°25 ' - 40°38 'E
Area: 70 000 ha (total wetland area)
Altitude: 600-608 m asl
Nearest Towns: Adis Ababa (220 km SW); Harer (190 km ESE)
General: At the southern extremity of the system the Awash divides into three streams, one of which traverses the swamps while the others skirt them on either side. At first the rivers cross a seasonal floodplain, but a permanent swamp soon appears along the central channel, beginning at 11°04'N and quickly reaching 6 km in width. At a latitude of 11°10'N this swamp becomes permanently flooded and gives way to Lake Yardi, now enlarged behind a barrage at 10°14'N/40°33'E to give an open water area of 6600 ha. The permanent swamp above the lake covers 5200 ha, and the floodplain about 30 000 ha. Another swampy tract occurs below the barrage. It is studded with little lakes and covers at least 20 000 ha in a strip 4 km wide on either side of the river which flows in a single channel below Lake Yardi. The largest of these lakes is Lake Kaddabasa. These swamps contain papyrus, *Phragmites* and *Typha* together with a spectrum of aquatic and floodplain grasses, and submerged and floating aquatics.
Farther north the river cuts through another lava field between latitudes 10°47' and 11°02'N and then flows through a small swamp/lake system (11°17'-11°21'N/ 40°53'-40°57'E) of some 3000 ha, above and below which it receives tributary wadis on the the

right bank. Then, at Dubti (11°44'N/41°04'E), it swings SE and enters the Dubti Swamps.

Wetland Name: The Dubti Swamps
Country: Ethiopia
Coordinates: 11°35 '-11°43 'N/41°08'-41°25 'E
Area: 23 500 ha
Altitude: c. 400 m asl
Nearest Towns: Adis Abeba (380 km SW); Harer (295 km SE)
General: This swampy tract is 34 km long and up to 12 km wide, and comprises at least 23 500 ha of semi-permanent wetland. An irrigation scheme at Dubti, just north of the swamps, covers about 7000 ha and withdraws water from the river. Much of the peripheral area of the swamps has been converted for cultivation in recent years, with cotton the principal crop. Towards the end of these swamps the Awash branches into eastern and western channels. Natural vegetation is dominated by *Phragmites mauritianus,* but a wide spectrum of the East African wetland species associated with herb swamps is also present (see regional introduction).

Wetland Name: The Gemeri Lake/Swamp Complex
Country: Ethiopia
Coordinates: 11°20 ' -11°41'N/41°27'- 41°42'E
Area: c. 76 000 ha
Altitude: 260-339 m as1
Nearest Towns: Adis Abeba (400 km SW); Harer (240 km SSE)
General: Immediately below Aisaita (11°33'N/41°27'E) the eastern channel of the Awash enters the Lake Gemeri swamp complex where it breaks into two channels. One (now the central channel) skirts the western margin of the swamps, the other (eastern channel) crosses them eastwards to Lake Gemeri. The swamps measure 40 km from N-S and 28 km from E-W and cover some 72 000 ha at high water. They have developed where the river, flowing eastwards, meets a N-S escarpment and spreads its waters both north and south along its foot. At the southern end of the escarpment the waters encounter the lava fields of a young volcano (Dama Ale) which further deflect the flow back to the SW, before it finally clears the obstruction and continues south.
The swamps begin 26 km upstream from the escarpment, and Lake Gemeri with its surface at 339 m, lies immediately beneath it. The eastern shore of the lake rises very steeply, to 1358 m as1 within 2 km of the lake near the northern end. The lake is oriented roughly N-S, is 15 km long and 5 km wide (11°29'-11°37'N/41°37'-41°42'E), and covers 6000 ha. South of Gemeri, Lake Afambo (11°21'-11°28'N/41°40'-41°42'E) is separated from the rest of the wetland having developed down the eastern margin of the lava field. This lake is 13 km long and up to 2 km wide, with an open water surface of 1760 ha. To the west of this are two small lakes in the lava, and Lake Bario (11°21'-11°24'N/ 41°34'-41°37'E) which is set in the swamps abutting the northwestern face of the lava field. The eastern channel of the Awash flows from Lake Gemeri, southwards through the swamps to Lake Bario, leaving the latter lake from its southwestern corner to flow SW along the edge of the lava to rejoin (11°19'N/41°31'E) both the western branch of the river, which

flows west of the swamp, and the central branch, which skirts its western boundary. From here the combined stream flows in a single channel down the western side of the lava field to enter Lake Abbe (243 m asl) south of the volcanic massif.
The swamp vegetation is dominated by *Phragmites mauritianus,* although both *Cyperus papyrus* and *Typha domingensis* are present. The lakes are fringed by aquatic grasses and contain the typical spectrum of submerged and floating aquatics. *Crocodylus niloticus, Hippopotamus arnphibius* and *Phacochoerus aethiopicus* are common in the swamps, together with snakes, small mammals and an abundance of water birds. The fish and amphibian faunas are however, not well known.

Wetland Name: Lake Abbe
Country: Ethiopia
Coordinates:11°01'-11°16'N/41°37'-41°54'E
Area: 45 000 ha (34 000 ha open water + 11 000 ha salt-flat)
Altitude: 243 m asl
Nearest Towns: Adis Abeba (380 km SW); Harer (200 km SSE)
General: The volcanic peak of Dama Ale (1069 m asl) dominates the northwestern shoreline of the lake, while vast saltflats, locally 10 km wide, extend around the southwestern and southern shores. The lake is set in an endorheic basin, which during pluvial phases of the Pleistocene, was once the site of a very much larger lake. The present open water area of the lake is close to 34 000 ha, but in recent years successive droughts and the extraction of water for irrigation has greatly reduced this area, and the saltflats bear testimony to this. It is believed that the water level has fallen by 5 m since 1954. The Awash enters the northwestern corner of the lake and other watercourses, notably the Oleldere and Abana Merekes Wadis, enter from the west and south, crossing the saltflats. The lake has a maximum depth of 36 m. Its biology is poorly understood, but stromatolites occur along the eastern margins and the banks support large colonies of *Phoenicopterus ruber.*

Wetland Name: Lakes of the Danakil (Afar) Depression
Country: Ethiopia
General: The Danakil Plains lie between the Ethiopian Highlands and the Red Sea/Gulf of Aden. The Danakil Depression is an actively widening rift valley oriented NW-SE, parallel with the Red Sea coast. At its southern end it impinges at right angles upon the Ethiopian Rift Valley, aligned SW-NE. This structure runs across the southern edge of the Danakil Plain and continues through Djibouti as the Gulf of Tadjoura and then the Gulf of Aden. Both rift systems are marked by lines of active volcanoes along their axes. Mt. Dama Ale, immediately NW of Lake Abbe, is one of those on the Ethiopian Rift.
The Danakil Depression *per se* is 260 km long and 70 km wide and descends to depths exceeding 125 m below sea level. The central part of the depression is covered by a vast diamond shaped lava field, 200 km from NW-SE, and 100 km wide in the centre. Several volcanic cones rise above this lava field, the highest to 1501 m asl (12°53'N/40°35'E), but on either side of the volcanic ridge the land surface sinks below sea level, with a maximum depth being attained on the axis of the depression immediately north of the

ridge. Here the surface of Lake Asale, now split into two basins, is 125 m below sea level. In the east centre of the lava field the surface of Lake Afrera is 102 m below sea level. Both these lakes are fed by subterranean waters.
The depression is separated from the Red Sea along its eastern boundary by hills which rise to 2218 m asl (13°23'N/41°43'E) and which drain from their drier western slopes into the depression by deep wadis which peter out in a series of narrow pans, aligned in parallel SW-NE along the eastern side of the floor of the depression just above and below sea level. A similar series of wadis and pans, with similar parallel alignment is present on the opposite side of the depression but is far less well developed, no doubt as a consequence of the greater aridity on that side.
The depression is very hot and arid. Rainfall is unreliable, less than 100 mm/yr, while temperatures of 50°C have been recorded and potential evaporation reaches 5000 mm/yr locally.

Wetland Name: Lake Afrera
Country: Ethiopia
Coordinates: 13°12'-13°24'N/40°52'- 40°59'E
Area: 12 500 ha
Altitude: 102 m bsl
Nearest Towns: Adis Abeba (520 km SW); Harer (460 km SSE)
General: Lake Afrera is set in a barren lava landscape in the south central part of the depression and has a mean surface level of 102 m below sea level. It is reputedly 160 m deep, but we cannot confirm this. It is saline with a mean pH of 7.9, and is fed by subterranean thermal water. Sodium and chloride are the principal ions. Its biology is not known, it appears to be little utilised and is unprotected.

Wetland Name: The Asale Lakes
Country: Ethiopia
Coordinates: 13°56'-14°06'N/40°22'-40°32'E
Area: 7000 ha
Altitude: 125 m bsl
Nearest Towns: Mits'iwa (200 km NW); Adis Abeba (575 km NNE)
General: There are two lakes, separated by about 2.5 km. The northern lake (4500 ha) has a mean surface level of 125 m below sea level, but the surface level of the southern lake (2500 ha) appears not to have been published. However, it is certainly close to that of the northern lake. A long salt-flat, 10 km wide and 45 km long, covers 30 000 ha, and extends northwestwards away from the northern lake along the axis of the depression. It represents the floor of a much larger fossil lake, present some 7-10 000 years ago. The Asale Lakes are clearly fed by underground water, but run off from the coastal hills may occasional reach them. One wadi enters the northern lake on its eastern shore and 8 wadis discharge onto the fossil lake bed. Very little is known of the biology of the Asale Lakes, which are little utilised and unprotected.

Wetland Name: River Floodplains
Country: Ethiopia

General: Because of the intensity of rainfall over the Ethiopian Highlands for a few months each year, rivers rise rapidly and most overtop their banks locally. Thus floodplains with deep alluvium tend to occur wherever the slopes of river valleys flatten out, and this is especially true of the torrential rivers draining the Ethiopian Massif.
The Shebele and Genale Rivers drain the Bale Mountains on the southeastern side of the Rift Valley, and floodplains occur on both watercourses where they flow SE across the plains into Somalia. Flooding also occurs on the Omo River which drains the SW part of the massif north of the Rift Valley. Farther west, floodplains and extensive permanent swamps occur on the Akobo River along the border with Sudan. Swamps are best developed between the village of Neum (7°23'N/34°03'E) and the confluence with the Pibor River at Akobo Town (7°49'N/33°05'E). In parallel, to the north, other permanent swamps including two substantial lakes, are situated on the Gilo River (7°33'-7°43'N/ 34°11'-34°25'E) and there is a floodplain along the Baro or Sobat River. These latter rivers carry broad galleries of forest right across the floodplains, and there are areas of swamp forest in depressions. Seasonally inundated savannas occur behind the galleries. The flora and fauna of these soudanian wetland types is discussed in the regional introduction. In the far north, small wetlands occur in the headwater valleys of several tributaries of the Atbara River, and also in the great Wadi Baraka which reaches the Red Sea in Sudan.

9. Artificial Impoundments

K'ok'a Lake (8°17'-8°29'N/38°55'-39°07'E) was created in 1960, by closure of a dam on the Awash River in the Rift Valley 70 km SE of Adis Abeba. It is situated 1500 m asl, and, with an open water area in excess of 25 000 ha at capacity, it is currently the 20th largest artificial lake in Africa in terms of surface area. It is a multipurpose reservoir and supports a small fishery. Fincha'a Lake is situated behind a dam (9°33'N/37°24'E), 2000 m asl, in a broad swampy valley in the western highlands. It impounds a left bank tributary of the Blue Nile. Permanent herb swamps are scattered over an area of 70 000 ha (9°15'-9°39'N/37°15'-37°29'E) on either side of the lake, at altitudes of 2100- 2400 m asl. Zula Lake (15°16'N/39°38'E), 57 m asl on the Haddas River, was also created in 1960. It is situated in the Red Sea coastal region, 75 km WSW of Asmera (15°19'N/38°56'E).

10. Other Wetlands

The Tufta Swamps are situated near Butajira (8°08'N/38°24'E) high in the Western Highlands above Lake Ziway in the Rift Valley, to which they drain via the Me'ki River. The swamps are in the headwater valley of the river and its tributaries, which rise above Butajira at altitudes close to or above 3000 m.
There is a floodplain on the Akaki River near Adis Abeba. We have no biological information on these wetlands.