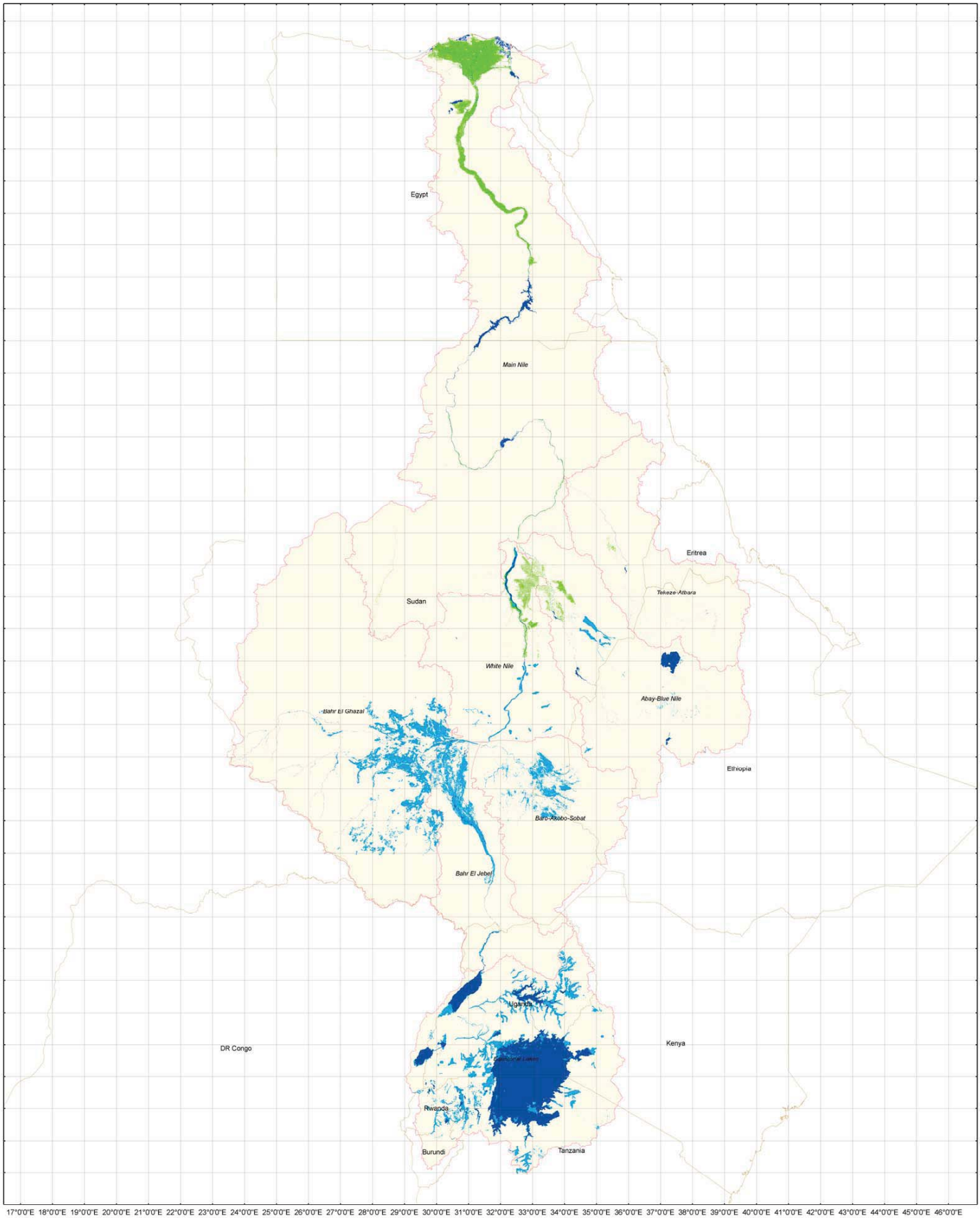
# *Appendices*

# *Appendix 1 Full Size Maps*




# Nile Wetlands

## Nile Basin

No. 1

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

## Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

## Layers

- Country Boundary
- SubBasin Boundary

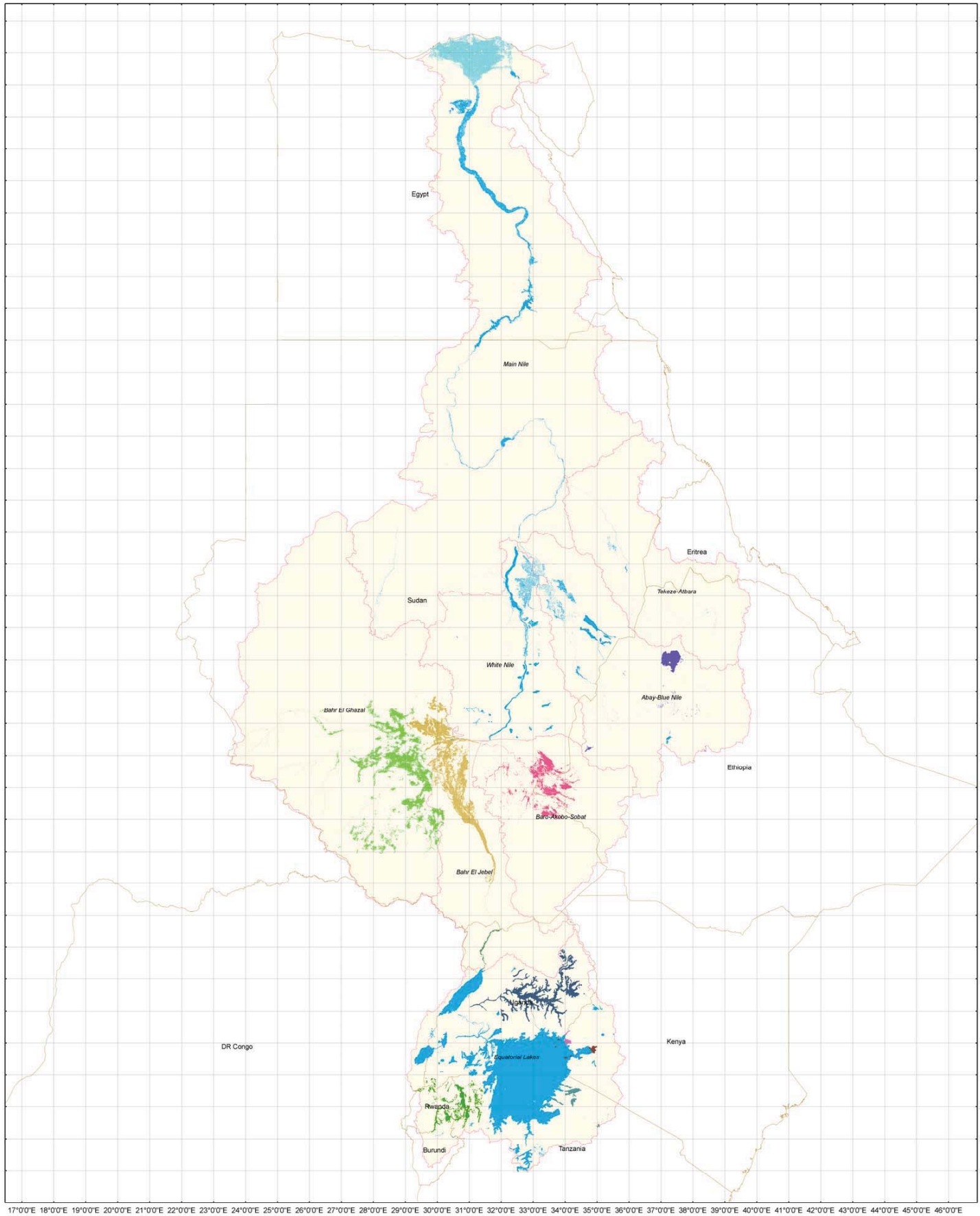
Scale 1:6000000

N

0 80 160 240 320 400 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Wetland Regions

No. 2

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

## Wetlands

- Sio Malaba Wetlands
- Mara Wetlands
- Sudd Wetlands
- Nile Delta
- Sobat Marches
- Ghazal Swamps
- Kyoga Swamps
- Albert Nile Swamps
- Winamp Gulf Wetlands
- Kagera Wetlands
- Lake Tana Wetlands

## Layers

- Country Boundary
- SubBasin Boundary
- Other Wetlands

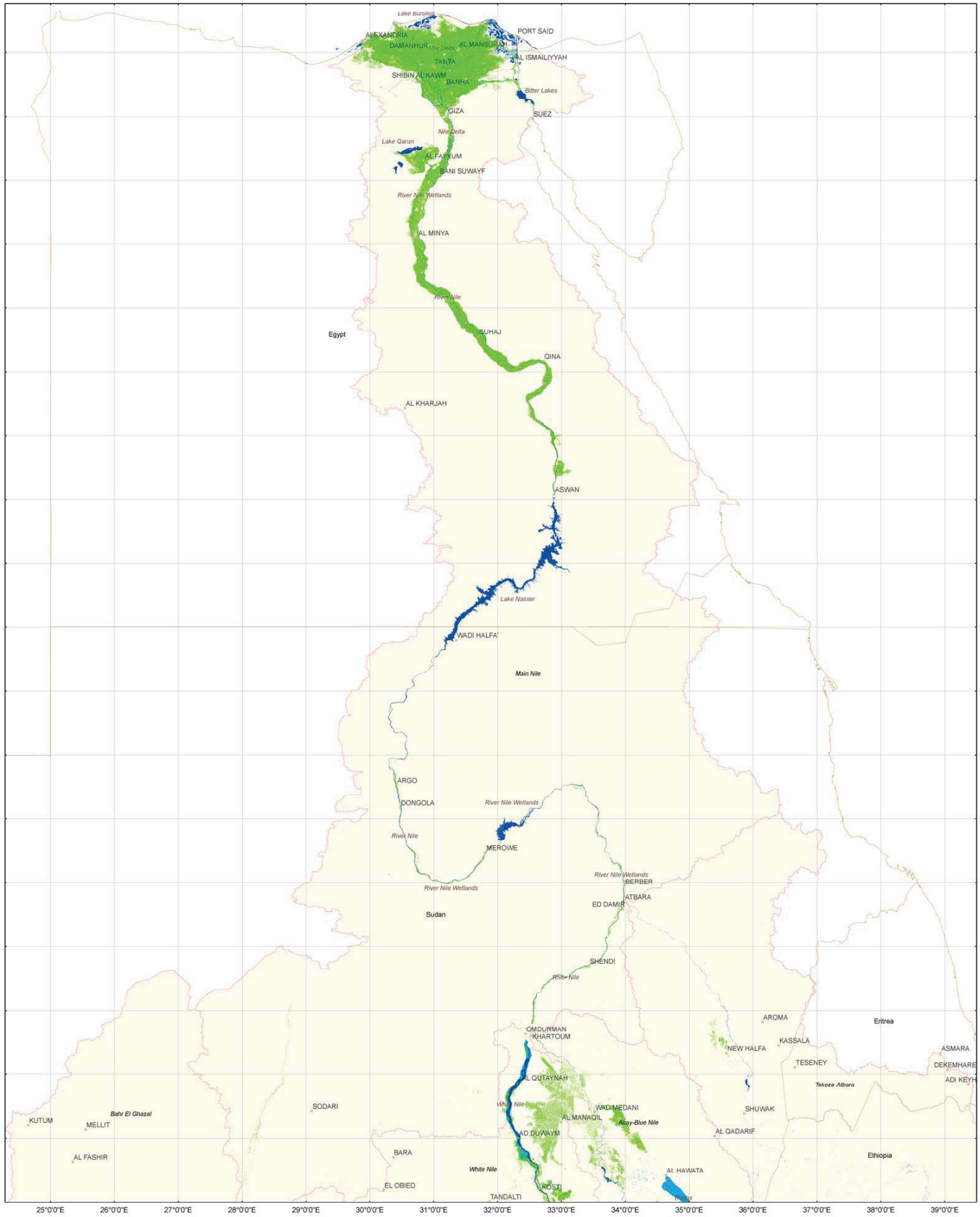
Scale 1:6000000

N

0 80 160 240 320 400 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Main Nile

No. 3

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

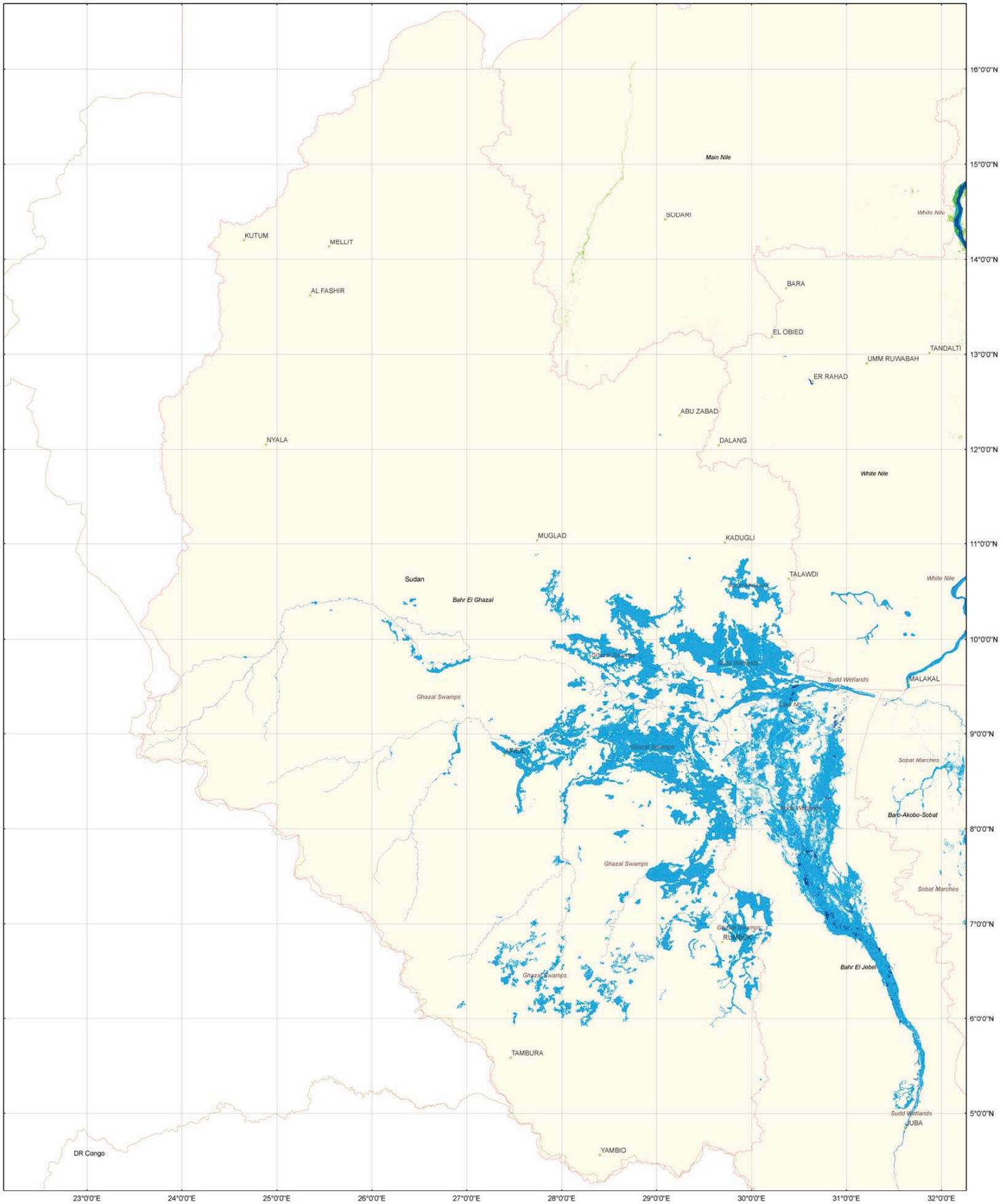
Scale 1:3000000

N

0 40 80 120 160 200 Km


Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Bahr El Ghazal

No. 4

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

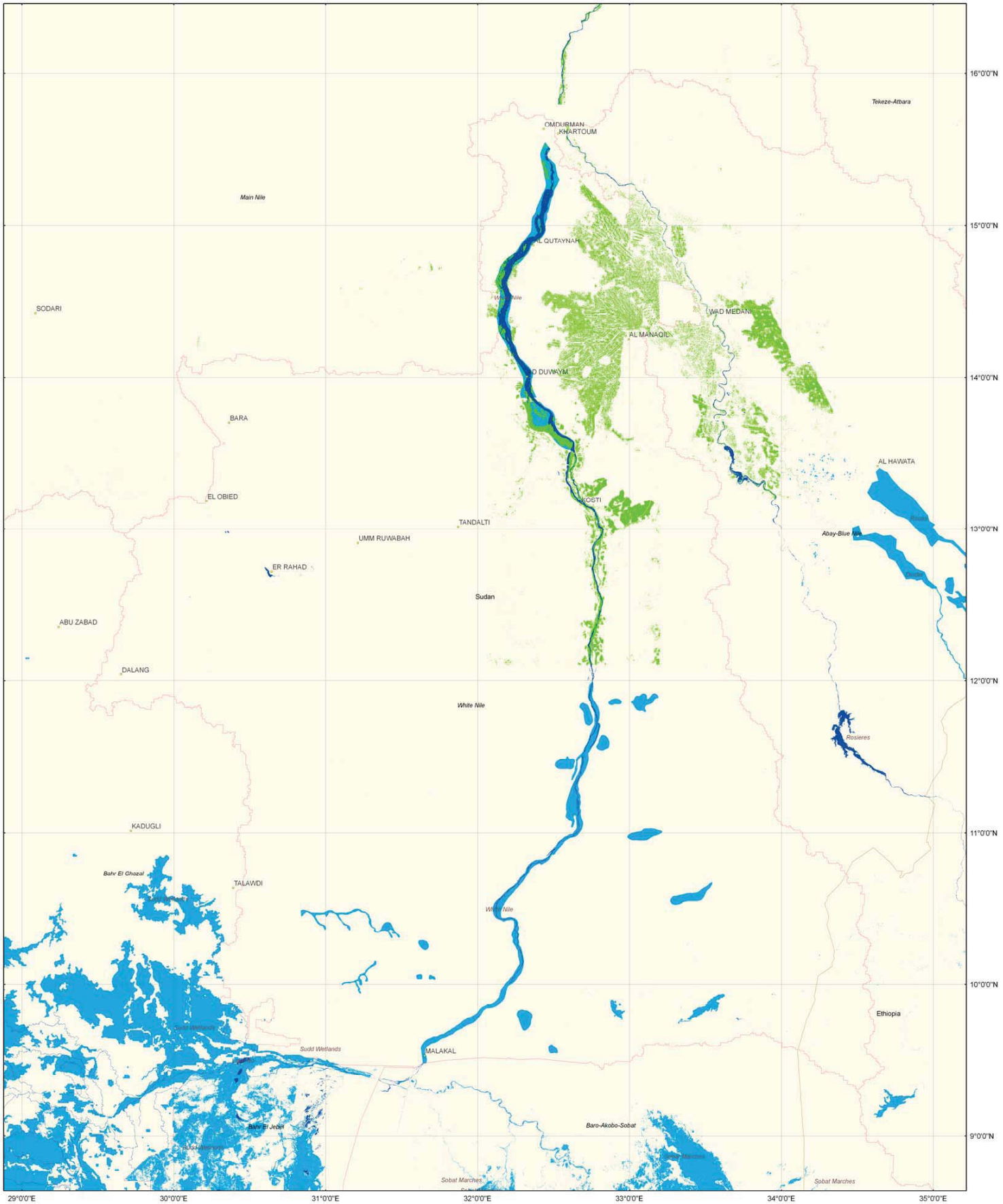
Scale 1:2000000

N

0 25 50 75 100 125 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




## Nile Wetlands

### White Nile

No. 5

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

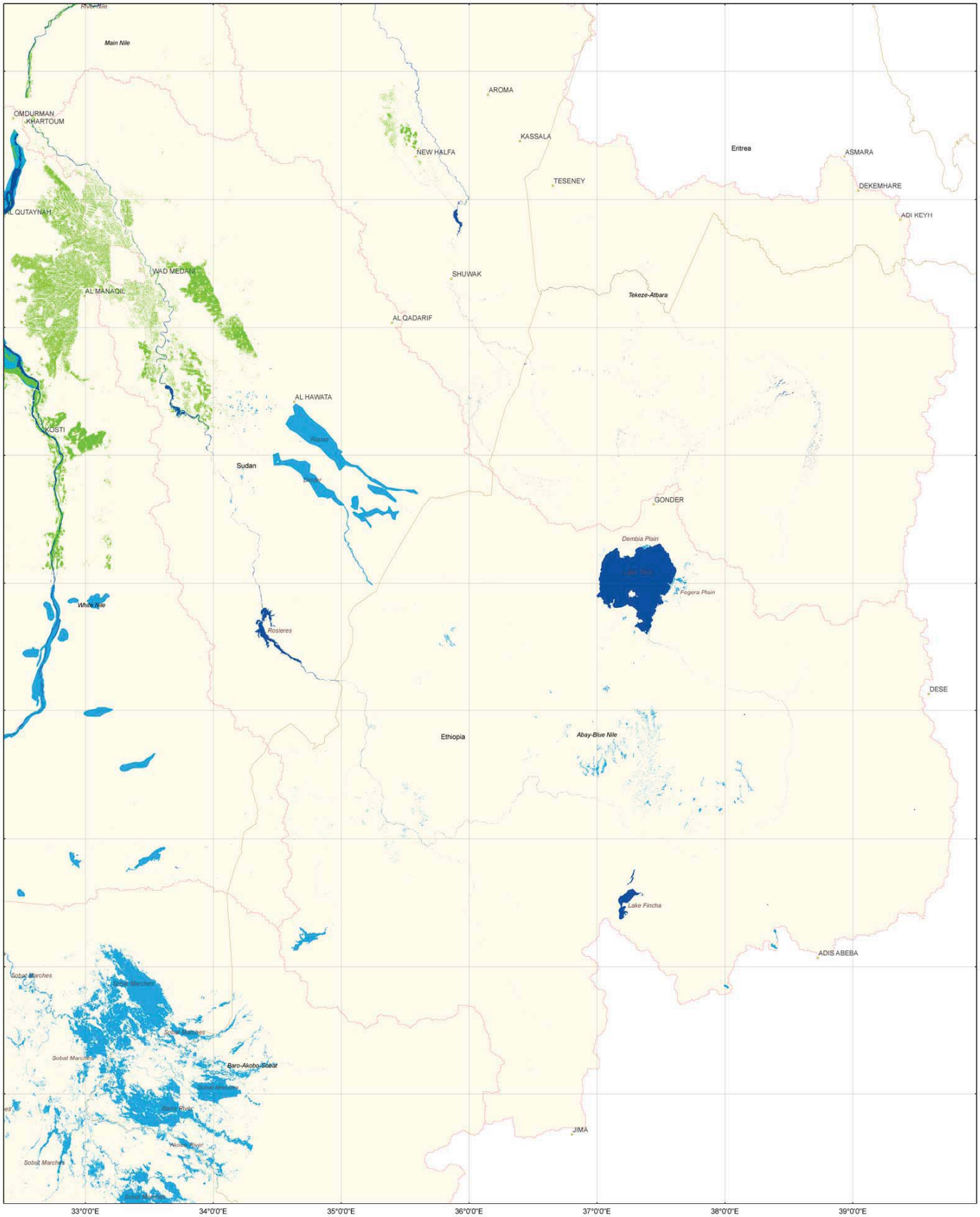
Scale 1:1250000

N

0 10 20 30 40 50 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Abay-Blue Nile

No. 6

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

Scale 1:1500000

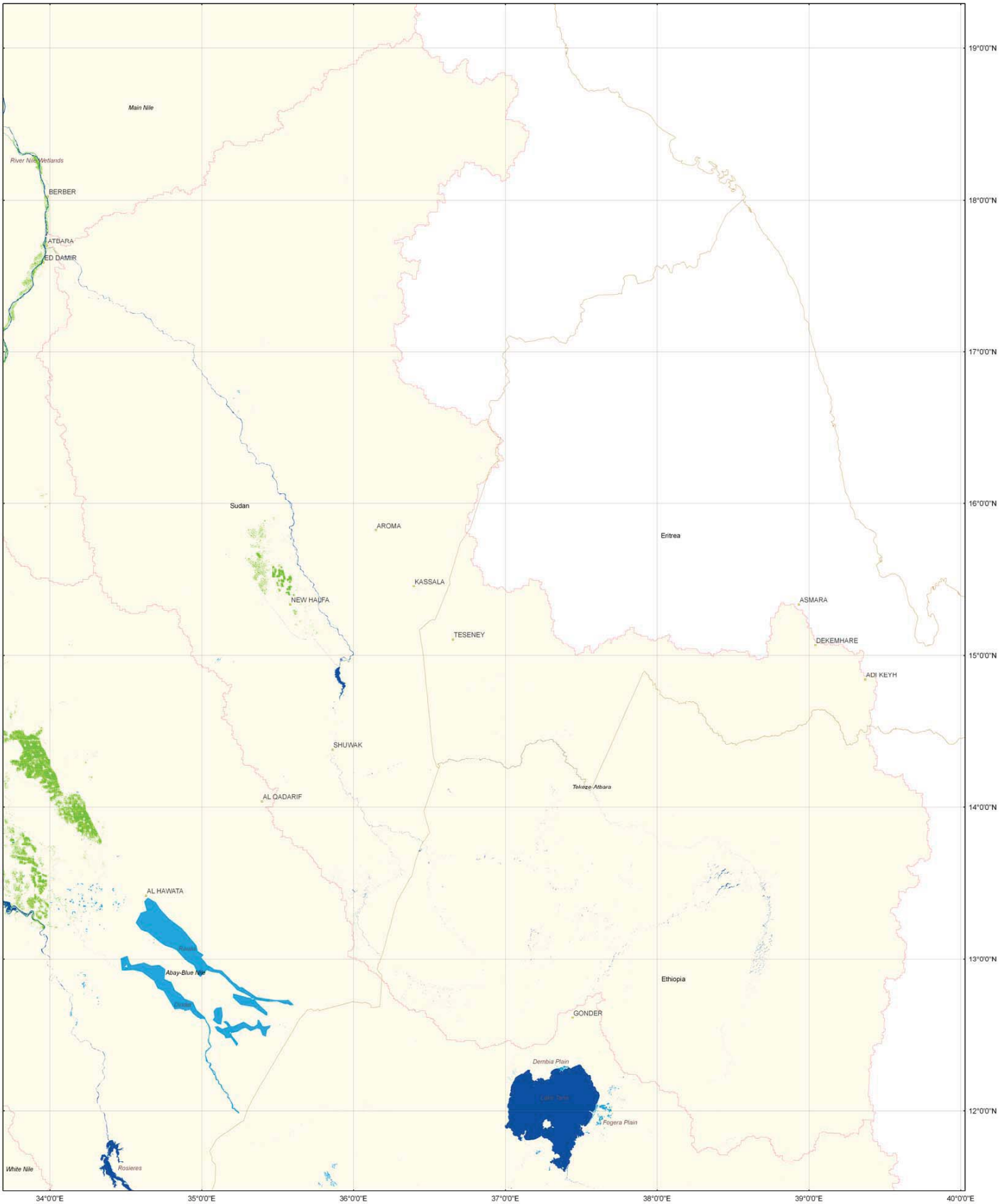
N

0 20 40 60 80 100 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org

NILE BASIN INITIATIVE
Initiative du Basin du Nil




# Nile Wetlands

## Tekeze-Atbara

No. 7

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

## Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

## Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

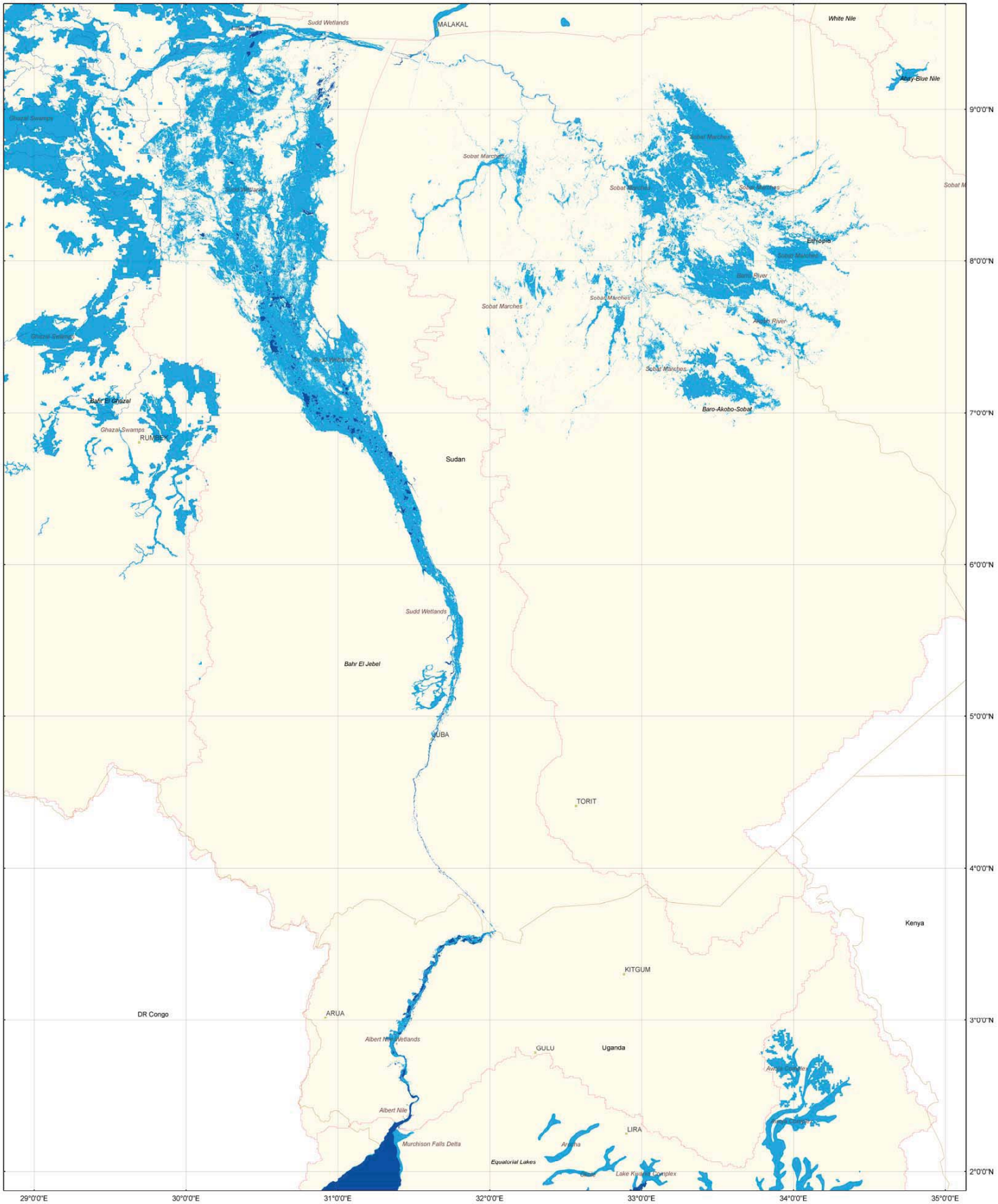
Scale 1:1250000

N

0 10 20 30 40 50 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Bahr El Jebel

No. 8

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

Scale 1:1250000

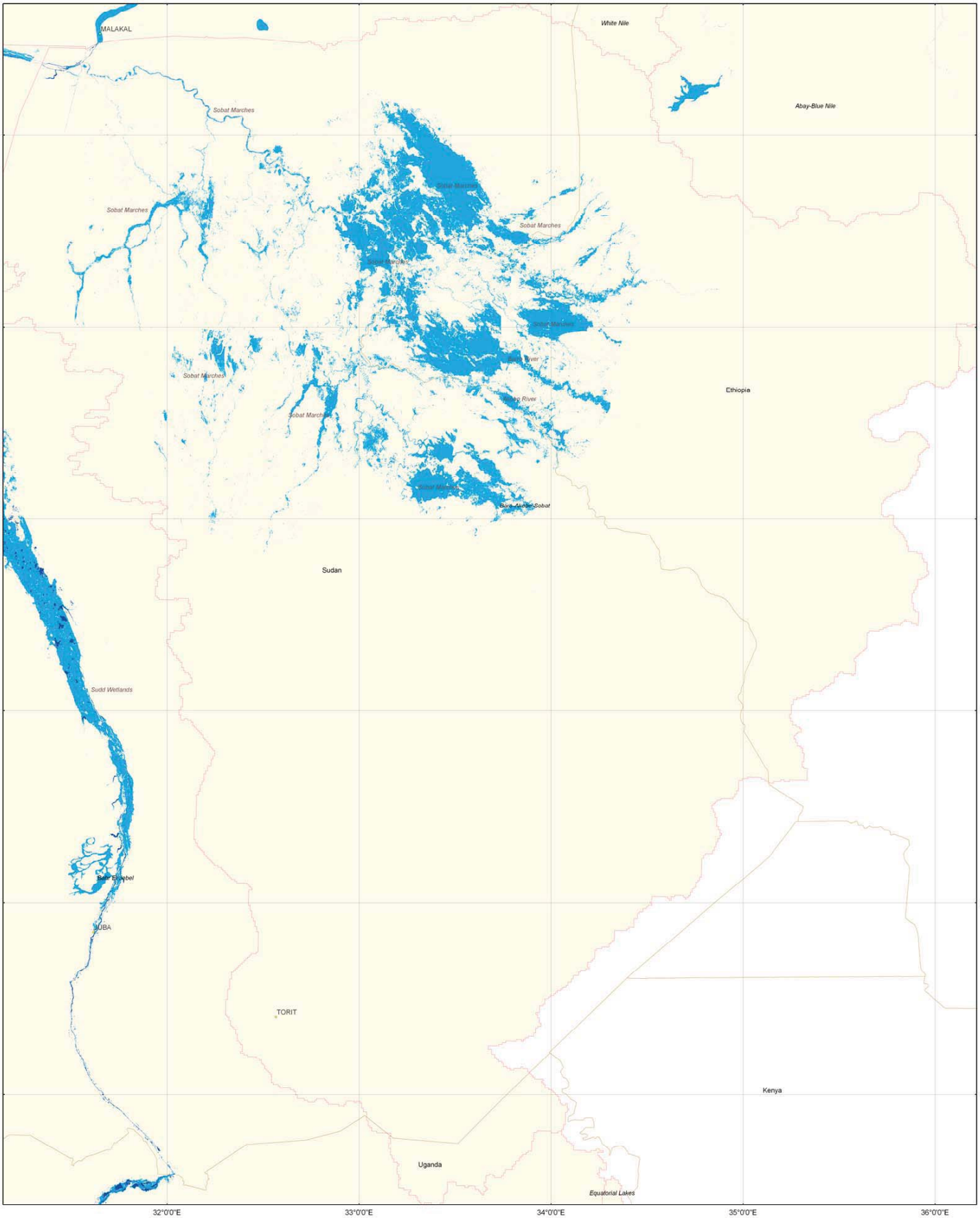
N

0 10 20 30 40 50 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org

NILE BASIN INITIATIVE
Initiative du Basin du Nil




# Nile Wetlands

## Barro-Akobo-Sobat

No. 9

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

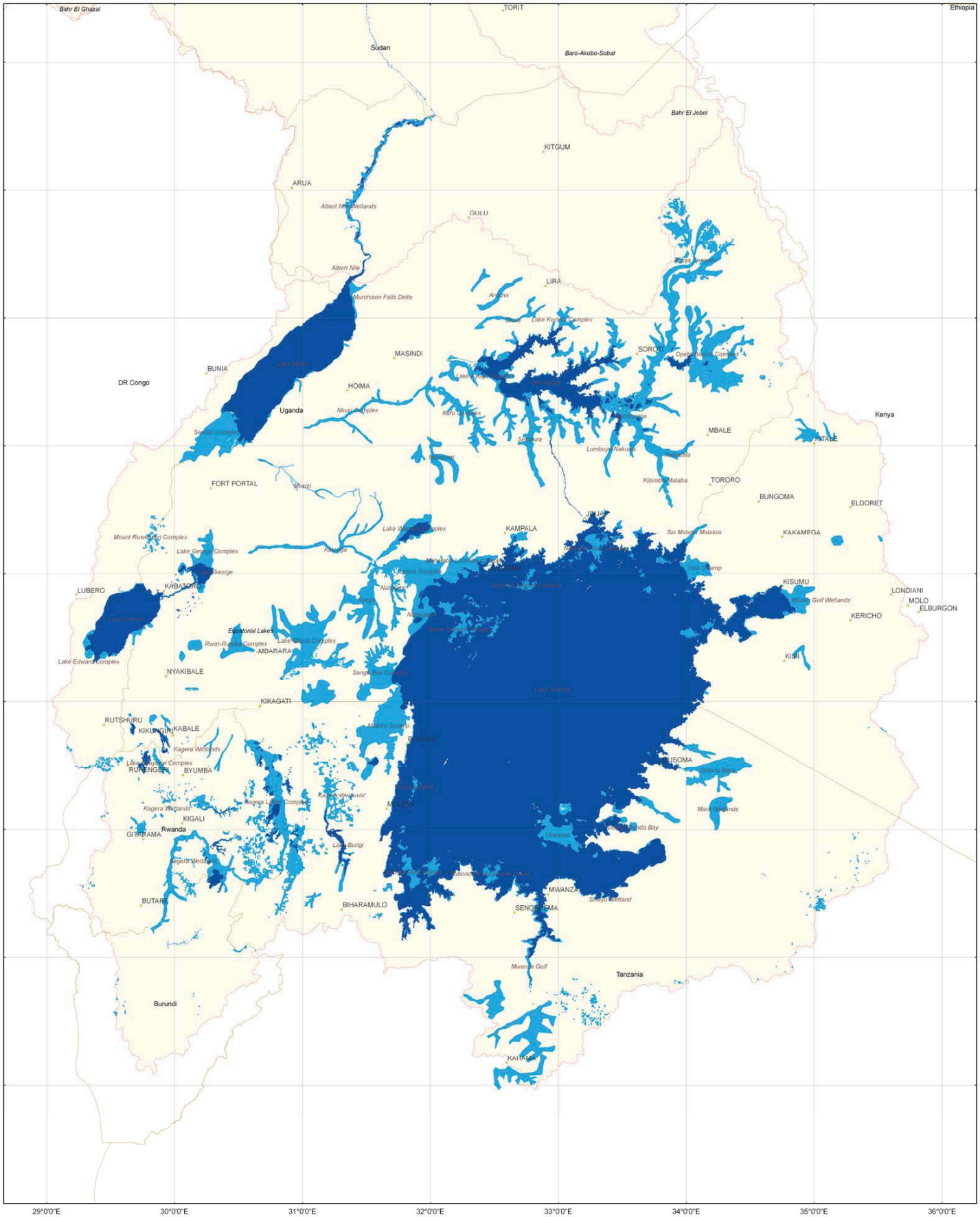
Scale 1:1000000

N

0 10 20 30 40 50 Km

Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org




# Nile Wetlands

## Equatorial Lakes

No. 10

This map was produced as part of the project: "The Wetlands of the Nile Basin: Baseline Inventory and Mapping." The wetland extents were derived from Landsat TM5 and ETM7 imagery, dated 1984-1988.

### Wetland Class (NDVI)

- Irrigated Area
- Open Water
- Wetland

### Layers

- Major Towns
- Country Boundary
- SubBasin Boundary

Scale 1:1500000

N

0 20 40 60 80 100 Km


Nile Basin Initiative,
P.O.Box 192,
Entebbe,
Uganda

email:nbisec@nilebasin.org

# *Appendix 2 Country Specific Descriptions of Wetlands in the Different Nile Riparian Countries*

# *Country specific descriptions of wetlands in the different Nile riparian countries*

## 1. Introduction

With an approximate length of approximately 6,800 km, the Nile is the longest river in the world (Dumont 2009). The nineteenth century quest for the source(s) of the Nile is a heroic chapter in the history of the exploration of the African continent, and it was long thought that Lake Victoria was its ultimate source. Yet, that lake itself is fed by rivers that arise further south, the most important of which is the Kagera. Until recently, it was believed that its tributary, the Luvironza, that springs in Tanzania, was the Nile's ultimate "source". However, a revised length estimate of 6,718 km was established in 2006, when a British–New Zealand expedition found that the tributary of the Kagera River arising furthest to the south is the Rukarara. It springs in the Nyungwe forest, Rwanda.

The Nile is the only permanent river that manages to cross the Sahara, the largest desert in the world, and reach the Mediterranean Sea, yet its early beginnings are in an equatorial climate, and it traverses a series of climatic zones before reaching its delta (Dumont 2009). Its basin orientation is unique among the major rivers in the world in that it runs almost perfectly from south to north. Each climate zone which it crosses shows considerable variability in precipitation and run-off (Dumont 2009), but over more than half its length it receives less than 150 mm of rain per annum. Its basin is relatively narrow and small ($2.9 \times 10^6$ km$^2$) compared to that of most other large rivers of the world (Dumont 2009).

The Nile basin covers the whole of Egypt and the Sudan, except for the short rivers that drain the Red Sea Hills towards the Red Sea. Most of these are wadis that only discharge water for few days after rare desert rains. The basin also covers about one third of Ethiopia, the whole of Uganda, and part of Kenya, Tanzania, Congo, Rwanda and Burundi. *(Note: Eritrea which is geographically located in the Nile Basin is not part of the politically cooperating Nile Basin countries or part of the Nile Basin Initiative)*

Conventionally, the Nile is divided into a number of sub-basins: the White or Equatorial Nile and its source lakes, the Blue Nile and Lake Tana, and the Main Nile. The River Atbara is often considered a separate, although small, sub-basin.

The next sections contain information extracted from the Directory of African Wetlands (Hughes, 1992) for all Nile Basin countries except Eritrea which has not joined the Nile Basin initiative. While part of the Nile Basin itself, Eritrea has not been included in this report. The information used for the wetlands overview is available from the Ramsar website[1].

The information provided for the different countries despite some general country specific description has been trimmed to reflect only Nile Basin related wetland information. The described wetlands are anyhow not comprehensive. Being a historic document, it should be noted that some names may be spellt in their old ways and some numbers may be outdated. While details may have changed, the overall physical description of the wetlands anyhow remains valid. Updated sources of information may be found for up to date research details.

[1] http://ramsar.wetlands.org/ADirectoryofAfricaWetlands/tabid/824/language/en-US/Default.aspx. Permission is pending from the originators of the information for the use in this report. We are required to therefore restrict release of this document to the project team until this has been formally granted.

# A Directory of African Wetlands.

R.H. Hughes and J.S. Hughes

1992

IUCN, UNEP, WCMC.
Gland, Switzerland, Cambridge, UK and Nairobi, Kenya

**2 The Nile**

The principal drainage system in the area of interest is that of the Nile, the longest river in the world. The source farthest from the sea flows as the Luvironza River in Burundi (3°44'S/29°47'E), rising about 1750 m asl in mountains on the eastern side of Lake Tanganyika. From this point the river flows 6695 km to the Mediterranean Sea, which it reaches at 31°38'N at the extremity of its delta, having traversed 35°22' of latitude. The published area of the drainage basin varies greatly, e.g. by 1 448 870 $km^2$ between the Times Atlas(1985) which gives an area of 1 900 000 $km^2$ and the Encyclopaedia Brittanica (1975) which gives 3 348 870 $km^2$. Most other sources place the area in the vicinity of the latter figure. Welcomme (1972) for example gives 3 004 400 $km^2$. These discrepancies probably arise because much of the northern basin is extremely arid and of little relief, and thus does not provide active drainage to the river. Our calculations for the basin give an area of 3 026 000 $km^2$. The eastern watershed runs SSE through Egypt and Sudan, along a mountainous crest parallel with the Red Sea. From Port Sudan it runs inland, SSW, passing east of Kassala in Sudan, it then snakes southeastwards through the Ethiopian Highlands to the vicinity of Dese, and then SSW, looping east of Addis Ababa, and passing west of Lakes K'ok'a, Ziway, Abiyata, Shala, Awasa, Abaya, Ch'amo and Turkana (Rudolph), thus encompassing much of the Western Highlands. Thereafter it passes east and south of Lake Victoria, closely skirting the southern shore, before finally running west to the source of the Luvironza in Burundi.

The Nile proper has five major tributaries, the Bahr el Jebel (River of the Mountains), the Bahr el Ghazal (River of Gazelles) and the Sobat River, which unite to form the White Nile, and the Blue Nile and Atbara River. The southernmost headwater stream, the Luvironza River, flows south for some 20 km, then north for 100 km, before swinging eastwards past Gitega (3°23'S/29°56'E) when it becomes the Ruvuvu River. Two other important headwater streams, the Akanyaru and Nyawarungu Rivers rise well above the 2000 m contour in Rwanda, east of Lake Kivu, and some 150 km north of the source of the Luvironza. At first these both flow eastwards in parallel, but then they diverge, the Akanyaru to the south and the Nyawarungu to the north, until having both described imperfect semi-circles, they meet in central Rwanda. Prior to their confluence they both drain swampy lakes, and below it the combined stream traverses extensive swamps en route to the Rwanda/Tanzania border where it joins the Ruvuvu River, thereafter being known as the Kagera River. This latter stream is the largest affluent of Lake Victoria. It flows north for 250 km through a shallow swampy valley containing 14 major lakes and innumerable minor ones, before turning sharply east near Kakitumba (1°04'S/30°45'E) to flow for a further 230 km to Lake Victoria. It enters the lake through another 30 km of valley swampland near the midpoint of the western shore at an altitude of 1134 m asl.

Lake Victoria is the third largest lake in the world, in terms of area, after the Caspian Sea and Lake Superior. It is a shallow lake, with a maximum depth of 85 m, several small islands, and much swampy shoreline. Its southern shore receives many short seasonal streams, while its eastern shore

receives a number of perennial rivers draining the mountains to the east. The most important of these rivers is the Mara which drains the Loita Plains and Lebetero Hills (2683 m) of SW Kenya, and the southern mountains of the Mau Escarpment along the western side of the Eastern Rift Valley, where there are several high wet peaks, e.g. Mau (3049 m) and Melili (3098 m). The Mara enters Lake Victoria about half way along its eastern shore, while a further 8 large perennial rivers, and several small ones, enter in the NE quadrant of the lake. These drain both the northern and central parts of the Mau Escarpment and the Cherangany Hills, and the massif of Mt. Elgon.

The western side of the Lake Victoria basin was tilted in the late Pleistocene. This reversed the flow of several rivers which used to flow westwards across the basin to Lakes Edward and Albert, and gave rise to Lake Victoria. The Katanga River now drains the country between Lake Victoria and Lake Edward, but a waterway is virtually continuous between the two lakes because there is now a swampy watershed from which the river flows both east and west. That the old river used to flow west to Lake Edward is clear from the incident angles of its tributaries, but since the basin was tilted, flow has reversed so that the eastern part now flows sluggishly to Lake Victoria, entering it through swamps. Moreover, flow in the old lower reaches, between Lake George and Lake Edward, is also sluggish and may reverse temporarily.

Some 86% of the water in Lake Victoria is derived from direct precipitation, and as much as 82% is lost by evaporation. Only 18% of the water which enters the lake continues downstream in the Victoria Nile, which leaves the lake close to its northern extremity at Jinja (0°27'N/33°12'E) in Uganda. The river used to cascade over waterfalls but these were submerged by the construction of the Owen Falls Dam in 1954. From here the river flows NNW for 150 km, before traversing the swampy southern basin of Lake Kyoga, to receive, still in swampland, the drainage of Lake Kwanta. Thereafter the river flows west to a confluence with the Kafu River, another stream in which drainage has been partially reversed, so that although the river appears on maps as a continuous watercourse between the Victoria Nile and the top end of Lake Albert, water in it flows in opposite directions at its two ends. The Victoria Nile then descends the eastern wall of the Western Rift Valley by the Murchison Falls.

Lake Albert collects run-off from the mountains (Karisimbi and Muhavura) at the northern end of Lake Kivu, from the northern Mitumba Mountains of Zaire, and from Mt. Stanley, via Lake Edward and the Semliki River. These waters, together with those of the Victoria Nile, flow from the northern end of the lake as the swamp fringed, into the Albert Nile. Together with Lake Victoria, Lake Albert acts as a reservoir, collecting the run-off from the high rainfall areas of Equatorial East Africa. Both lakes remove sediment from the waters and buffer the flow of the upper Nile which, below Lake Albert, is clear. However, by contrast with the situation in Lake Victoria, only a small fraction of the water which enters Lake Albert is lost by evaporation. The mean annual discharge from Lake Albert was 22 102 million $m^3$ between 1905-1962, giving a mean rate of flow of 700 $m^3$/sec, but between 1963-1980 these figures doubled.

At a point (3°36'N/32°01'E) near Nimule, the river enters Sudan in a region of gorges, culminating in the Fola Rapids, and is then known as the Bahr el Jebel (River of the Mountains). It flows swiftly, and is confined to a narrow bed until Juba (4°44'N/31°37'E), about 330 km downstream, where it flows smoothly onto a very flat clay plain at an altitude of about 430 m. This plain descends a comparatively narrow valley, with hills on either side, at a mean gradient of 1:13 000. Here the river overtops its banks following seasonally heavy rain in the catchments, and inundates almost the entire valley floor. A vast permanent swamp, known as the Sudd, begins below Mongalla (5°12'N/ 31°42'E), 75 km downstream from Juba. At first the Bahr el Jebel traverses a broad swampy trough in a well defined, but branched channel, with raised banks. However, below Bor the river banks are not discernible, the swamp widens progressively and there are numerous peripheral lakes and parallel streams, e.g. the Atem River. The river channels are deep, but beset with islands of floating vegetation, and the swamp extends northwards for 400 km, attaining a width of 100 km locally. Another river, the Bahr el Zeraf, rises in the swamps to the east of the Bahr el Jebel and the two streams are artificially united by short

canals where they approach each other at Zeraf Cuts (7°47'N/30°32'E). Today only the southern canal remains open and water flows through this from the Bahr el Jebel to the Bahr el Zeraf, only to re-enter the Bahr el Jebel at a confluence east of Tonga (9°22'N/31°06'E). A large area, 180 km long and up to 65 km wide, known as Zeraf Island, is thus isolated between the two streams. This was once mostly dry land, but following the rise in water levels which has been sustained since 1963-1964 it is now almost totally inundated, and the total area of the swamps now approaches 1 650 000 ha. Around the periphery of the swamp is a large seasonal floodplain occupying about 1 500 000 ha.

Some 26 920 million $m^3$ of water entered the Sudd each year between 1905-1960, but between 1961-1980 this had increased to 50 324 million $m^3$/yr. Approximately 17 % used to be contributed by seasonal and torrential tributaries of the Bahr el Jebel, and 83% by discharge from Lake Albert, but these figures have changed slightly since 1961, with a higher % contribution from Lake Albert. In traversing the Sudd about 50% of the water is lost by evaporation and the rate of flow is much reduced. The mean annual discharge from the Sudd, measured above the confluence of the Sobat at Malakal, was 14 158 million $m^3$ until 1960, but has averaged 21 387 million m3 in subsequent years. Long term changes in outflow from the East African lakes are responsible for the increased annual flows; they are well documented but poorly understood.

Because so much water is lost by evaporation in the swamps the Jonglei Canal is being cut to the east of the Sudd to bypass the swamp. The canal was supposed to run from Bor to a point just above Malakal. However, the reduction in volumetric flow is compensated for at the northern end of the Sudd by the inputs of three tributaries. The Bahr el Ghazal joins the Bahr el Jebel at Lake No, a large lagoon on the left bank, after which the stream swings sharply east for 150 km, receiving first the Atar and then the Sobat Rivers on the right bank. Below this the river again flows northwards and is referred to as the White Nile (Bahr el Abiad). Remarkably, although it flows freely after leaving the Sudd, the gradient of the river valley is less than in the Sudd, flattening here to 1:19 000.

The Bahr el Ghazal drains a dry plateaux of that name on the Sudan/Zaire border, together with a part of Southern Darfur, but neither it nor the Atar contributes much water to the White Nile compared to the Sobat which drains the southeastern part of the Ethiopian Highlands. So high does the Sobat rise in flood that the volume of water carried between Malakal and Khartoum (15°34'N/32°32'E) may double in October and November.

Nevertheless, the mean annual flow at Malakal is only 17 000 million $m^3$, 63% of what it is when entering the Sudd. The Jebel Aulyia Reservoir above Khartoum was constructed to hold back the floods created by the Sobat, and to regulate river flow downstream. This impoundment is the seventh largest in Africa with a surface area of 150 000 ha at capacity. Rain which falls on the catchments of equatorial East Africa reaches the lower Nile the following summer. This long delay is occasioned by retention in Lake Victoria and by the sluggish traverse of the Sudd. Between the Sudd and Khartoum much of the White Nile is fringed by swamps in strips generally about 300 m wide.

The volume of water carried by the Blue Nile changes quite dramatically through the year. Heavy rains fall over the Ethiopian Highlands in July and August and pass down the Blue Nile and Atbara Rivers to produce the deep sediment laden floods that develop in Egypt between September and November. The Blue Nile is said to rise as the Abbai, the longest of several torrential, but seasonal, streams feeding Lake Tana, from which the Blue Nile *per se* emerges (11°34'N/37°28'E) at an altitude of 1829 m. Lake Tana is shallow and is situated in the Western Highlands of Ethiopia, where it is ringed round by high peaks including Mts. Ras Dashen, Guna and Amedamit. On leaving the lake, the Blue Nile flows swiftly southeastwards, plunging over rapids for 200 km in a deeply cleft valley, before traversing a giant bend in which it sweeps through 135°, to flow almost due west for a further 400 km. All along this deep valley, often over 1200 m below the level of the plateaux, it receives tributaries, but then flows NW in a widening valley for 200 km to Er Roseires (11°49'N/34°20'E) where it is impounded in the foothills of the mountains, producing a lake with a surface area of 29 000 ha (at

capacity). Below the dam the gradient flattens and the river meanders across the Sudan Plains for 330 km to Sennar (13°33'N/33°37'E) where it is again impounded (lake area 16 000 ha), before continuing NW for a further 330 km, to a confluence with the White Nile just below Khartoum. On this latter stretch the river receives its two most important tributaries on the right bank. These are the ad-Dindar and the ad-Rahad, both of which are perennial and drain the western slopes of the Western Highlands. Following summer rains in the mountains the Blue Nile begins to rise in June, and reaches a maximum at Khartoum in September. It is estimated that a mere 7% of the water reaching the confluence at Khartoum is derived from Lake Tana, the bulk being contributed by the many tributaries.

The Atbara River, and its principal tributaries rise on the western slopes of the mountains enclosing Lake Tana, and following the summer rains, they flow swiftly northwestwards, for 550 km to an impoundment at Kashm el Girba (14°53'N/35°55'E), which has produced an artificial lake with an area of 12 500 ha. The river continues less swiftly below the dam, but in the same direction, for 600 km to reach a confluence with the Nile at Atbara (17°43'N/34°00'E), 310 km below Khartoum. While the Atbara River is an important tributary of the Nile, it is reduced to a trickle, and sometimes to a series of shrinking pools, towards the end of the dry season. Nevertheless, when both the Blue Nile and Atbara are in flood, the rate of flow in the White Nile, below Atbara may increase seven fold. The Blue Nile may rise by more than 6 m at Khartoum in August and its flood then holds back the flow of the White Nile, creating local floods south of the city.

## 3. The Nile Basin Countries

### 3.1 BURUNDI

**Wetlands**
There are a number of small lakes in the mountains and four substantial lakes including Lake Tanganyika, about 8% of the surface of which is situated in Burundi. There are floodplains and permanent swamps along many of the rivers, especially in the headwater regions, and on the lower plateaux. The following sections describe wetlands that are located within the Nile Basin

**List of Nile Basin Wetlands Described**
A. Natural Lakes
  (a) Lake Tshohoha South
  (b) Lake Katshamirinda
  (c) Lake Rwihinda
  (d) Lake Rugwero
  (e) Lake Kanzigiri
B. Riverine Swamps & Floodplains
  (a) The Luvironza/Kayongozi/Ruvuvu System
  (b) The Akanyaru River

**A. Natural Lakes**

**Wetland Name:** Lake Tshohoha South
**Country:** Burundi
**Coordinates:** 2°20'-2°32'S/29°59'-30°10'E
**Area:** c. 7000 ha (5000 ha in Burundi)
**Altitude:** c. 1750 m asl
**Nearest Towns:** Bujumbura (125 km SW); Gitega (100 km S)
**General:** Lake Tshohoha South (Lake Tshohoha North is in Rwanda) is 30 km long, oriented SE-NW, and is shallow with a highly indented perimeter. It reaches 5 km in width at the southeast, but is generally 1.5-2 km wide. It lies on the floor of a swampy forested basin between two low hill

ridges. It is fed at the southeastern end and drains to the Akanyaru River from the northwestern end through 4 km of swamps. It is fringed by papyrus and *Miscanthidium* swamps, with patches of arborescent swamp forest containing *Bridelia micrantha, Ficus verruculosa, Myrica kandtiana* and *Phoenix reclinata,* while the submerged vegetation and fauna are typical of Equatorial East African Plateaux lakes as described in the regional introduction. The surrounding basin contains some seasonally inundated savanna dominated by *Acacia polyacantha* var. *campylacantha* and A. *sieberana.* The lake is fished, some agriculture occurs higher in the basin, but it is not protected.

**Wetland Name:** Lake Katshamirinda
**Country:** Burundi
**Coordinates:** 2°27 'S/30°01 'E
**Area:** 400 ha
**Altitude:** c. 1450 m asl
**Nearest Towns:** Muhinga (57 km SE); Kitega (105 km S)
**General:** This little lake is oriented SE-NW. It is 4 km long and about 1 km wide, and is situated southwest of Lake Tshohoha South, in an adjacent and parallel basin. The southeastern end is set in forested country, but the northwestern end merges into papyrus swamps, through which it drains for 4 km to the Akanyaru River. Its flora and fauna are similar to those described for Lake Tshohoha South and it is unprotected.

**Wetland Name:** Lake Rhwihinda
**Country:** Burundi
**Coordinates:** 2°32'-2°34'S/30°03'-30°06'E
**Area:** 9200 ha (1200 ha open water + 8000 ha swamps)
**Altitude:** c. 1480 m asl
**Nearest Towns:** Muhinga (42 km SE); Kitega (95 km SSW)
**General:** Like the two previous lakes, this shallow waterbody is also oriented SE-NW. It is 6 km long and 2.5 km wide at the southeastern end. It is flanked by an extensive belt of permanent swamps on its southwestern shore, and drains to the Akanyaru River from its northwestern end through a tract of swampland 11 km long and 2 km wide. The swamps are dominated by *Cyperus papyrus* and *Miscanthidiunzviolaceum* but with some *Phragmites mauritianus* and occasional *Dissotis incana. Phoenix reclinata* is common in substantial patches of low swamp forest dominated by *Ficus verruculosa* and *Myrica kandtiana.* The lake is unprotected. It is fished and there is some agriculture on the northeastern side.

**Wetland Name:** Lake Rugwero
**Country:** Burundi
**Coordinates:** 2°21'-2°28' S/30°16' -30°22 'E
**Area:** c. 6000 ha (open water, excluding swamps)
**Altitude:** c. 1750 m asl
**Nearest Towns:** Bujumbura (143 km SW); Muyinga (43 km S)
**General:** The surface area of this lake varies considerably from wet to dry years. It is 15 km long, and up to 8 km wide at the north end at maximum. The lake is shallow, c. 2-4 m, and lies at the southern end of the Mugesera/Rugwero Lake/Swamp Complex. The northern part of the lake just intrudes into Rwanda. The southern and southwestern shores are forested, while the western, northern and northeastern shores abut extensive swamplands. The lake drains northeastwards, through a short swampy tract to the Nyawarungu River. Innumerable small circular or semi-circular papyrus islands float on the lake surface, and the shores are fringed by papyrus with *Vossia cuspidata* and other aquatic species along the outer faces. *Dryopteris gongylodes* forms an understorey in the papyrus, while to landward there are wide *Miscanthidium* swamps and occasional trees and *Phoenix reclinata* palms. The lake is fished, the hinterland is cultivated locally, and it is unprotected.

**Wetland Name:** Lake Kanzigiri
**Country:** Burundi
**Coordinates:** 2°26' -2°29' S/30°21 ' -30°23 'E
**Area:** 1600 ha (open water) + 3600 ha (swamps)
**Altitude:** c. 1490 m as1
**Nearest Towns:** Muhinga (38 km 5); Kitega (113 km SW)
**General:** Lake Kanzigiri is situated 10 km SE of Lake Rugwero. It is 8 km long and 2 km wide, and aligned SW-NE. It is fed through a 6x3 km tract of swampland at the southern end by the Kabanga and Runombe Rivers, and drains from its northern end through swamps to Lake Rugwero. However, along most of its western shores it is separated from Lake Rugwero by forested land. It is fished and some cultivation occurs around its margins. It is unprotected.

**B. Riverine Swamps & Floodplains**

**General:** The climate is marked by a long dry season, which in many years may be virtually rainless, followed by a 6 month wet season when 2000 mm may fall in the highlands, and up to 1200 mm on the plateaux. Thus highland rivers are torrential at this time, deeply eroding the land, while in the flatter valleys much alluvium is deposited and floodplains have developed. Some of the lower valleys are characterised by permanent and semi-permanent swamps.

**The Luvironza/Kayongozi/Ruvuvu system**
**General:** The Luvironza rises at a point 3°44'S/29°47'E at an elevation close to 1950 m as1 on the high dorsale immediately east of Lake Tanganyika. It flows north over a boggy plateaux, where *Sphagnum* sp. grows with *Drosera madagascariensis, Loudetia phragmitoides, Lycopodium carolinianum, Rhynchospora brownii, Utricularia appendiculata* and *Xyris angularis.* Such bogs are common above 1700 m, but may also occur at the heads of valleys down to 1500 m. The Luvironza eventually turns NE and decends below 1500 m into a deep valley, in which it receives several tributaries, including the Karuzi River on the left bank, and after this becomes known as the Ruvuvu. Another major tributary, the Kayongozi River, rises in the far east of Burundi, close to the Tanzanian border, and flows southwestwards, anti-parallel with the Ruvuvu for 48 km, before turning abruptly northwards to a confluence with the Ruvuvu at 3°15'S/30°19'E, just below the 1500 m contour.

Extensive permanent swamps, dominated by papyrus, occur in the headwater basin of the Kayongozi (3°04'S/30°32'E-3°00'S/30°36'E) and its affluent the Mumizi (3°03'S/30°37'E). Many other deep high valleys above the Ruvuvu are blocked by *Cyperus papyrus* with, occasionally, some *Polygonum strigosum.* So dense are these swamps, and so variable the water levels, that agriculture is precluded, while the shallow valleys are largely given over to cultivation. These valleys tend to be flooded for half the year, but rather dry for the other half, and behind the papyrus along the thalwegs, they were once filled by swamp forests, dominated either by *Syzygium guineense* or *S. owariense.* The former is associated with *Ficus verruculosa* and *Myrica kandtiana* and occupies the drier sites. Little relict stands are still apparent, but the trees have mostly been cleared. *Syzygium owariense* forests occupy the wettest sites and the trees develop pneumatophores. They are associated with *Cyathea dregei, Lonchitis natalensis, Lygodium scandens, Osnzunda regalis, Pteris intricata* and *Renealmia engleri,* but this type of forest has also been intensively cleared, and where there is no cultivation there are now secondary swamps of *Cyperus latifolius.* There is little *Phragmites* in the high valleys, but in some relatively undisturbed wet situations one meets *Cyperus nudicaulis* and *Pycreus inundtii* fringing standing water which supports floating mats of *Azolla pinnata* and *Lemna paucicosta,* over submerged beds of *Enhydra fluctuans, Hydrocotyle ranunculoides, Lemna paucicosta* and *Ludwigia adscendens.*

Gallery forest in the upper Ruvuvu system is confined to the narrow and often rocky valleys of tributaries. It is inundated only for short periods when the rivers are in spate, and is locally dominated by *Newtonia buchananii,* with *Albizzia gumnzifera, Bridelia micrantha, Cleistanthus polystachyus,*

*Harungana nzadagascariensis, Magnistipula bangweolensis, Millettia dura, Sapiunz ellipticunz* and *Xynzalos monospora.*

The Ruvuvu River meanders along its lower valley at altitudes of 1400-1100 m asl, accompanied by a narrow, tree covered floodplain, 3-5 km wide. On this there are many pools, and the dominant trees are savanna species such as *Acacia seyal.* The river itself is densely fringed by *Cyperus papyrus* and *Phoenix reclinata,* with gallery forest behind. The pools on the floodplain support typical submerged and floating leaved aquatics including *Ceratophyllum demersum, Leersia hexandra, Ludwigia adscendens, Nymphaea caerulea, Potamogeton* spp. and *Vossia cuspidata.*

Large animals are comparatively common in the lower valley and include *Crocodylus niloticus*, *Hippopotamus anzphibius*, *Hippotragus equinus, Kobus ellipsiprymnus, Phacochoerus aethiopicus, Syncerus caffer, Tragelaphus scriptus* and *T spekei*. There is an abundance of water birds including *Mycteria ibis* and *Pelecanus onocrotalus*. Some 46 000 ha of the lower valley including much wetland, is protected in the Ruvuvu National Park. Otherwise, pressures on the land are great. Hunting and fishing take place everywhere, but the population is very centralised and agricultural pressure around towns and villages is enormous in view of the extremely high population density.

**The Akanyaru River**

**General:** The river rises in Rwanda, about 2300 m asl, but the important headwater tributary, the Mugere, rises in Burundi with sources at 2°50'S/29°27'E and 2°52'S/29°29'E, both close to 2450 m asl. In its lower course the Akanyaru meanders through a shallow valley, flanked on both banks by permanent swamps, beyond which are seasonally inundated savannas. The swamps begin at a point 2°46'S/29°50'E, from where the river flows more or less due north forming the border between Rwanda and Burundi. The swamp belt is best developed on the Burundi side, especially at the confluences of tributaries, up the valleys of which it reaches 6-10 km. There are estimated to be 14 600 ha of permanent swamps on this river in Burundi in a strip 63 km long. Both these swamps, and those in the valleys of right bank tributaries, are dominated by papyrus, with strips of swamp forest parallel with the river on less deeply inundated sites. In these, *Bridelia micrantha, Ficus verruculosa, Myrica kandtiana* and *Phoenix reclinata* are dominant close to the river, but with *Acacia polyacantha* var. *campylacantha, A. sieberana* and *Albizia gummifera* locally common farther away. No part of the valley is protected. The river and swamps are fished by artisans, and much of the seasonally inundated land is cultivated.

## 3.2 EGYPT

**Wetlands**

There are some important wetlands on the Mediterranean coast, and others of lesser size and importance on the eastern coasts. In Sinai, and on the Red Sea, some small swamps exist in the lower valleys of intermittent watercourses and there are extensive saltmarshes along the littoral. Mangroves have a discontinuous distribution from the tip of Sinai southwards. There are lakes in some depressions of the Western Desert. The Nile has a floodplain and a delta, and it is impounded at Aswan to form Lake Nasser. The following sections describe wetlands that are located within the Nile Basin

**List of Wetlands Described**

A. Wetlands of the Nile Delta
- (a) The Delta Proper
- (b) Lake Maryut
- (c) Lake Idku
- (d) Lake Burullus
- (e) Lake Manzala

(f) Sabkhet el Bardawil
B. The Lower Nile Valley
C. Lake Nasser/Nubia

**A. Wetlands of the Nile Delta**

**Wetland Name:** The Delta Proper
**Country:** Egypt
**Coordinates:** 30°07 '-31°36'N/29°53 ' -32°31'E
**Area:** 2 292 500 ha (total delta)
**Altitude:** 0-30 m asl
**Nearest Towns:** Alexandria (at W edge); Port Said (at E edge)
**General:** The delta is symmetrical. It is 175 km from apex to base, i.e. from Cairo to the sea, and some 263 km wide at the sea. Since the construction of the Aswan High Dam the delta is no longer subject to annual flooding, and much of the marshland has been reclaimed for agriculture. Of the persisting marshland, most is associated with the lakes and lagoons along the seaward face and is discussed in the succeeding sections. However, coastal erosion is increasing now that the Aswan Dam impounds most of the silt coming down river, and the integrity of the delta lakes is threatened. Below Cairo the Nile divides into the Rosetta (western) and Damietta (eastern) branches which reach the sea at places of these names. Several major canals and numerous distributary streams branch off from these main rivers. A number of small lakes occur in the delta, many representing sections of abandoned river channel. To the west of the Rosetta channel, just below Cairo, there are the two El Mallah Lakes (30°05 '-30°07 'N/31°03'-31°04'E) and Lake el Qatta (30°12'N/30°59'E), and farther north a cluster of 15 small lakes (30°48'-30°57'N/ 30°16'- 30°39'E) near El Dilingat. Between the Rosetta and Damietta branches, shortly below the bifurcation, there is Lake Faraontya (30°21'-30°28'N/30°56'-31°03'E) which is a section of abandoned channel. To the east of the Damietta branch there are Lakes Sinnera and Sanel Hagar (31°05'N/31°55'E), just south of the large coastal lagoon of Manzala, and the Miheishar Lakes (30°44'N/31°53'-32°04'E).

**Flora & Fauna:** The delta wetlands have coastal fresh water floras and faunas as discussed in the regional introduction. *Phragrnites australis, Typha capensis* and *Juncus tnaritimus* are common here, together with some small sedges. Papyrus is now virtually absent from the delta. Some marine fishes enter the delta, e.g. *Anguilla* spp., *Mugil cephalus* and *Solea vulgaris.* Several European animals are present including *Lutra lutra* and *Vulpes vulpes* and there is an abundant avifauna.

**Human Impact & Utilisation:** Most of the delta wetlands have been reclaimed for agriculture, but since the construction of the High Dam at Aswan the upper delta has tended to become progressively more saline. This is due in part to the intrusion of seawater, but also to the use of artificial fertilisers in the lower Nile Valley to compensate for the loss of silt which used to be deposited by the flood each year. By contrast the delta lakes have become less saline due to increased drainage from irrigation schemes.

**Wetland Name:** Lake Maryut
**Country:** Egypt
**Coordinates:** 31°07'N/29°53'E
**Area :** 2 7 0 0 ha (lake proper )
**Altitude:** 3 m bsl (water surface) Nearest Town: Alexandria (2 km SW)
**General:** This lake fills a depression below sea level and is separated from the sea by a limestone ridge. The water surface is now 3 m bsl. The lake used to have an area of about 11 000 ha, but most of this was reclaimed between 1950 and 1980. The Nozha Hydro-dome was isolated from Lake Maryut in 1939 and is now enclosed by a 9 km concrete embankment and is used as a fish farm.

**Hydrology & Water Quality:** Water depths vary between 90-150 cm and the bottom is covered by silt, clay and shells. It is fed chiefly by the Qalaa Drain and water from the lake is pumped to the sea. Water temperatures range from 13-30°C and Secchi depths of 10-100 cm are obtained. pH ranges from 7.0-9.7 and is lowest near industrial inputs. Total dissolved solids range from 1750-11400 mg/l. Chloride ion concentrations range from 3-9 mg/l and silicate from 8-17 mg/l. High nitrate and nitrite concentrations have been recorded but these are not permanent. The lake may become deoxygenated when levels of organic matter are high. The lake is unstratified because of wind action. Pesticides such as DDT and Lindane have been detected in the water in comparatively high concentrations.

**Flora & Fauna:** The southern shores are covered by dense reedbeds *(Phragrnites australis),* together with *Cyperus* and *Juncus* spp. *Ceratophyllum denzersum* and *Najas pectinata* occur in the centre of the lake. The lake is eutrophic and primary production is high. Most of the Nile delta birds and mammals are found here.

**Human Impact & Utilisation:** A fishery on the lake is highly productive yielding some 17 000 tormes/yr, i.e. 6200 kg/ha/yr. Currently *Oreochromis* spp. comprise 77% of the catch and *Clarias* spp. 17%. The lake is polluted by industrial and agricultural effluents and there is evidence of both heavy metal and pesticide accumulation in the fish.

**Conservation Status:** Unprotected.

**Wetland Name:** Lake Idku
**Country:** Egypt
**Coordinates:** 31°12'-31°16'N/30°08'-30°18'E
**Area:** 10 400 ha
**Altitude:** sea level
**Nearest Towns:** Alexandria (17 km W); Cairo (162 km SE)
**General:** This shallow brackish lake contains a number of islands and is situated 15 km SW of the mouth of the Rosetta branch of the Nile. It is 16 km long, has a maximum width of 10 km, and is separated from the sea by a narrow sand barrier. An extensive reed swamp at the eastern side has been partially reclaimed in recent years.

**Hydrology & Water Quality:** Water is received by drainage of the surrounding delta lands and exchange with the sea occurs through the Bougaz el Maadiah, with inflow from the sea occurring principally in winter. The lake is usually well oxygenated and water temperatures range from 15-29°C. Chloride ion concentrations range from 0.5-23 mg/l, and total dissolved solids from 1000-45 000 mg/l.

**Flora & Fauna:** The flora and fauna are much as described in the regional introduction. The lake supports *Ceratophyllum demersum* and dense mats of *Eichhornia crassipes,* with *Potamogeton crispus* and *P. pectinatus* in the most saline areas. It is eutrophic and highly productive. The eastern marshes are dominated by *Phragmites australis.* European animals such as *Lutra lutra* occur here.

**Human Impact & Utilisation:** There is a flourishing fishery in which *Oreochromis* spp. account for 82% of the catch, *Anguilla anguilla* for 10% and *Mugil* spp. for 6%.

**Conservation Status:** Unprotected.

**Wetland Name:** Lake Burullus
**Country:** Egypt
**Coordinates:** 31°22'-31°35'N/31°31'-32°08'E
**Area:** 71 000 ha
**Altitude:** sea level

**Nearest Towns:** Alexandria (57 km SW); Cairo (154 km S)
**General:** This is a shallow brackish lagoon with numerous small islands. It is open to the sea through a narrow mouth at the northern extremity near the town of El Burg. Depths vary from 0.7-2.4 m, and changes in water level expose large areas of shoreline. The northern shore is separated from the sea by a long dune covered spit. The bottom is muddy along the southern shore, but sandy on the northern side.

**Hydrology & Water Quality:** Inflows from the land occur from 7 major drains along the southern shore, and discharges from these, together with rainfall and seepage from the Rosetta branch of the Nile, cause the lake level to rise and induce a net discharge to the sea in summer. However, seawater may enter in winter. Water temperatures range from 11°C in winter to 30°C in summer. The water is well mixed and well oxygenated, although turbid, with Secchi depths of only 8-37 cm. Chloride ion concentrations range from 0.3-14 mg/1, while silicate levels may reach 400 mg/l.

**Flora & Fauna:** This is essentially as described in the regional introduction. There are extensive reed beds dominated by *Phragmites australis,* with *Potamogeton* spp. dominant in the lake. *Ceratophyllum demersum, Eichhornia crassipes* and *Lemna gibba* are also present; *Lemna* forms scums on stagnant backwaters while *Eichhornia* is dominant in the drains. About 30 different fishes have been recorded from the lake including species of *Anguilla, Mugil* and *Solea.*

**Human Impact & Utilisation:** There is a fishery on the lake.

**Conservation Status:** protected.

**Wetland Name:** Lake Manzala
**Country:** Egypt
**Coordinates:** 30°51'-31°33'N/31°45'-32°35'E (total system)
**Area:** 90 000 ha (open water) + 68 800 ha salt- marsh
**Altitude**: sea level (saltmarsh partly below sea level)
**Nearest Towns:** Port Said (at E end); Cairo (135 km SW)
**General:** This is the largest of the delta lagoons. It is situated between the Damietta Branch of the Nile and the Suez Canal, while the El Manzala Canal, which traverses the lagoon, connects Port Said with Damietta. The lagoon is shallow, with a mean depth of 1 m, and salt-marshes extend southwards and eastwards from the SE corner. Some 48 800 ha of the salt-marsh, east of the Suez Canal, are below mean sea level. Because of reclamation the open water area has been decreasing steadily, from 170 000 ha at the turn of the century, to 90 000 ha in 1983. The present lagoon is 64 km long with a maximum width of 49 km and contains numerous islands.

**Hydrology & Water Quality:** There are several connections with the sea, the largest being at El Gamil. A number of drains enter on the southeastern shore, the largest of these being the Bahr el Bagar Drain and the Hadous Drain which between them discharge 5 billion $m^3$/yr. The lake is moderately well oxygenated, but concentrations may fall to 4-5 mg/I or less in the south at night. Salinity has fallen over the last 50 years due to increased fresh water inputs from irrigation schemes and decreased connection with the sea. In 1926 mean salinity was in the region of 17%, but this had decreased to a value of 3% by 1982. Salinity is now lowest in September-October and highest in March-April.

**Flora & Fauna:** Marshlands on the periphery are dominated by *Phragmites australis* and *Typha capensis.* The southern part of the lake supports beds of *Ceratophyllum demersum, Potanzogeton crispus* and *P. pectinatus* and there is a dense phytoplankton. The lake is eutrophic and highly productive. *Eichhornia crassipes* is present and has been fought by aerial spraying. The fauna of peripheral wetlands is as described in the regional introduction.

**Human Impact & Utilisation:** The lagoon is the site of important capture fisheries and fish farms, the yields from which have increased with eutrophication. The total catch from open water fisheries in 1979-80 was 40 000 tonnes, while fish farms produced an additional 20 000 tonnes. *Oreochromis niloticus* is the most important species landed, closely followed by *0. aureus, 0. galilaeus* and *Tilapia zillii. Liza ramada* used to be the most important species taken, but its proportion in the annual catch has declined to 2%. Other components of the catch include the marine species *Anguilla anguilla,* D*icentrarchus labrax, D. punctatus, Liza saliens, Mugil cephalus, Sciena aquila, Sparus aurata* and the shrimp *Palaemon elegans,* together with the freshwater species *Bagrus bayad, Clarias lazera, Labeo niloticus* and *Lates niloticus,* the latter now very scarce. Some 17 000 fishermen work the lagoon using 4000 boats. In addition some 14 300 ha of hosha (fish-farm) enclosures are in operation, employing a further 9000 people. Part of the discharge of the El Bagar Drain, which is rich in Cairo sewage water, is being diverted to the Um el Rish Lake where a similar program of intensive exploitation is starting.

**Conservation Status:** Partially protected.

**Wetland Name:** Lake Bardawil
**Country:** Egypt
**Coordinates:** 31°02 ' -31°14 'N/32°41 ' -33°36 'E
**Area:** 68 100 ha (open water)
**Altitude:** sea level
**Nearest Towns:** Port Said (38 km W); El Arish (19 km W)
**General:** The Sabkhet el Bardawil is a salt water lagoon, 90 km long and up to 24 km wide, on the Mediterranean coast of Sinai. It is bounded on the seaward side by a long narrow spit, and on the landward side by a sandy coastal plain 25-20 km wide. It is open to the sea, through a narrow mouth, towards the eastern end. The lagoon is not presently exploited, but there are plans for the development of a fishing port. Rainfall over the lagoon is about 125 mm/yr, evaporation is about 2000 mm/yr, and some fresh water enters along the southern shore after rain.

**B. The Lower Nile Valley**

**General**: The Nile Valley below Aswan varies between 20-30 km in width and is confined by steep sides, particularly on the east. Since the closure of the High Dam at Aswan the valley is no longer flooded each year. It is however, irrigated and traversed by a number of streams and canals on the western side. The longest of these, flowing in parallel with the Nile is the Bahr Yûsef. This receives water from the Nilel at various points and terminates in vicinity of El Faiyûm, from where, ultimately, its waters drain to Lake Qaroun. A number of small lakes also occur along the western side of the valley. A succession of deep wadis run down from the eastern hills to the right bank of the river, and comparatively little agriculture occurs on this side of the valley. The valley is becoming progressively more saline as a consequence of the use of artificial fertilisers. These are now used to compensate for the silt which is no longer deposited by the annual floods. There are 6 protected areas and 2 IBAs in the lower Nile Valley.

**C. Lake Nasser**

**Wetland Name:** Lake Nasser/Nubia
**Country:** Egypt
**Coordinates:** 20°27'-23°58'N/30°07'-33°15'E
**Area:** 685 000 ha (581000 ha in Egypt)
**Altitude:** 186 m as1 (at capacity)
**Nearest Towns:** Aswan (at dam); Cairo (700 km NNW)
**General**: In the past the Nile flooded its lower valley and delta each year, depositing a fertile layer of silt on which crops could be grown. The highest flood on record was in 1879 and the lowest in 1913.

During successive dry years, water for irrigation was in very short supply and agricultural production was greatly reduced. Each year water flowed into the Mediterranean without having been used for irrigation or power generation. However, since the construction of the High Dam at Aswan, 7 km below the old Aswan Dam, the Nile no longer overtops its banks in Egypt and river flow is controlled to provide water for hydroelectric power and year round irrigation. The dam is rock-filled, 111 m high at its crest, 980 m wide at its base and 40 m wide at the top. It has an impervious core, a grout curtain extending 180 m under the core to meet the bedrock, and a horizontal upstream impervious blanket. It is 3600 m long, 520 m lying between the banks of the Nile with the remaining 3080 m stretching outward in the form of two wings on both sides of the river. The irregular shoreline of the lake is approximately 7900 km long, and is presently unprotected.

The lake can be divided into three sectors. The northern sector is fully lacustrine and extends south from the dam to Tushka. The middle sector is semi-riverine and comprises the southern part of Lake Nasser and the northern part of Lake Nubia, up to Daweishat. It is characterised by riverine properties during the flood season but by lacustrine properties during the rest of the year. The southern sector has riverine characteristics all year round. The irregular shoreline is some 7900 km long.

**Hydrology & Water Quality:** The dam holds back 161 billion $m^3$ of water at capacity, comprising a dead volume of 31 billion $m^3$, below which the generators will not operate, a live capacity of 90 billion $m^3$, and a flood control capacity of 41 billion $m^3$. Maximum depth is 98 m. It is anticipated that it will take 500 years for the dead capacity to be filled by silt. There is a diversion system on the east bank, used during dam construction, which can accommodate the full flood capacity of the river, while on the west bank there is a tunnel which can accomodate the passage of surplus water when the lake is full. This has a carrying capacity of 9400 $m^3$/sec. In the case of successive high flood years occurring, water can be sent 40 km from Aswan to the Talkha Dam, constructed across a depression in the Western Desert.

When the annual flood enters the southern part of the lake it destroys stratification in the lake and the turbid floods push lake water, with relatively high conductivity, ahead of them. Secchi depths at the high dam range from 3.4 m in winter to 1.5 m in summer, and from 2.3 m in winter to 80 cm in summer at Tushka. It is estimated that 134 million tonnes of suspended matter enter the lake each year. Chloride ion concentrations have increased since impoundment and are now 8.83-9.83 mg/1, while sulphates range from 5-10 mg/1, the highest concentrations being in bottom water. Sulphide ion concentration increases sharply close to the bottom, sometimes exceeding 400 mg/1 at depths below 90 m. The principal cation concentrations are 8.2-27.8 mg/1 for sodium, 2-8 mg/1 for potassium, 14-27.5 mg/1 for calcium and 4.5-12.5 mg/1 for magnesium. Carbonate and bicarbonate concentrations have fallen since the lake was first filled and carbonate concentrations at the surface are now in the range of 0 -1 mg/l. The waters have become more alkaline since impoundment and current pH values are 8-8.85, with some seasonal variations, increasing in winter.The highest surface water temperatures are recorded in August and range from 29.3-31.8°C, while the lowest surface water temperature of 16°C was recorded during winter 1970/71. In winter the water column is oxygenated from top to bottom with concentrations of 6.7-11 mg/1 at the surface and 5.4-8.7 mg/1 at the bottom, but in the summer bottom water may become deoxygenated. Surface water oxygen concentrations in summer range from 5.2-10.1 mg/l.

**Flora & Fauna:** The lake is set in the desert. It has a bluish-green colour due to the presence of blue-green algae which are particularly abundant in early summer. *Volvox* comprises the bulk of the phytoplankton, while cladocerans *(Daphnia)* and copepods *(Cyclops)* provide the bulk of the zooplankton. Primary production ranged from 10.7-16.4 g carbon/$m^2$/day in 1979. Most of the Nile fishes, referred to in the regional introduction, have been recorded from the lake, but the lacustrine and riverine sectors have these species in different proportions so that their fish faunas are distinct. For example, *Eutropius niloticus, Schilbe nzystus* and *S. uranoscopus* thrive where riverine conditions predominate and are most common at the southern end of Lake Nubia, while *Alestes nurse* and

*Hydrocynus forskalii* are most common in the clear waters of northern Lake Nasser under lacustrine conditions. The importance of the lake to birds has not yet been properly ascertained.

**Human Impact & Utilisation:** The power station has a generating capacity of 2.1 MW, producing 10 billion KW/hours/yr. Annual catches from the fishery which has developed on the lake have increased from 645 tonnes in 1966 to 33 933 tonnes in 1981. The principal species landed are *Bagrus bayad, B. docinac, Clarias* spp., *Eutropius niloticus, Labeo* spp., *Lates niloticus, Oreochronzis galilaeus, 0. niloticus* and *Synodontis* spp. The two cichlids are by far the most important species, having formed 27 % of the catch in 1968 but 90% in 1981. Gill and trammel nets are commonly used for fishing in the lake. Gill nets are about 2 m deep and mainly catch *Alestes* and *Hydrocynus.* The other species are generally caught in trammel nets. Fish are usually iced, and then frozen or processed in some other way. A small proportion of the catch, say 6%, is salted. Some 8960 fishermen operate on the lake, using mainly two-man canoes or traditional Nile boats manned by 4-5 men. Few of the craft are motorised. Signs of fishing stress, seen in decreasing fish sizes, have begun to appear at certain centres in recent years. References and a good introductory account of the fishery are given by Latif (1984). The high dam has had a deleterious effect upon the Nile below it, in that the number of species of fish in the river has decreased from 71 to 31. Despite this the annual production of the lower Nile fishery has increased since the dam, but chiefly because of intensified effort. The coastal fishery, and in particular the sardine fishery, has however, declined. The Egyptian catch from the Mediterranean fell from 38 000 tonnes in 1962 to 7000 tonnes in 1969, but recovered to 20 000 tonnes in 1979. Sardines, which once formed 37% of the annual catch now constitutes only 9%.

## 3.3 ETHIOPIA

### Wetlands

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 Plateaux, 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. The following sections describe wetlands that are located within the Nile Basin.

### List of Wetlands Described

A. Lake Tana
B. River Floodplains
C. Artificial Impoundments

### A. Lake Tana Wetlands

**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:** Addis Ababa (480 km SE from Bahir Dar Town); 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 a hotel at Bahr Dar on the lakeshore and the lake is used for recreational purposes.

**Conservation Status:** Unprotected.

**B. River Floodplains**

**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.

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.

### C. Artificial Impoundments

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.

## 3.4 KENYA

**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. The following sections describe wetlands that are located within the Nile Basin

**List of Wetlands Described**
A. Southwestern Rivers
B. Natural Lakes
  (a) Lake Victoria

### A. Southwestern Rivers

**General:** These rivers rise in the highlands and flow into Lake Victoria, contributing a mean total volume of 7.29 billion $m^3$ 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.

**B. 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 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 $m^3$ 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 Kisyan, Muguruk, Luanda, Awach Seme, Nyandina, Obera, Awach Kibos, Awach Kaboun, Awach Tende and Olando, have an estimated mean average combined dis- charge of 473 million $m^3$ of water each year, assuming run-off to be 18% of rainfall over the catchments..

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 for the whole lake. It is normally well oxygenated throughout the water column, with concentrations ranging from 4.6-9.4 mg 0/1.

**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 denzersunz* 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 essen- tially 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, 0. 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, Oreochronzis 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 *Oreochroinis* 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.

### 3.5 RWANDA

**Wetlands**
There are two great swamps in Rwanda. These are the Mugesera-Rugwero Swamps in the south and the Kagera Swamps along the Tanzanian border in the east. There are other minor swampy areas in flat places in the high valleys, and many very extensive bogs on the mountainous dorsale and on the high central plateaux. There are several natural lakes of very different characters. The following sections describe wetlands that are located within the Nile Basin

**List of Wetlands Described**
A. The Nyawarungu/Akanyaru River System
B. Lakes Bulera, Luhondo & Tributaries
C. The Tshohoha Lakes
D. The Mugesera/Rugwero Lake/Swamp Complex
E. The Kagera Swamps & Lakes
F. The Northeastern Rivers

**A. The Nyawarungu/Akanyaru River System**

**General:** The Nyawarungu has several sources in southern Rwanda in forested country at 2600-2750 m asl, chief among which are the Birurume and Lukarara/Mwogo Rivers. Below the confluence of these major headwater tributaries the Nyawarungu flows east, through much boggy highland country, before descending to 1500 m and entering a deep and narrow valley

oriented N-S. It continues in this valley for 80 km before swinging SE at Muramba (1°43'S/29°36'E). From here it meanders over its narrow valley floor, receiving first the overspill from Lake Mohasi via the Nyabugogo River on the left bank, and then, some 35 km farther on, the Akanyaru River on the right bank.

The Akanyaru is the most important tributary of the Nyawarungu. It has sources at 2°45'S/29°26'E and 2°46'S/29°26'E, close to 2300 m asl in the south of the country, but the Mugere, an important headwater tributary, rises in Burundi at 2450 m asl. In its lower course the river flows sluggishly through a broad belt of permanent swamps, up to 7 km wide and 82 km long immediately above its confluence with the Nyawarungu. The swamps cover some 25 000 ha, of which the lower 7000 ha are in Rwanda. The Akanyaru descends from 1465 m asl at the head of the swamps in Burundi (2°47'S/29°50'E), to 1400 m asl at the confluence with the Nyawarungu (2°05'S/3°01'E) where the swamps end. Above this, in the swamp belt in Rwanda, it receives overspill from the two Tshohoha Lakes on the right bank. The boundary between Rwanda and Burundi runs through Lake Tshohoha South for 22 km, and about 25% of the lake surface is in Rwanda. Below this the river receives the seasonal overspill from Lake Tshohoha North. Many of the higher tributary valleys are choked by papyrus, with seasonal swamp forest behind. This latter is dominated by *Syzygium guineense,* but with *S. owariense* in the wettest sites, and often with *Ficus verruculosa* and *Myrica kandtiana* as associates. Seasonally inundated savannas, with *Acacia polyacantha* var. *campylacantha, A. sieberana* and *Bridelia nzicrantha* occur on the margins of Lake Tshohoha and around the permanent swamps.

Below the Akanyaru/Nyawarungu confluence the swollen river flows due east in a broad valley which soon becomes swampy again. At first it carries galleries of forest flooded only seasonally, but *Ficus verruculosa, Myrica kandtiana, Phoenix reclinata* and *Cyperus papyrus* become progressively more common at the riverside in passing downstream. Then, after turning SE again, the river traverses the Mugesera/Rugwero Swamp, dominated by floating islands of *Cyperus papyrus,* with great beds of *Miscanthidium violaceunz* rooted on the margins. After leaving the swamps the river flows 35 km eastwards to a confluence with the Ruvuvu River, forming the Kagera River, which is the principal affluent of Lake Victoria.

The Nyawarungu/Kagera River system descends with a mean gradient of 1:2326 in traversing Rwanda between the head of the high valley at 1500 m and the Tanzanian border. The floor of the high valley of the Nyawarungu is inundated in the wet seasons but is intensively cultivated in the long dry season. There are mine workings along it at several points. Swamps in some tributary valleys along its upper course have been drained, more or less completely, with attendant problems of increased erosion, and decreased soil fertility because silt is no longer deposited. Along the swampy middle course, some areas are being used for rice cultivation, and many drier sites have been converted for the cultivation of sugar cane.

There is a rich avifauna in undisturbed parts of the river system, especially in the Mugesera/Rugwero Swamps, while in developed areas some water birds still survive, including Balearica pavonina. Very many of the animals listed for Eastern Equatorial Africa in the regional introduction are present in undisturbed areas, but only the smaller species survive in densely populated areas. No part of the valley is protected.

**Wetland Name:** The Kamiranzovu Swamp
**Country:** Rwanda
**Coordinates:** approximately. 2°29 ' S/29°15 'E
**Area:** 1300 ha
**Altitude:** 2300 m asl
**Nearest Towns**: Cyangugu (40 km W); Butare (55 km ESE)

General: This swamp is situated in an area receiving some 2200 mm rain/yr in the Afro-montane vegetational zone on the high dorsale of southern Rwanda. The centre of the swamp is dominated by clumps of *Cyperus* and *Lobelia spp*. The margins are fringed by a swamp forest dominated by *Anthocleista grandifolia*, *Podocarpus latifolius* and *Syzygiunz guineense*. Animals present include *Aonyx capensis*, *Cephalophus niger, Tragelaphus scriptus* and some snakes, birds and rodents. The swamp is an important natural reservoir near the source of the Lukarara River, a headwater tributary of the Nyawarungu River. It is protected in the Nyungwe Forest Reserve.

**Wetland Name:** Lake Mohasi
**Country:** Rwanda
**Coordinates*:*** 1°49 '-1°54 ' S/30°11 '-30°30 'E
**Area:** 3450 ha
**Altitude:** 1480 m asl
**Nearest Towns:** Kigali (22 km ENE); Kibungu (31 km SSE)
**General:** This lake is 40 km long and has a mean width close to 1 km, with a maximum width of 2 km. It occupies the floor of a system of valleys, tributary to a main valley aligned E-W, and extends into the tributary valleys as a series of 13 narrow arms. Much of the lake shore is swampy and there are swamps at the heads of all 13 arms. The lake is fed by the Mohagumbo River at the eastern end, and by 13 other small streams, and drains from the western end via the Nyabugogo River to the Nyawarungu River.

**B. Lakes Bulera, Luhondo & Tributaries**

**General**: These lakes are situated on the southern slopes of Mt. Muhavura in NW Rwanda. Lake Bulera (1°23'4 °30' S/29°45'-29°49'E), 1862 m asl, is 12 km long and reaches 8 km in width. It contains two small islands and is fed by 6 streams. The largest affluents are the Kabga and Kageri Rivers, and the Hondo River which drains the Rugezi Swamp. The lake has a maximum depth of 173 m and an open water surface of approximately ¸3500 ha. It drains from its southwestern extremity to Lake Luhondo (1°28 '-1°33 ' S/29°42 '-29°46 'E), 1764 m asl. This latter lake is shaped like an inverted `V'. Its eastern arm is 9 km long and reaches 3 km in width, and the lake has an area of 2800 ha. In addition to the overflow from Lake Bulera, it receives water from 4 other streams, of which the Gasura is the most important. There is a 500 ha swamp at the northern end of the lake, i.e. at the apex of the 'V'. It drains to the southwest via the Mukungwa River, a tributary of the Nyawarungu, and a hydroelectric power station has been constructed where the Mukungwa leaves the lake. Both lakes are very young, a fact reflected by their poor floras and faunas. They both contain Clarias sp., while tilapias have been introduced and now constitute the basis of a local fishery.

**Wetland Name:** The Rugezi Swamp
**Country:** Rwanda
**Coordinates:** 1°22'-1°36'S/29°50'-29°59'E
**Area:** 12 000 ha
**Altitude:** c. 1950-2150 m
**Nearest Towns:** Biumba (9 km E); Ruhengeri (25 km W)
**General**: This high altitude swamp is situated immediately east of Lakes Bulera and Luhondo below the high peaks of the Virunga volcanoes. It is 30 km long, oriented NW-SE in the valley of the Hondo River, and reaches a maximum width of 6 km at the southeastern end. It drains via the Hondo River, from its northwestern end, over two waterfalls, into Lake Bulera. It contains *Cyperus papyrus*, *Miscanthidium violaceum*, and several lesser species of Cyperus and Scirpus. Part of it has been drained and cultivated in recent years, and it is not protected. The fauna includes an abundance of amphibians, a variety of water birds including herons, egrets, ducks, warblers and weavers, and *Aonyx capensis, Lutra inaculicollis* and some rodents among the mammals. It is an important reservoir, buffering inflows to lake Bulera to which it drains.

### C. The Tshohoha Lakes

**General**: The Rwanda/Burundi border runs through Lake Tshohoha South (2°20'-2°32'S/ 29°59'-30°10'E) which covers some 7000 ha at high water, and of this about 2000 ha is situated in Rwanda. The lake is 30 km long, about 1.3 km wide, oriented SE-NW, and has a highly indented perimeter with several long narrow arms. It is situated on the floor of a forested basin at about 1460 m asl, between two low hill ridges rising in parallel to 1531 m on the southwestern side and to 1510 m on the northeastern side. It is fringed by papyrus and *Miscanthidium* swamps, with scattered patches of swamp forest. It is fed at the southeastern end (in Burundi) by the Muburiba River, and drains to the Akanyaru River some 3.5 km distant from the northwestern end in Rwanda. The lake is fished but is not protected.

Lake Tshohoha North is situated entirely in Rwanda (2°14'-2°19' S/30°05 '-30°09 'E). The lake is fed at its southern end by a river from Burundi, and drains from its northeastern end through 10 km of permanent swamps to the Akanyaru River. The lake occupies the floor of a triangular basin about 1450 m asl, situated between two low undulating ridges oriented SW-NE and NW-SE. Its effluent river passes between these hills at the narrow western end of the basin. The shallow lake is 12 km long and about 1 km wide, with an open water surface of 1200 ha at high water. It is fringed at the waterside by papyrus, and peripheral vegetation. Agriculture is locally intensive on the floodplains of the affluent and effluent rivers, and in places around the lake margin where it has been possible to drain the swamps. The system is not protected.

### D. Mugesera/Rugwero Lake/Swamp Complex

**Wetland Name:** The Mugesera/Rugwero Lake/Swamp Complex
**Country:** Ruwanda
**Coordinates:** 2°04'-2°28'S/30°12'-30°27'E
**Area:** 55 500 ha (including open water)
**Altitude:** c. 1300 m asl
**Nearest Towns:** Kigali (33 km NW); Kibungu (18 km W)
**General:** The system occupies the lowest part of a very flat valley, 35 km wide, aligned NNW-SSE. The Nyawarungu River meanders through this, overtopping its banks, filling depressions which contain lakes, and inundating a zone of permanent swamps and a peripheral floodplain. The permanent swamps occupy a central zone up to 14 km wide, but are best developed on the right (west) bank of the river. There are 4 lakes on the left (east) bank. From north to south these are Lake Mugesera, an un-named lake, and Lakes Birira and Sake. The left bank lakes are, also from north to south, Lakes Gashaga, Murago, Rumira, Milay, Kilimbi, Gaharwa, Rugwero and Kazigiri. The last is situated entirely within Burundi, while Lake Rugwero is mostly in Burundi.

The largest lakes are Mugesera (2°04 ' -2°13 ' S/30°18 ' -30°27 'E) and Rugwero (2°21 ' -2°28 ' S/ 30°16'-30°23'E). Lake Mugesera (4000 ha) at the upper (northeastern) end of the system is fed by the Bubindi, Gitinga, Mwambu, Nyaruvoma and Rwazurasu Rivers and ten other minor streams, which are all in spate twice a year. These rivers originate on hilly ridges to the north, east and south of the lake, north of Kibungu, while the southern swamps near Lake Rugwero receive several similar streams from hills in the east, south of Kibungu. Lake Mugesera comprises a main basin oriented NNE-SSW, with 4 arms running roughly eastwards separated by ridges of low hills. Lake Rugwero (10 000 ha) is fed by streams from the central plateaux of Burundi, and by overspill from Lake Kanzigiri which finds its way northwards through the swamps, either to Lake Rugwero or directly to the Nyawarungu River. The other lakes, none of which is known to exceed 5 metres in depth, are much smaller, each a few hundred hectares in extent in the dry seasons. Flood waters which are not dissipated in the main swamp basin collect back into the Nyawarungu which leaves the southeastern end of the basin and flows through a narrow swamp

belt to a confluence with the Ruvuvu River immediately above the Rusumu Falls (2°23'S/30°47'E).

**Hydrology & Water Quality:** Water levels rise 1-2 m twice a year, corresponding with the rains. Mean water temperatures in the lakes are 24-26°C and the level of oxygen is generally high, but the bottoms may become anoxic during the long dry season. The mean pH of Lake Gaharwa is 10.0, that of Lake Rugwero is 7.5, and that of Lake Gashanga is 7.0, while the others have a range of 7.7-8.2. Transparencies vary between 30-90 cm, depending upon the season, with the lowest figures during the long rains.

**Flora & Fauna**: The central swamp is essentially a papyrus swamp with many islands of floating vegetation, and these are especially well developed on Lake Rugwero. The papyrus grows 4-5 m tall, with an understorey of *Dryopteris gongylodes* up to 1.5 m, and *Ipomoea fragrans* climbing to 4 m. *Polygonum* spp. are also common associates, while *Echinochloa cruspavonis, Hydrocotyle ranunculoides, Leersia hexandra, Utricularia inflexa* and *Vossia cuspidata* occur in the water along the outer margins of the papyrus. Islands of papyrus occur in the lakes, and are especially abundant in Lake Rugwero. Extensive stands of *Miscanthidium violaceum* are rooted in the shallower parts of the swamp. There are also groves of *Phoenix reclinata* and thickets of *Aeschynomene elaphroxylon, Dissotis incana, Ficus verruculosa* and *Myrica kandtiana* on the margins, on levees, and on island shores. Permanent deep water is covered by carpets of floating-leaved or free floating plants, principally *Lenzna paucicosta, Ludwigia stolonifera, Nynzphaea caerulea, N. nouchalii, Pistia stratiotes* and *Trapa natans,* and it supports dense beds of submerged aquatics, including *Ceratophyllum denzersunz, Myriophyllunz spicatum,Potantogeton pectinatus,Utricularia* spp., and *Vallisneria spiralis.* Savannas surrounding the lakes, subject to seasonal inundation, are dominated by *Acacia campylacantha* and *A. sieberana,* with *Boerhaavia plumbaginea, Bridelia micrantha, Cordia abyssinica, Crassocephalum bojeri, Panicunt deustunz, Securinega virosa, Setaria kagerensis* and *Sorghum verticilliflorum.* Peripheral floodplain supports the grasses *Hyparrhenia filipendula* and *H. rufa,* or *Bothriochloa insculpta* and *Therneda triandra.*

The phytoplankton and zooplankton are abundant, if not very diverse, and there is a high mollusc biomass. Some 30 species of fish have been identified belonging to 9 families, and of these, 22 are also found in Lake Victoria. *Alestes*, *Clarias* and *Oreochromis* are well represented, and some cichlids have been introduced, reputedly *Oreochromis esculentus* and *0. macrochir*. No less than 173 birds have been identified, of which 30 are piscivorous and 50 feed on insects and molluscs. There are a number of European migrants, e.g. *Hippolais icterina*, *Hirundo rustica*, *Motacilla flava, Phylloscopus trochilus, Riparia riparia* and *Sylvia borin.* Other species of interest include *Anhinga rufa, Ardea goliath, Ardeola ralloides, Balearica regulorum, Ceryle rudis, Haliaeetus vocifer, Pandion haliaetus, Phalacrocorax africanus, P. carbo, Plectropterus gambensis and Quelea erythrops*. There are water turtles (*Pelusios*), crocodiles, monitors, snakes, otters and rodents. *Hippopotamus amphibius* is now scarce.

**Human Impact & Utilisation**: The lakes and swamps are fished, mainly from canoes, with yields of up to 125 kg/ha/yr, comprising some 60% cichlids and 20% clariids. Population density of the swamp margins is locally very high.

**Conservation Status:** Unprotected.

**E. Kagera Swamps & Lakes**

**Wetland Name:** The Kagera Swamps & Lakes
**Country:** Rwanda
**Coordinates***:* 1°19'-2°1 1 'S/30°33'-31°01'E

**Area:** 144 400 ha (50 000 ha lake surfaces)
**Altitude:** 1270-1300 m asl
**Nearest Towns:** Kigali (69 km W); Kibungu (20 km W)
**General**: The wetland lies in a N-S anticline on the Rwanda/Tanzania border between two ridges of low hills, below Rusumu Falls. The Kagera River, which delimits the Rwanda/Tanzania border, meanders along the centre of the the flat bottomed valley for about 110 km, spilling over to inundate a swamp belt 2-18 km wide. This is lined on each margin by a series of substantial lakes, 20 on the right bank being situated in Tanzania. These are, from north to south, Lakes Gwelu, Nyakatale, Nyaruwale, three un-named, Lubuga, Ishaka, Duko, Kashani, Twamwala, Mujunju, un-named, Kashanga, Weru Kwa Kalambi, three un-named, Katabi-Kazinga and Bisongo. The swamp belt is more extensively developed on the left bank, in Rwanda, where there are 21 lakes, and from north to south these are Lakes Ferongo, Rwanye-Kizinga, Mihindi, un- named, Kishandju, two un-named, Muhari, Hago, Nkelenhe, Kivumba, Sekama, five un-named, Ihema, Rwakibale, Nasho, Rwehikama and Rwampanga. The lakes lie partly in and partly out of the permanent swamp belt. Outside the permanent swamps some are fringed by seasonally inundated savannas. The river descends about 40 m from the foot of the Rusumu Falls to an altitude of 1270 m asl at the northern end of the swamp complex.

The largest lakes are Ihema (9100 ha), which measures 20 km in length and is 7 km wide in places, Mujunju (2250 ha), which is 11 km long and up to 3 km wide, and Bisongo (c. 2000 ha). Lake Mujunju is the deepest, with a maximum depth of 11 m and a mean depth of 5.9 m; the others have maximum depths between 7.8 and 4.3 m and mean depths between 5.2 and 2.6 m (Rwanye-Kizinga). Very few of the lakes have permanent connections with the Kagera River, and in the past 30 years, the river has changed course and lost connection with lakes with which it formerly had continuity.

**Hydrology & Water Quality**: Many small seasonal streams feed the lakes or swamps directly and flow twice a year, but the bulk of the riverine inflow is provided by the Kagera River, which also rises in response to seasonal rains. Direct precipitation contributes some 650-900 mm/rain/yr, and the water level in the system has an annual amplitude of 1-1.5 m. During the dry season several of the lakes are isolated from the river. The water of the lakes tends to become stratified during the dry season when temperature differences as great as 4°C have been observed between the top and bottom waters of an individual lake. Mean pH values are 6-7.5 at the lake bottoms, and 7-9 at the surfaces.

**Flora & Fauna**: The flora and fauna is very similar to that described in the previous section for the Mugesera/Rugwero Swamps, but with the difference that a variety of large mammals survive in the Kagera National Park covering the northern half of the swamp complex. These include *Hippopotamus amphibius, Hippotragus equinus, Kobus ellipsipryinnus, Loxodonta africana, Panthera pardus, Phacochoerus aethiopicus, Redunca arundinum, Sylvicapra grimnzia, Syncerus caffer* and *Tragelaphus spekei*. Amphibians, crocodiles and water turtles are abundant.

**Human Impact & Utilisation**: A controlled fishery operates on Lake Ihema, but otherwise, outside the National Park, fishing is uncontrolled, and overfishing occurs locally. Fishing in the Kagera National Park is illegal but this fact does not prevent it from occurring. Many channels through the vegetation, connecting the lakes with the river, are kept open by local fishermen.

**Conservation Status**: Some 60 000 ha of swampland is protected in the Kagera National Park, but the remainder is unprotected and subject to intense hunting and fishing pressures.

**F. The Northeastern Rivers**

**General:** Long strips of permanent swampland occur along the three major rivers which flow across the northeastern extremity of the country to join the Kagera River north of its Lake/Swamp Complex. Swamps occur on the Kamababa River above its confluence with the Kagera, and also on its

headwater tributaries in patches up to 10 km long and 1.5 km wide. North of this, swamps extend for over 40 km up the Kalangaza River, beginning about 18 km above its confluence with the Kagera. In the far NE, other swamps occur on the Kakitumba River, and on its two affluents, the Muvumba and Kalungeri Rivers. In total there are close to 19 000 ha of permanent swamp on these rivers, together with narrow peripheral floodplains. The flora and fauna of these rivers is similar to that along the Akanyaru/Nyawarungu/Kagera system.

### 3.6 SUDAN

**Wetlands**

Vast swamps, known as the Sudd, occur along the Bahr el Jebel and its tributaries in upper Sudan, and these enclose several substantial lakes e.g. Lake Ambadi (8°43'N/29°21'E) on the Bahr el Ghazal, Lakes Nuong (7°23'N/30°32'E) and Fajarial (6°17'N/31°28'E) on the Bahr el Jebel, and Lake Nyubor (6°52'N/30°18'E) on the River Lau. To the north and east of the Sudd (north of the Sobat River) lie the Machar Marshes, fed by the Dagar River (Dakar Wenz) and drained by the Adar River to the right bank of the White Nile at a point (10°20'N/32°16'E) just below Melyut. Immediately south of Khartoum, a large area of land between the Blue and White Nile Rivers, above their confluence, was in the past subject to inundation when the flood on the Blue Nile caused the waters of the White Nile to back up. This area, El Geizira, is now irrigated and cultivated whenever conditions are suitable. Three different types of swamps are recognised along the Nile; (a) permanent swamps fringing rivers, lakes, lagoons, channels and subsidiary streams; (b) the most deeply flooded landward fringes of the permanent swamps, which nevertheless experience great seasonal variations in water level and may dry completely in the dry season; and (c) extensive peripheral floodplains around the swamp margins which are flooded shallowly for a few months each year. The latter two categories are often both referred to as toiches and are heavily exploited by people and wildlife during the dry seasons.

The Jonglei Canal Project provides for a canal 360 km long, bypassing the Sudd between Bor (6°16'N/31°33'E) and the point where the Sobat River enters the White Nile. Excavation began in 1978, but was halted in 1984, for technical, financial and political reasons. However, with the completion of the canal, evaporation in the Sudd will be reduced and far less White Nile water will be lost to Egypt and Sudan. Completion of the canal will significantly alter the ecology of Jonglei Province.

There are a number of impoundments, the largest being the lake on the Nile behind the Aswan High Dam in Egypt which produces Lake Nasser, stretching back into Sudan where it is known as Lake Nubia. The Atbara was impounded (14°53'N/35°55'E) near Khasm el Girba in 1972, and the Blue Nile is dammed at El Roseires (11°49'N/ 34°20'E) and Sennar (13°33'N/33°37'E).

Surface water is scarce in the north, except in a few gueltas in canyons in rocky hills. Some of the larger wadis, e.g. Wadis Malik, Abu Habl and Azum flow for several days in the July-September period, after which pools may persist at the surface for some time. Some pools are persistent, and those on the Wadis Umm Badr, Abu Zabad and Er Rahad may last until the following rainy season. Some pans may hold water until January or February, and brick-making activities in the vicinities of En Nahud (12°43'N/28°26'E), El Obeid (13°10'N/30°12'E) and Umm Ruaba (12°51'N/31°19'E) have created semi-permanent reservoirs or fulas.

South of the parallel 12°N there are a number of perennial lakes such as Lake Keilak (10°48'N/29°19'E) in Kordofan and Lake Kundi (10°30'N/25°15'E) in Darfur, as well as many other rain fed pools and small artificial reservoirs. Small rivers at these latitudes may hold water for parts of the year. Mangrove swamps, salt-marshes and coastal reed swamps are found along the 1000 km

Red Sea Coast, reed swamps being best developed in deltas at the mouths of large wadis, e.g. Wadis Oko and Ibib.

The following sections describe wetlands that are located within the Nile Basin

**List of Wetlands Described**

A. Permanent Swamps & Seasonal Floodplains
- (a) Kenamuke/Kobowen Swamp
- (b) The Lotilla Swamps
- (c) Badigeru Swamp
- (d) The Veveno/Adiet/Lilebook Swamps
- (e) The Sudd
- (f) The Machar Marshes
- (g) The Dinder/Rahad Floodplain
- (h) Minor Wetlands
- (i) The Nile Valley below Malakal
- (j) The Bahr el Ghazal
- (k) Floodplains of the southern rivers

B. Natural Lakes
- (c) Lake Ambadi
- (e) Lake Yirol
- (f) Lake Anyi
- (g) Lake Nyiropo

C. Artificial Impoundments
- (a) Lake Nubia/Nasser
- (b) El Roseires
- (c) Sennar
- (d) Kashm el Girba
- (e) Gebel Auliya

**A. Permanent Swamps & Seasonal Floodplains**

**Wetland Name:** Kenamuke/ Kobowen Swamp
**Country:** Sudan
**Coordinates:** 5°17'-6°27'N/33°37'-34°06'E
**Area:** c. 172 000 ha
**Altitude:** 600-700 m asl
**Nearest Towns:** Juba (260 km WSW); Malakal (450 km NW)
**General:** The Kenamuke/Kobowen Swamp is approximately 130 km long and varies in width from 5-30 km. It is oriented N-S and is supplied by a number of rivers, the most important ones rising either in the Didinga Hills to the south or the Ethiopian Highlands to the east. The long narrow swamp occupies the floor of a valley system and drains from the northernmost end by the Kangen River to the Sobat River, and thence to the White Nile. A southeastern outlier at the head of the system is a SE-NW oriented depression, lying immediately below the western side of the Moru Agippi Plateaux at an altitude close to 700 m asl. Occasionally, after heavy rains, this latter area floods, and in 1940 for example, it contained a boomerang-shaped lake 25 km long and 12 km wide (5°07'-5°16'N/ 34°16'-34°28'E). Chief among the tributary streams are the Gerra, Lomen, Chilmun, Chalbono and Nakua Rivers. Rainfall over the system is 800 - 1100 mm/yr.

**Flora & Fauna:** A broad floodplain grassland swamp containing black cotton soils in the Soudanian savanna zone, with typical floodplain grasses as described in the regional introduction and *Cyperus papyrus, Miscanthidiunz violaceum, Phragnzites mauritianus* and *Typha domingensis* in the wettest sites. A rich mammal flora is present including *Hippotragus equinus, Kobus kob leucotis,*

*Loxodonta africana, Panthera pardus, Redunca arundinum* and *Syncerus caffer*. See regional introduction.

**Human Impact & Utilisation:** The floodplain is impassable during the wet season, but there is some fishing, and the swamp area is relatively undisturbed, although traditional hunting occurs in the surrounding *Acacia* woodlands.

**Conservation Status:** Largely contained within the Boma National Park.

**Wetland Name:** The Lotilla Swamps
**Country:** Sudan
**Coordinates:** 5°02 ' -6°43 'N/32°34 ' -33°15 'E
**Area:** 219 000 ha
**Altitude:** 415-620 m as1
**Nearest Towns:** Pibor (at N end); Juba (170 km W of S end)
**General:** The swamps are situated in the valley of the Lotilla River which has its headwaters in the Didinga Hills and flows north to join the Kangen River at Pibor Post (6°49'N/33°08'E). The swamps comprise two major blocks, a southern block 140 km long and up to 27 km wide, which contains patches of swamp forest on the plateaux at about 600 m asl, and a smaller northern block, c. 95x7 km which ends some 30 km above Pibor. The course of the river is not always clear in the upper swamp, but it is well defined where it meanders through the lower northern swamp.

**Flora & Fauna:** This is a typical floodplain system dominated by grasses, as described in the regional introduction, with areas of permanent swamp dominated by *Cyperus papyrus, Phragmites inauritianus* (or *P. karka?)* and *Typha donzingensis* along the river.

**Human Impact & Utilisation:** This swamp is very sparsely inhabited and comparatively undisturbed. Some fishing occurs on the floodplain and in the rivers, and there is some hunting.

**Conservation Status:** Unprotected.

**Wetland Name:** Badigeru Swamp
**Country:** Sudan
**Coordinates:** 4°41 ' -5°31 'N/31°57 ' -32°31 'E
**Area:** 55 000 ha
**Altitude:** c. 480-700 m as1
**Nearest Towns:** Juba (75 km SW); Bor (90 km NW)
**General:** Badigeru Swamp is supplied by the Kinyeti River and other streams which drain the northern slopes of the Kinyeti Massif (3187 m) on the Sudan/Uganda border. The swamps are discontinuous and are oriented SSW-NNE. They are 110 km long and up to 25 km wide at high water, but have a mean width of just 5 km. Water from the northern end of Badigeru Swamp may filter east to the Veveno River basin and thence eventually to the Sobat and White Nile, or west to the Bahr el Jebel above Mongalla (5°12'N/31°46'E). Rainfall over the swamps varies from 800-900 mm/yr but is over 2000 mm/yr in the upper catchments.

**Flora & Fauna:** A valley swamp with papyrus along the river and typical grasses on the floodplain.

**Human Impact & Utilisation:** Little disturbed and little utilised except for hunting and fishing on the floodplain.

**Conservation Status:** Unprotected.

**Wetland Name:** The Veveno/Adiet/Lilebook Swamps

**Country:** Sudan
**Coordinates:** 5°27'-7°04'N/32°00'-33°03'E
**Area:** 645 000 ha
**Altitude:** 400-500 m asl
**Nearest Towns:** Bor (47 km W); Pibor Post (at NE end)
**General:** This vast area of seasonal swampland lies to the east of the Sudd and is oriented SW-NE. It is 215 km long and up to 60 km wide. Run-off, from the highlands to the south and southeast, flows northwestwards until it meets the Veveno River which crosses its path from SW to NE. The Veveno leaves the swamp at the northeastern end, to join the Lotilla River, and thereafter the combined stream joins the Pibor River. North of the Veveno, water drains north or northwestwards until it collects into tributaries of the Adiet (Manaam) River, which flows outside the swamp, on the northern side, parallel with the Veveno. The Lilebook River drains the far northeastern end of the swamp, flowing northeastwards between, and in parallel with, the Adiet and Veveno Rivers. Like them, it enters the Pibor River *en route* to the Sobat and the White Nile. Broad belts of permanent swampland occur along all these rivers.

**Flora & Fauna:** See regional introduction. A seasonal river valley/floodplain swamp system with large areas of permanent swampland. Papyrus, *Phraginites, Miscanthidium* and *Typha* dominate the permanent swamps, and floodplain grasses the seasonal swamps.

**Human Impact & Utilisation:** The southwestern and central parts of the system are very sparsely inhabited, but there are numerous villages along the Kangen/Pibor River at the northeastern end of the swamp. The floodplains are fished and the area is subject to hunting.

**Conservation Status:** Unprotected.

**Wetland Name:** The Sudd
**Country:** Sudan
**Coordinates:** 4°55'-9°37'N/29°59'-31°57'E
**Area:** c. 1 650 000 ha (permanently inundated in 1980)
**Altitude:** 380-450 m asl
**Nearest Towns:** Mongalla (at S end); Malakal (at N end)
**General:** Permanent swamps begin on the west bank of the Bahr el Jebel 10 km below

Juba, at a point (4°55'N/31°38'E) near Gondokora Village, and on the east bank (5°00'N/31°41'E) near the village of Tibari, some 20 km below Juba. Below Mongalla (5°12'N/31°46'E) the river channel widens in places to more than 2 km, bifurcates at a latitude of 5°30'N, and flows in three or more channels for some distance below Buka (5°47'N). The banks, which are generally clearly defined in the upper reaches of the Sudd, become lower and finally disappear below Bor (6°14'N/31 °34'E). Then the swamp widens, with numerous lakes and parallel streams, all beset with islands of floating papyrus. Between Mongalla and Bor the swamps are 10-13 km wide over a straight line distance of 115 km, but below Bor they widen to 25 km and with the peripheral floodplains are wider still. Major channels occur to the east, and there are several large lakes enclosed by permanent swamps on both banks, e.g. Lakes Fajarial (6°22'N/31°26'E) and Nuong (7°26'N/30°34'E) on the west bank. Both have open water areas close to 2500 ha, and there are at least 40 other lakes between Bor and Zeraf Cuts (7°46'N/ 30°32'E) on this stretch of the river. At Zeraf Cuts two canals on the east bank join the main channel of the Bahr el Jebel with the Bahr el Zeraf, but only the southern canal is kept open. Here, water flows from the Bahr el Jebel to the Bahr el Zeraf, which re- enters the Bahr el Jebel near Tonga (9°22'N/31°06'E) and thus isolates Zeraf Island between the two rivers. This island, east of the Bahr el Jebel, 180 km long and up to 65 km wide, was once mostly dry land, but following the rise in water levels which has been sustained since the 1963-64 floods, it has become a seasonal floodplain. Meanwhile the seasonal floodplain on the west bank of the Bahr el Jebel is 25 km wide in places and at Lake No (9°31'N/30°27'E), 190 km due north of Zeraf Cuts, the Bahr el

Jebel receives the Bahr el Ghazal. This river flows NE for 200 km through a broad swampy tract to reach Lake No, a shallow lake of some 2000 ha. From Lake No, the river, now often known as the White Nile, swings abruptly eastwards for 115 km to a confluence with the Sobat River (9°22'N/31°33'E). It then flows northeastwards, past Malakal, having left the Sudd above the Sobat. The riverine distance through the Sudd, between Gondokoro and the Sobat confluence exceeds 680 km, and the total area of permanent wetland, including lakes and open river surface, is in the region of 1 650 000 ha (Mefit-Babtie, 1983), to which can be added at least a further 1 500 000 ha of seasonally inundated floodplain.

**Hydrology & Water Quality:** Long term variations in the amount of water dis- charged from the East African lakes are well documented. Prior to 1960 the mean annual inflow to the Sudd at Mongalla was 26 831 billion $m^3$, but between 1961-1980 it was 50 324 billion $m^3$, while the respective mean annual outflows at Malakal were 14 158 and 21 387 billion $m^3$. The high water levels after 1961 led not only to a great increase in total wetland area, but also to a corresponding increase in loss by evaporation. While current outflow is 58% of inflow, the apparent reduction of 42% does not take account of the input by direct precipitation. This ranges from 780-910 mm/yr over the swamps, and thus amounts to between 23.4 and 27.3 billion $m^3$/yr assuming a swamp area of 3 million ha. The total loss by evaporation and seepage can thus amount to as much as 56 237 billion $m^3$/yr, considerably more than the riverine inflow at Mongalla, and the total input from all sources can exceed 77 624 billion $m^3$/yr. The extent of the permanent swamp reflects annual riverine inflow closely, since this has proved more variable than direct precipitation over the past 82 years. During the low water phase of 1950-52, the area of permanent swamp was reduced to about 300 000 ha, while by 1980 it had increased to 1 650 000 ha. During these 30 years, riverine inflow increased by some 24 000 billion $m^3$, but outflow only by about 7250 billion $m^3$, i.e. approximately 66% of the additional riverine inflow was lost in the swamps.

The annual input from the Bahr el Ghazal is of the order of 925 million $m^3$, with normal peak flow rates of 46 $m^3$/sec, although rates of 92 $m^3$/sec occur in exceptional years. This is only a fraction of the volume carried by the Bahr el Jebel at Lake No, but the waters of the White Nile back up to Lake No, and even above it, when the Sobat River is in flood. The seasonal floodplain area is greater in the east than the west. Often direct precipitation seals the black cracking clays of the floodplains before the riverine flood. Often the flood first begins to rise as a consequence of surface run-off from local rain which moves on a front in a northwesterly direction down very shallow gradients. It is the seasonal floodplains which account for the great evaporative losses from the system, since comparatively little water returns from the floodplains to the river as the flood subsides, and the eastern areas at least, dry very quickly. Nevertheless, there are many isolated pools on the floodplain which persist well into the dry season.

Water quality varies seasonally and spatially. In the main channels water temperatures vary between 22 and 30°C, but higher temperatures are recorded on the floodplain as the water is receding. Transparency is greatest during the dry season, and over the year Secchi depths in the channels range from 17-150 cm, while conductivity ranges from 150-370 la Siemens/cm at 20°C. The waters are generally well oxygenated in the channels, but decomposition in the swamps invariably leads to low oxygen concentra- tions. River water has been found to have lowered oxygen concentrations during the flood, possibly because organic materials are flushed out of the swamp at this time. The river water and swamps become more alkaline in the dry season over a pH range of 6.7-8.4. The principal cation concentrations are calcium 4-9 mg/1; magnesium 3-10 mg/l; silicon 1-14 mg/1 and iron 0.05-1.3 mg/l, while the principal anion concentrations are chloride 4-12 mg/1; sulphate 0.5-10 mg/1; phosphate 0.005-0.14 mg/l; nitrate 0.0060.06 mg/1 and ammonium 0.006-0.11 mg/l. The concentrations of silicon, iron and ammonium increase northwards, i.e. downstream, whereas those of nitrate, phosphate and sulphate decrease.

In the Sudd, every gradation from riverine to lacustrine conditions may be found. There are widenings of river channels, through which flow rate is reduced, extensive basins with tenuous river connections with long retention times, and apparently isolated shallow water bodies. Few of these 'lakes' have depths greater than 3 m at high water. Lakes enclosed by papyrus tend to have clear water throughout the year. Shallow lakes, with much submerged vegetation, become saturated with oxygen, but the interstitial waters of the swamps are strongly reducing.

**Flora & Fauna:** *Cyperus papyrus* is dominant at riversides, forming a riparian belt which extends right through the swamps. *Phragnzites karka* and *Vossia cuspidata* are associated with the papyrus and, in places, *Phragmites* dominates swamps behind the papyrus. Elsewhere, *Typha dontingensis* forms enormous pure stands behind the papy- rus, and this species has probably shown the greatest increase since the water level rise of 1961-62. *Eichhornia crassipes,* which was first recorded on the Nile in 1950, occupies the niche formerly held by *Pistia stratiotes.* However, this latter species is still present in the Sudd although diminished in importance. Other common macrophytes are *Ceratophyllunz demersunz, Najas pectinata, Nymphaea lotus, Ottelia* spp., *Potamogeton* spp., *Trapa natans* and *Vallisneria spiralis. Oryza longistaminata* is the predominant floodplain grass, with *Echinochloa pyramidalis* and *Vossia cuspidata* its most widespread associates.

The invertebrate zooplankton is abundant and rich in terms of species, but the zoobenthos is impoverished and comprises mainly oligochaetes, but molluscs are important in the lakes. Just under 100 species of fish have been recorded from the Sudd including 31 siluroids, 16 characoids, 14 cyprinids, 11 mormyrids, 8 cichlids and 7 cyprinodonts. Many species leave the rivers and move onto the floodplains to spawn as the flood rises, returning to the permanent watercourses when it recedes. The most numerous species are *Alestes dentex, Auchenoglanis biscutatus, Chelaethiops bibie, Citharinus citharus, Distichodus rostratus, Eutropius niloticus, Heterotis niloticus, Hydrocynus forskalii, Labeo niloticus, Lates niloticus, Micralestes acutidens, Mormyrus cashive, Oreochromis niloticus* and *Synodontis frontosus. Aplocheilichthys* spp., *Clarias* spp., *Epiplatys* spp., *Gymnarchus niloticus, Heterotis niloticus* and *Polypterus bichir are* associated with the papyrus and *Typha* swamps.

Frogs are abundant. There are several species of snakes in the swamps, and *Crocodylus niloticus is* still widespread. The Sudd is important to migratory birds, and has a rich avifauna, including numerous water birds and species associated with reeds as listed in the regional introduction. Numerous weavers, warblers, flycatchers (including *Alseonax aquatica),* kingfishers, ducks, herons, ibises, egrets, storks (including *Balaeniceps rex),* kites, crows and vultures *(Necrosyrtes monachus)* are found here. Large mammals found in the wetland system include *Alcelaphus buselaphus, Damaliscus korrigunz, D. lunatus, Hippopotamus amphibius, Hippotragus equinus, Kobus ellipsiprymnus, K megaceros, Loxodonta africana, Panthera pardus, Redunca redunca* and *Syncerus caffer.*

**Human Impact & Utilisation:** Traditionally cattle are driven onto the floodplains for grazing as the floods recede. The cattle and their herders follow established routes and set up cattle camps along the way, from which they hunt and fish in the swamps. Fishing is mostly spear fishing, and *Clarias, Gymnarchus, Heterotis, Polypterus* and *Protopterus* are prominent in the catches. It is estimated that some 400 000 people live in the Sudd area. There are few villages and communications are seriously disrupted during the flood season, and, since the 1960-61 water level rise, the area available for seasonal grazing has decreased while that available for permanent fishing has increased. Hence, in recent years, the number of permanent fishing camps in the Sudd has increased greatly. Here fishing is chiefly by staked gill nets, but cast nets, seines and drift nets are also used. Fish to be sent to market are mostly sun-dried, but a salt-fish industry, operated by Arab merchants and the Government Fisheries Department has recently been established. The catches comprise, in decreasing order of importance, species of *Distichodus, Citharinus, Heterotis, Oreochromis, Lates, Gymnarchus, Mormyrus, Clarias* and *Labeo.* Nomadic fishermen also visit the

swamps. Coming from the western provinces they set up temporary camps on the west bank, often on lakes shores such as those of Lake No. An FAO/UNDP Sudd Fisheries Development Programme has been established with a base at Bor, but at present, reliable predictions as to the maximum sustained yield from the Sudd are unavailable. Certainly the Sudd is presently underfished, and equally certainly some past estimates of MSY (e.g. 200 000 tonnes) are too high.

Hunting has always been an important activity on the floodplains, being concentrated around the villages, with *Alcelaphus buselaphus, Damaliscus lunatus* and *Gazella dama* the principal species taken.

It is intended to reduce water loss from the Sudd by channelling water around the swamps through the Jonglei Canal, which will run from a point below Bor, near Jonglei Village, to a point on the Sobat River, just above its confluence with the White Nile. The canal will be 360 km long, 50 m wide and 4 m deep and will divert some 20 million $m^3$ of water per day, or 7.3 billion $m^3$/yr, around the swamps. The canal will be navigable and will be constructed beside an allweather road, both of which will improve communications in the area. However, it is clear that the canal will bring about a diminution of the Sudd and a change in the distribution of wetlands in the area. Predictions are that the permanent swamps will shrink by 21-25% and the floodplains by 15-17%, provided that the flow of the Nile does not fall from its present high levels. Should it decline to its 1950-52 level however, an operational Jonglei Canal would bring about a drastic reduction in the size of the Sudd. Drijver & Marchand (1985) analyse the present and future consequences of the construction of the Jonglei Canal.

The Nile is of great importance for navigation and the main waterways are kept clear of sudds by cutting or by the use of explosives. *Eichhornia crassipes* obstructs minor waterways and passages have to be cleared by local fishermen, but in addition weevils, *Neochetina* spp., have been introduced as a biological control. Harvesting and utilisation of *Eichhornia* has also been suggested.

**Conservation Status:** The Sudd is one of the most important wetlands in Africa and three areas have been designated as game reserves. These are Zeraf Island (675 000 ha), Shambe (100 000 ha) on the west bank and Mongalla (7500 ha) on the east bank.

**Wetland Name:** The Machar Marshes
**Country:** Sudan
**Coordinates:** 8°27 ' -9°58'N/32°11' -34°09'E
**LocationArea:** c. 900 000 ha (500 000 in Sudan)
**Altitude:** 290-600 m as1
**Nearest Town:** Malakal (60 km W)
**General:** The Machar Marshes are not well mapped. They comprise a vast area of swamps and seasonal floodplains interlaced by an intricate reticulate system of water- courses and numerous lakes. Run-off from direct precipitation, and drainage from the Ethiopian Highlands, tends to move across the 'marshes' to, or towards, the White Nile below Malakal. The wetland system extends at least 200 km from north to south and 180 km from east to west and is situated north of the Sobat River. Streams from the Ethiopian Highlands descend quite abruptly to a very flat area around 300 m asl, and on this plain the rivers break up into the complex of minor watercourses mentioned above, often losing their integrity in the swamps. The wetland system extends over the border into Ethiopia in the SE, where there is at least 400 000 ha of wetland, much in the valley of the Gambela River. The major river in Sudan is the Daga, which becomes the Khor Daga and then the Khor Adar.

**Flora & Fauna:** There are extensive grassy floodplains and permanent herb swamps dominated either by papyrus along the innumerable watercourses, or by *Phragmites* and *Typha* away from them. See regional introduction for details of species found in the area.

**Human Impact & Utilisation**: Little utilised. The area is sparsely populated. Cattle are grazed on the floodplain areas during the dry season, and hunting and fishing occur in the wetland system.

**Conservation Status:** Unprotected.

**Wetland Name:** The Dinder Floodplain
**Country:** Sudan
**Coordinates:** 11°45%12°47'N/34°46%35°49'E
**Area:** c. 500 000 ha
**Altitude:** 700-800 m asl
**Nearest Towns:** Sennar (130 km NW); Khartoum (360 km NW)
**General:** The floodplain occupies the land between the Dinder and Rahad Rivers which flow down from the Ethiopian Highlands to a flat plain, sloping gently northwestwards towards the Blue Nile. A number of tributary rivers, e.g. the Galegu, with numerous ox- bow lakes, lie between the two major rivers, and much of the intervening land may be flooded during the rainy season in the mountains. Direct precipitation over the floodplain amounts to 800 mm/yr in the south and 600 mm/yr in the north, and is received between June and October. Daily maximum temperatures range from 20°C in January to 44°C in May.

**Flora & Fauna:** Gallery forests subject to inundation, occur along the watercourses and contain *Acacia sieberana, Ficus* spp., *Mimosa pigra, Tamarindus indica* and *Ziziphus abyssinica,* or in places stands of *Hyphaene thebaica.* Areas of thornbush savanna are also subject to inundation and are covered by *Acacia seyal* and *Balanites aegyptiaca,* with *Sorghum* and *Brachiaria* spp. the dominant grasses. In swampy lakes *Echinochloa* spp., *Ipomoea aquatica, Leersia hexandra* and *Nymphaea* spp. are dominant. *Oryza longistaminata* and *Echinochloa pyramidalis* occur on the most deeply flooded parts of the plain, but with *Cynodon dactylon, Hyparrhenia* spp., *Panicum* spp., and *Themeda triandra* covering those parts of the floodplain which are less deeply inundated. The swampy areas around lakes, lagoons, pans, pools and depressions are very important grazing sites for wildlife during the dry season. Large mammals present include *Dama- liscus lunatus, Hip potragus equinus, Kobus ellipsiprynznus, Redunca redunca, Syncerus caffer, Tragelaphus scriptus* and T *strepticeros. Panthera pardus* is the chief predator. *Acinonyx jubatus, Crocuta crocuta, Giraffa camelopardalis, Ourebia ourebi, Hyaena hyaena* and *Panthera leo* are present in the dry season, as is *Struthio canzelus.*

**Human Impact & Utilisation:** While the area is fully protected, poaching and illegal herding are threats to both the vegetation and wildlife.

**Conservation Status:** The entire wetland system is protected in the Dinder National Park, which has also been designated a Biosphere Reserve. There is an extensive (270 000 ha) buffer zone immediately to the west, but illegal farming has penetrated this latter zone, and up to 60% of the park is burnt each year, either by park rangers or nomadic herdsman. The combination of burning and grazing by cattle has altered the flora significantly in recent years. The dry season is very harsh and the wildlife in the park (wetland) has always depended upon adjacent grazing areas, which the buffer zone helps to protect. Thus the additional pressure created by the presence of herds of cattle is very detrimental, in addition to which it is believed that serious outbreaks of disease among the wildlife have been introduced by cattle driven onto the floodplain in the dry season.

**Minor Wetlands**
**General:** Seasonally flooded areas with some permanent swampland occur at innumerable sites on the plains on either side of the White Nile below Malakal. The principal wetlands known on the eastern side occupy 50 000 ha (10°30'-10°46' N/32°45 ' - 33°00'E); 15 000 ha (10°32'-10°37'N/33°16'-33°29'E); 5250 ha (10°57'-11°00'N/33°00'- 33°08'E); 9750 ha (11°49 '-11°55 ' N/33°01 ' -33°10'E) and 5000 ha (11°50%11°58' N/32°51 ' -32°55 'E). On the western side they occur at 10°08'-10°18'N/31°48'-

31°57'E (9000 ha); 10°09'-10°19'N/31°35'-31°49'E (18 000 ha); 10°31'-10°37'N/31°52'-32°00'E (6600 ha) and 11°02'-11°05'N/31°39'-31°46'E (7500 ha). Some of these wetlands contain permanent or semi-permanent lakes. They are little utilised and most occur in very sparsley populated areas. None is protected.

South of Malakal there are numerous swamps on the plateaux to the west of the Nile Valley, i.e. west of the Sudd at altitudes between 400-600 m asl. Wetlands, most incor- porating areas of permanent swamp have been mapped around the centres 5°05'N/ 31°18'E (5000 ha);

5°10'N/31°06'E (1200 ha); 5°11'N/29°13'E (3000 ha-720 m asl);
5°19'N/31°25'E (4500 ha); 5°25'N/31°33'E (2000 ha); 5°25'N/31°24'E (5200 ha);
5°27'N/31°29'E (4000 ha); 5°34'N/30°07'E (3000 ha); 5°36'N/31°13'E (1500 ha);
5°48'N/30°03'E (5500 ha); 6°05'N/29°52'E (6800 ha); 6°14'N/29°46'E (3500 ha);
6°36'N/29°41'E (3200 ha); 6°41'N/29°55'E (5600 ha); 6°48'N/28°45'E (2500 ha);
6°51'N/29°46'E (16 000 ha); 6°52'N/29°35'E (2000 ha); 6°52'N/29°59'E (9000 ha);
6°54'N/29°11'E (4000 ha); 6°55'N/29°56'E (4000 ha); 7°02'N/29°13'E (3000 ha);
7°05'N/29°04'E (4000 ha); 7°12'N/30°11'E (31 500 ha); 7°29'N/29°37'E (8400 ha);
7°45'N/29°43'E (5000 ha); 7°46'N/29°35'E (6000 ha); 7°52'N/29°51'E (6000 ha);
7°53'N/29°57'E (4000 ha) and 8°00'N/29°38'E (9600 ha).

**The Nile Valley below Malakal**

**General:** The Nile flows in a broad sandy trough below Malakal, descending northwards at a mean gradient of 1:19 000. Within the trough, which may be 6 km wide in places, the river channel is accompanied by old abandoned channels on both banks. During the flood the entire trough is inundated, but in dry season the river is confined to its incised channel. Swamps, 200-300 m wide, line the riverside, but in places these may expand, and between 11°03' and 11°52'N for example, the swamp belt reaches 20 km in width locally. The channel is island-studded between latitudes 12°30' and 15°00'N, but then bifurcates and even trifurcates. The incised sandy trough flattens and the river develops a floodplain at latitude 13°30'N which persists, 3-10 km wide, to latitude 15°00'N, after which the river broadens into the lake behind the Jebel Auliya Dam (15°15'N). In total the floodplain covers 113 000 ha. Below the dam there is another floodplain which leads into Khartoum and the confluence with the Blue Nile. When the latter stream is in flood, water in the White Nile backs up; hence the floodplain above Khartoum. The Jebel Auliya Reservoir contains and regulates the flow of the White Nile when the Blue Nile is in spate. Below Khartoum the Nile receives the Atbara River on the right bank, its final major tributary, and follows a course locally and narrowly fringed with swamps through the desert until it enters Lake Nubia at Ambikol (21°24'N/30°54'E), just above the Egyptian border.

**The Bahr el Ghazal**

**General:** Swamps and floodplain accompany the Bahr el Ghazal from Meshra' er Req (8°26'N/29°16'E) through Lake Ambadi virtually continuously to Lake No and the confluence with the Bahr el Jebel. The perennial swamp belt is 10 km wide from Meshra' er Req downstream for 70 km, but it then tapers over the succeeding 60 km, while a floodplain behind the swamps widens and eventually, to the south of Lake No, merges with the floodplain of the Bahr el Jebel. There are some 90 000 ha of perennial swamps on the river, the flora and fauna of which are similar to that of the Sudd. No part of the Bahr el Ghazal is protected. Artisanal fisheries occur on the river.

**Floodplains of the Southern Rivers**

**General:** Mean annual rainfall over the provinces of Western Equatoria and El Buheyrat in southern Sudan ranges from 800 -1400 mm and, because most of this is received over a period of just a few months, the intensity of precipitation is high and the rivers rise rapidly and overtop their banks. Thus there are floodplains on the Pongo, Busseri, Wau, Numatinna, Yabu, Mbungu, Biki, Sue, Lesi, Ibba, Maridi, Era, Lau and Gel Rivers. These rivers all flow through the Soudanian Savanna zone down

to the Nile Valley and the Sudd, their waters reaching the Nile on the west bank, largely by diffuse drainage through the swamps. Rainfall decreases to the west in these provinces and the western rivers are not perennial, while those of the east are. *Andropogon gayanus* and *Setaria sphacelata* are important grasses in the headwater floodplains, where *Mitragyna inermis* and *Terminalia macroptera* are scattered trees. The latter may however, fill depressions, and is then usually accompanied by *Brachiaria jubata* as the dominant grass. Long stretches of these rivers are fringed by gallery forest, subject to seasonal inundation, carrying trees such as *Acacia sieberana, Diospyros mespilifonnis, Khaya senegalensis, Ficus sycomorus, Tamarindus indica* and *Syzygium cordatum,* behind which there are areas of floodplain which carry savanna vegetation where *Hyparrhenia cyanescens, Pennisetum polystachion* and *P. unisetum* are the dominant grasses and *Borassus aethiopum, Mitragyna inermis* and *Terminalia macroptera* are common but scattered trees. The floodplains in these provinces have not been mapped comprehensively, but there are more than 4250 km of major river channels, and from the few areas indicated as subject to inundation on available maps an estimate of 500 000 ha of floodplain appears conservative.

**B. Natural Lakes**

**Wetland Name:** Lake Ambadi
**Country:** Sudan
**Coordinates:** 8°38'-8°43'N/29°17'E
**Area:** c. 1000 ha
**Altitude:** 388 m
**Nearest Towns:** Malakal (280 km ENE); Juba (500 km SE)
**General:** The lake is formed by a widening of the channel of the Bahr el Ghazal. It is 10 km long, 1-3 km wide, and has a maximum depth of 3 m. It is set in perennial herb swamps on an otherwise featureless plain. The Bahr el Ghazal flows in at the south and out at the north, while the River Jur flows in on the western side. The principal input is from the Jur, a seasonal stream, the flow rate of which may reach 35 million $m^3$/day in September. The water of the lake is generally clear with Secchi depths exceeding 2 m. It is acidic, with a pH range of 6.4-6.8, and moderately well oxygenated. The floor is covered by a mat of vegetation dominated by *Ceratophyllum demersum, Myriophyllum spicatum, Najas pectinata* and *Potamogeton pectinatus.* The peripheral vegetation is dominated by *Vossia cuspidata,* with some *Echinochloa,* and floating carpets of *Eichhornia crassipes.* It has a distinctive fish fauna, supports an artisanal fishery, and is unprotected.

**Wetland Name:** Lake Yirol
**Country:** Sudan
**Coordinates:** 6°33'-6°37'N/30°27'-30°31'E
**Area:** 1600 ha
**Altitude:** c. 440 m asl
**Nearest Towns:** Shambe (65 km NE); Juba (230 km SE)
**General:** Lake Yirol is 9 km long, 2.5 km wide at maximum, and is fed by a local stream. It is shallow, swamp-fringed, has a peripheral floodplain and drains from its southern end to the Lau or Yei River, which eventually peters out in the Sudd. The lake supports a small artisanal fishery, is an important watering point for wildlife and is unprotected.

**Wetland Name:** Lake Anyi
**Country:** Sudan
**Coordinates:** 6°25'-6°28'N/30°34'-30°38'E
**Area:** 1400 ha
**Altitude:** c. 450 m asl
**Nearest Towns:** Shambe (75 km NE); Juba (210 km SE)
**General:** This lake is shaped like an inverted L, with each arm 6.5 km long and 1-2 km wide. It is shallow, swamp-fringed, and has a peripheral foodplain. It has a rich avifauna and supports a small

artisanal fishery. It is fed by two streams at the southern end, the largest of which, the Rara River, is 40 km long and rises only a few metres higher than the lake. It appears to drain to the Lau or Yei River from the northwestern end. It is unprotected.

**Wetland Name:** Lake Nyiropo
**Country:** Sudan
**Coordinates:** 6°08'N/30°11 'E
**Area:** c. 700 ha
**Altitude:** 500 m asl #
**Nearest Towns:** Bor (150 km W); Juba (210 km SE)
**General:** This small lake is 5 km long and 1.5 km wide at high water, and is oriented SW-NE at an altitude of 500 m. It is a shallow lake, probably not exceeding 3 m in depth, and drains to the Lau River, 2 km distant from its northern end. It is situated 150 km west of the Bahr el Jebel as it flows past Bor. It is a permanent lake, with dense beds of aquatic vegetation and fringing swamps. It has a narrow peripheral floodplain and is unprotected.

**C. Artificial Impoundments**

**Wetland Name:** Lake Nubia/Nasser
**Country:** Sudan
**Coordinates:** 20°27 '-23°58'N/30°07'-33°15 'E
**Area:** 685 000 ha (104 000 in Sudan)
**Altitude:** 183 m asl (at capacity)
**Nearest Towns:** Dongola (260 km 5); Khartoum (632 km SSW)
**General:** This is the southern (Sudanese) sector of the Lake created by the construction of the Aswan High Dam. The lake is set in the desert and the surrounding country is virtually unvegetated. It can be divided into three sectors. The northern sector (in Egypt) is fully lacustrine and extends south from the dam to Tushka. The middle sector, which extends from Egypt into northern Sudan, is lacustrine in character for most of the year, but exhibits riverine features during the flood. The southern sector, which is entirely within Sudan, is essentially riverine. The fish fauna of the lake changes progressively in moving north, because of the changing character of the lake, and hence although the commercial fishery in Sudan produces a similar spectrum of species to that in Egypt, the proportions of each species in the catch tends to be different. As in Egypt, the relative importance of different species in the catch has changed from what it was immediately after impoundment, because the fish fauna of the lake has now stabilised and the number of species regularly recorded in the Sudanese part of the lake has decreased, from 40 in 1967 to 20 in 1979.

**Flora & Fauna:** The fishes now common in the lake are *Alestes baernose, A. dentex, A. nurse, Bagrus bayad, B. docmac, Barbus bynnie, Distichodus niloticus, Eutropius niloticus, Hydrocynus forskalii, Hyperopisus bebe, Labeo coubie, L. horie, L. niloticus, Lates niloticus, Oreochromis galilaeus, 0. niloticus, Schilbe uranoscopus, Synodontis batensoda, S. schall* and *S. serrata.* Species which have become scarce are the swamp/marsh and shallow water species, including *Auchenoglanis* spp., *Clarias* spp., *Gymnarchus niloticus, Heterotis niloticus, Malapterus electricus, Marcusenius* spp., *Polypterus* spp. and *Protopterus aethiopicus.*

**Human Impact & Utilisation:** Construction of the dam necessitated the resettling of people but led to the establishment of a more productive fishery. Today cichlids *(Oreochromis* spp.) comprise 64% of the annual catch by weight. Thereafter *Lates* comprises 14%, *Labeo* 11%, *Barbus 7%, Synodontis* 2% and *Bagrus* 2%. An account of the fishery, containing many references, is given by Ali (1984).

**Conservation Status**: Unprotected.

**Wetland Name:** El Roseires
**Country:** Sudan
**Coordinates:** 11°47'N/34°23'E
**Area:** 29 000 ha
**Altitude:** 480 m asl (at capacity)
**Nearest Towns:** El Roseires (10 km N); Khartoum (475 km NW)
**General:** The dam across the Blue Nile just above El Roseires was closed in 1966 to produce the 17th largest artificial lake in Africa, having a volume of 3 billion $m^3$ at capacity. When full, the reservoir has a maximum depth of 67.7 m and a mean depth of 10 m. Lacustrine conditions pertain for 120 km upstream of the dam, and the lake has a maximum width of 26.5 km at the northern end. There is a commercial fishery on the lake.

**Wetland Name:** Sennar
**Country:** Sudan
**Coordinates:** 13°36'N/33°37'E
**Area:** 16 000 ha
**Altitude:** 422 m (at capacity)
**Nearest Towns:** Sennar (on lake); Khartoum (260 km NW)
**General:** The Sennar Dam on the Blue Nile was closed in 1925 and subtends an artificial lake of 16 000 ha, the 25th largest impoundment in Africa. It has a maximum depth of 26 m at capacity, with an annual fluctuation of surface level of up to 17 m.

**Wetland Name:** Kashim el Girlba
**Country:** Sudan
**Coordinates:** 14°55'N/35°55'E
**Area:** 12 500 ha
**Altitude:** c. 420 m asl
**Nearest Towns:** Kassala (75 km NE); Khartoum (380 km ENE)
**General:** The Kashm el Girba Dam on the Atbara River was closed in 1964, producing a long (55 km), narrow (4 km) lake oriented N-S.

**Wetland Name:** Gebel Auliya
**Country:** Sudan
**Coordinates:** 15°15'N/32°28'E
**Area:** 150 000 ha
**Altitude:** 377 m asl (at capacity)
**Nearest Town:** Khartoum (25 km N)
**General:** This barrage across the White Nile above Khartoum was constructed in 1937 to hold back the flow of the White Nile during the period when the Blue Nile is in spate. Lacustrine conditions extend a very long way back up the valley of the White Nile, so that its lake is deemed to cover 150 000 ha and to form the 7th largest artificial impoundment in Africa. Water is used for irrigation and a commercial fishery operates on the lake.

### 3.7 TANZANIA

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

lakes, riverine floodplains and permanent swamps, tidal swamps at the coast, and a number of artificial impoundments. The following sections describe wetlands that are located within the Nile Basin

**List of Wetlands Described**

A. Riverine Wetlands
- (a) The Kagera River
- (c) The Mara River

B. Lake Victoria

**A. Riverine Wetlands**

**The Kagera River**

**General:** The Kagera forms the border between Rwanda and Tanzania for a distance of about 210 km, and for 180 km it traverses a shallow swampy valley (1°19'-2°11' S/30°33 '-31°01'E) at altitudes between 1270 and 1300 m asl. In this sector it flows sluggishly, almost due north, through permanent swamps which reach 18 km in width, but which are generally only 1-2 km wide on the Tanzanian side of the border. Very locally they extend 10 km into Tanzania. There are many papyrus fringed lakes in depressions on either side of the river, and those in Tanzania are, from north to south, Lakes Gwelu (1°20'S/30°39'E), Nyakatale (1°22 ' S/30°39 'E), Nyaruwale (1°23'S/30°41'E), Lubuga (1°26'S/30°47 'E), Ishaka (1°27'S/30°47 'E), Duko (1°30'S/30°46'E), Kashani (1°34'S/30°49'E), Twamwala (1°36'S/30°50'E), Mujunju (1°36'-1°44' S/30°51 '-30°55 'E), Kashanga (1°53' S/30°51 'E), Lweru Kwa Kalambi (1°59'S/30°52'E), Katabi (1°59'S/30°57'E), Kazinga (2°01'S/ 30°56'E) and Bisongo (2°08'S/30°58'E). The river rises and floods, following rains over the catchments along the Western Rift Valley in Rwanda and Burundi. About 35 000 ha of the wetland is situated in Tanzania. The swamps are dominated by papyrus, but there are patches of swamp forest, and seasonal floodplains outside parts of the permanent swamp system. There is a rich fauna including frogs, crocodiles, terrapins, monitors, snakes, birds, otters and rodents, but *Hippopotamus amphibius* is now scarce. The lakes and river are fished intensively by artisans, and there is some hunting. The area is unprotected in Tanzania, but most of the wetland on the Rwanda side of the border is included in the Kagera National Park.

**The Mara River**

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

**B. Lake Victoria**

**Lake Victoria**

**Location:** 0°30'N-3°12' S/31°37'-34°53'E
**Area:** 6 889 000 ha (c. 3 375 600 ha in Tanzania)
**Altitude:** 1134 m asl
**Nearest Towns:** Mwanza (on S lakeshore), Musoma (on E lakeshore)
**General:** In terms of surface area, Lake Victoria is the 3rd largest lake in the world, with 49 % of its area in Tanzania. It has a maximum recorded depth of 85 m and a mean depth of 40 m. It stretches 412 km from north to south between latitudes 0°30'N and 3°12'S, and 355 km from west to east between longitudes 31°37' and 34°53'E. It contains numerous islands and has a highly indented shoreline which Welcomme (1972) estimates as 3460 km long. However, published shoreline measurements are notoriously variable, since they depend absolutely upon the scale of map used for their determination and how far each indentation is measured. Welcomme's estimate appears conservative, especially if island shores are included. The innumerable bays and inlets of the lake

margin occupy valleys of the pre-lake system, and they differ in ecology from inlet to inlet, and from inlets to the main lake. Much of the margin is swampy, being fringed by dense papyrus stands. Mean monthly air temperatures over the lake range from 21.0-25.0°C. February and March are the warmest months, while December and January are the coolest ones.

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

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

A fossil cichlid, provisionally asigned to *Oreochromis spilurus,* which is now confined to the Ewaso Ngiro and the rivers flowing to the Indian Ocean, occur in deposits east of the lake. Again the interpretation of this is not certain, but it may be that the eastern side of the Lake Victoria Basin was once farther west than it is now. However, there seems no reason to doubt that the fish fauna of the present lake was derived from that of the old rivers flowing west across the area, which would have undergone `ponding' prior to the development of the lake. This was followed by a burst of speciation in the cichlid stock with the advent of true lacustrine conditions, as has occurred in the great lakes of the Western Rift Valley. Beadle (1981) gives a good introductory account of the history of the lake and its fauna.

**Hydrology & Water Quality:** The principal affluent is the Kagera River which drains the highlands of Burundi and Rwanda along the eastern rim of the Western Rift Valley. Thereafter the Nzoia River, which enters the northeastern corner, is the most important affluent. This river drains parts of the Mt Elgon Massif and the Cherangany Hills in Kenya, but it is far more seasonal in its discharges than is the Kagera. Other important inflows are from the other rivers of the northeastern and northwestern quadrants. Those of the northeast are very seasonal and comparatively swift flowing, while those of the northwest are less seasonal and very sluggish. The southeastern affluents are of comparatively little importance and drain areas of rather arid plateaux country, including the Serengeti Plains. Direct precipitation contributes more water to the lake than riverine inflows. It decreases from west to east across the lake, being 2000 mm/yr on the central western shore near Bukoba, but just over 1100 mm at the southwestern corner and only 750 mm in the southeast. The northern shores receive rather more than 1100 mm/yr. The lake is generally well oxygenated, at least to depths of 30 m, with concentrations ranging from 4.6-9.4 mg oxygen/l, although stratification does occur. Water temperatures range from 23.0-30.0°C, the highest readings being made in shallow bays. Secchi depths range from 35-200 cm. The concentrations of the principal ions, as given by Talling & Talling (1965) are: sodium 10.4 mg/1; potassium 3.8 mg/l; calcium 5.6 mg/l; magnesium 2.6 mg/1; chloride 3.9 mg/1; silicate 4.2 mg/1; and sulphate c. 1.0 mg/l.

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

The fish fauna is essentially nilotic, but there are many endemics, including nearly 200 endemic cichlid species and 4 endemic genera. More than 150 of the cichlids belong to the genus *Haplochromis* according to Greenwood (1974a). Many species leave the lake to spawn in the affluent streams. There have also been some introductions, e.g. *Lates albertianus, Oreochromis niloticus, 0. leucostictus* and *Tilapia zillii* were introduced before 1962 and are now widely distributed.

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

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

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

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

## 3.8 UGANDA

### Wetlands

Swamps have developed on several rivers which have been tilted back eastwards by the upwarping of the western margin of the Lake Victoria basin, and these are mainly dominated by papyrus. In the Virunga Massif a number of lakes have formed where valleys have been blocked by volcanic activity, and others have developed on valley floors where upwarping has raised the lower end of the valley so that it has flattened out. Many river valleys carry large strips of papyrus swamp along their thalwegs, especially those entering Lake Kyoga, while some rivers draining the northeastern districts have seasonal floodplains. There are many lacustrine swamps, and some seasonal floodplains at the heads of the rift valley lakes, and several small lakes in the Virunga Mountains.

### List of Wetlands Described

A. Natural Lakes & Lacustrine Swamps
  (a) Lake Victoria (with 5 Ramsar sites namely Lutembe Bay, Mabamba Bay, Lake Nabugabo, Nabajjuzi and Sango Bay (SAMUKA))
  (b) The Kyoga/Kwania Lake/Swamp Complex (with one Ramsar sites namely Lake Nakuwa)
  (c) Lake George (Ramsar site)
  (d) Lake Edward
  (e) Lake Albert (with one Ramsar sites namely Murchison Falls-Albert Delta)
  (f) The Bunyoni Lake/Swamp Complex
  (g) The Kijanebalola Lake/Swamp Complex (with one Ramsar sites namely Lake Mburo-Nakivali)
  (h) Lakes Bisina & Opeta (Ramsar sites)
  (i) Lake Wamala
  (j) Minor Lakes
B. Riverine Swamps & Floodplains
  (a) The Kafu System
  (b) The Nile

### A. Natural Lakes & Lacustrine Swamps

**Wetland Name:** Lake Victoria
**Country:** Uganda
**Coordinates:** 0°30'N-3°12 ' S/31°37 ' -34°53 'E
**Area:** 6 889 000 ha (c. 3 100 060 ha in Uganda)
**Altitude:** 1134 m asl
**Nearest Towns:** Entebbe (on N lakeshore); Kampala (13 km N)
**General:** In terms of surface area, Lake Victoria is the 3rd largest lake in the world, with 45% of its area in Uganda. 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 has a highly indented shoreline some 3460 km long (Welcomme, 1972), of which about half is in Uganda. The innumerable bays and inlets of the lake margin occupy valleys of the pre- lake system, and they differ in ecology from inlet to inlet, and from inlets to the main lake. Much of the margin is swampy, especially in the northwest in Uganda. Mean monthly air temperatures over the lake range from 21.0-25.0°C. February and March are the warmest months, while December and January are the coolest ones.

There are numerous islands off the northwestern lakeshore in Uganda, notably the 18 Sese Islands and 5 Kome Islands, 5 islands in Roseberry Channel, Buvuma and Bugaia Islands, Siguli and Lolui Islands, and the 3 Sagitu Islands. Permanent papyrus swamps with some patches of swamp forest occur around the Ugandan lakeshore. Such swamps are well developed around the mouths of the Kagera and Kibale Rivers, for example, in an area along and inland of Sango Bay immediately north of the Tanzanian border (0°37 ' -1°00 ' S/31°27 ' -31°42 'E). Other swamps occur on the lakeshore (0°20 ' - 0 °30'S/ 31°50'-31°58'E) encompassing Lake Nabugabo, and at the Katonga River mouth in two major blocks (0°08 '- 0 °19 ' S/31°51 ' -31°57 'E and 0°02 ' S/31°55 ' -32°04 'E), and farther east along Salisbury Channel where many short streams enter the lake through a deltaic zone (0°10'N-0°02'S/32°06'-32°20'E). Smaller swamps are situated (0°16'N/32°41'E) near Port Bell and (0°09'N/32°45'E) near Ntanzi. An extensive seasonal floodplain is situated behind the swamps at Sango Bay, extending 30 km up some of the affluent streams.

Lake Nabugabo (0°20'-0°23'S/31°53'-31°57'E) is 9 km long from SW-NE and 5 km wide. It occupies about 3600 ha at high water and has a maximum depth of 5 m. It is separated from Lake Victoria by a sand bar 1.2 km wide at its narrowest point. The lake is fringed by dense swamps, but the northwestern shore is forested with areas of sandy beach. This lake has been isolated only since the last fall in water levels some 3700 BP, but may have been in contact with the lake for short intervals during this period, possibly even in the late 1890s.

**Hydrology & Water Quality:** More water enters the lake from direct precipitation, which is heaviest over the Ugandan sector, than from riverine influxes. The most important affluents are situated in Tanzania and Kenya. The Katonga, the largest Ugandan affluent, is an extremely sluggish stream, more a swamp-course than a river in its lower reaches.

**Flora & Fauna:** Lake Nabugabo contains 9 species of *Haplochromis,* 4 of which are endemic according to Greenwood (1965b) and must have evolved over the last 3700 years. The other 5 are also found in Lake Victoria. Other fish from this lake include *Alestes nurse, Bagrus docinac, Clarias mossambicus, C. werneri, Gnathonemus longibarbis, Protopterus aethiopicus, Schilbe nzystus* and *Synodontis afrofischeri. Oreochronzis leucostictus, 0. niloticus* and *Tilapia zillii* were introduced to this lake in the 1950s.

The lacustrine swamps of Lake Victoria are dominated by papyrus, but in places there are arborescent associates, chiefly *Bridelia nzicrantha, Ficus verruculosa* and *Phoenix reclinata.* On the fringes of the papyrus, in areas less deeply inundated, there are strips and patches of swamp forest, as described in the regional introduction.

**Human Impact & Utilisation:** The shores of the lake are fairly densely populated. The lake is fished commercially using trawlers, and by artisans using seines and lines from beaches and canoes. The effluent river, the Victoria Nile, is dammed at Owen Falls (0°26'N/33° 11'E).

**Conservation Status:** Small sanctuary areas have been set aside at Entebbe (5200 ha) and Jinja (800 ha), otherwise the lake and its shore are unprotected in Uganda. Nkosi Island, south of Entebbe, is protected as a Sitatunga Sanctuary, but there is a lot of poaching.

**Wetland Name:** The Kyoga/Kwania Lake/Swamp Complex
**Country:** Uganda
**Coordinates:** 0°33 ' -1°56'N/32°18 ' -34°00 'E
**Area:** 560 000 ha (total wetland)
**Altitude:** 1033-1060 m asl
**Nearest Towns:** Kampala (112 km SSW of Kyoga); Mbale (50 km E of Kyoga)

**General:** This wetland occupies a shallow dendritic valley system, part of which is permanently flooded to form a series of shallow lakes, which have a combined maximum open water surface of 341 600 ha, and 218 400 ha of permanent swamps. The system is tributary to the Victoria Nile which flows through the southwestern end of Lake Kyoga, and then receives the discharge of Lake Kwania 32 km downstream. The system owes its existence to the upwarping of the western edge of the Lake Victoria basin, which has reduced the gradient and rate of flow in rivers flowing west, causing 'ponding' and turning them into sluggish swampy tracts.

Lake Kyoga (1°13'-1°47'N/32°33'-33°29'E) is the largest lake in the system. At high water its surface is 1034 m asl and covers 263 600 ha. The maximum depth is then 10.7 m and the mean depth about 3 m, and the surface level fluctuates by as much as 3.8 m during a year. The lake discharges at the western end into the Victoria Nile, and is oriented roughly E-W for 55 km immediately above the confluence, at which point it divides into two arms. The northeastern arm continues up the valley of the Omunyal River for a further 55 km, while the southeastern arm extends up the valley of the Mpologoma River for some 34 km. Many tributaries enter the Omunyal Arm the valley of which carries only minor swamps. By contrast, a vast permanent swamp extends up the Mpologoma Arm for 102 km above the lakehead, including many minor lakes, the largest of which are Lakes Adois (1°20'-1°25'N/33°30'-33°37'E), Kiando (1°23'N/33°24'E), Naragaga (1°23'N/33°27'E), Nyaguo (1°20'-1°22'N/33°41'-33°45'E), Nyasala (1°17'-1°22'N/ 33°34'-33°40'E), Namasajerl (1°21'N/33°22'E), Nakuwa (1°05'- 1°17'N/33°24'-33°30'E), Nawampasa (1°16'N/33'22'E), Kawi (1°12'N/33°37'E) and Lemwa (1°07'N/33°41'E). The swamp belt reaches widths of 20 km and extends up several side valleys, covering more than 106 000 ha if the very variable lake surfaces are included.

The Victoria Nile enters Lake Kyoga on its southern shore through a swampy valley, with a continuous block of swampland extending upstream for 21 km above the lake, while to the west another large swamp belt extends southwards from the lake, up the valley of the Sezibwa River. Here the swamps are continuous for 80 km above the lake, and thereafter, following the bifurcation of the valley, for a further 25 km SSW up the Lwajali Valley and for 27 km SSE up the Sezibwa. There are close to 16 000 ha of swamps on the Victoria Nile above Lake Kyoga and 47 000 ha on the Sezibwa system. Other extensive swamps (approximately 44 000 ha) occur at the northwestern end of the lake, between it and Lake Kwania, and also along the south bank of the Victoria Nile between Lakes Kyoga and Kwania, and along the north bank of the effluent channel joining Lake Kwania to the Nile. In addition there are numerous small swamps around the lakeshore, and a seasonal floodplain of some 5000 ha on the Mukate River immedi- ately above its mouth on the southwestern shore of Lake Kyoga.

Lake Kwania (1°35'-1°55'N/32°20'-33°02'E) is situated northwest of Lake Kyoga. It is 66 km long above the 25 km channel which connects it to the Victoria Nile. It is oriented roughly SW-NE and branches into two short arms near its northeastern end. At high water the lake surface is 1033 m as1 and covers some 54 000 ha if the effluent channel is included. The maximum recorded depth is 5.4 m at high water and mean depth is estimated as 4 m. There are several small swamps around the lake margin.

**Hydrology & Water Quality:** The catchment of the complex is enormous. The principal inflow to Lake Kyoga is from the Nile which drains Lake Victoria and contributes an average of 25.6 billion $m^3$ of water each year. The other affluents are much smaller, the most important being the Mpologoma, which brings some 610 million $m^3$ of water from southeast Uganda each year, and the Okere which contributes an average of 373 million $m^3$ water/yr, and drains much of the north and central eastern parts of the country. The Sezibwa discharges some 217 million $m^3$ of water to Lake Kyoga each year, while the Omunyal contributes a further 40 million $m^3$/yr, and the Adip and Abalang Rivers jointly discharge a similar volume into Lake Kwania. Direct precipitation over the major lakes amounts to about 6 billion $m^3$/yr, while the mean annual outflow from the system is 27 billion m3.

The water temperatures vary from 26-30°C and oxygen concentrations are moderate, but may fall to 3.8 mg/l in some of the small lakes. The pH values of Lake Kyoga range from 7.6-9.0, and conductivities from 210-365 pSiemens/cm. Concentrations of the principal ions are sodium 10.8 mg/l; potassium 9.6 mg/l; calcium 21.7 mg/l; magnesium 13.8 mg/l; carbonates 2.2 meq/l; chloride 12.0 mg/l; sulphate 31 mg/1 and silicate 34 mg/l.

**Flora & Fauna:** The lake margins are fringed by *Cyperus papyrus***,** which often detaches to produce floating islands, because of the substantial changes in water levels. There are extensive and dense carpets of floating macrophytes along the fringes of the open water, and beds of submerged macrophytes throughout the lakes. The swamps are dominated by papyrus, but seasonal floodplains carry grasses with some trees in less deeply inundated areas.

The fish fauna is nilotic. There was no effective barrier separating the fish faunas of Lakes Kyoga and Victoria until the Owen Falls Dam was completed in 1954, thus the fish fauna of the lakes in the complex is imilar to that of the inshore waters of Lake Victoria. By contrast the Murchison Falls have always been a barrier to interchange between these lakes and Lake Albert. *Oreochromis variabilis* is endemic to this system and Lake Victoria. *Oreochromis esculentus* occurs in Lake Kyoga, while *0. leucostictus, 0. niloticus* and *Tilapia zillii* were introduced. *Lates niloticus* was introduced in 1954 and was the most important commercial species by 1970.

*Crocodylus niloticus* is now scarce around the lakes, having been systematically killed as the human population has increased around the lakeshores. There is an abundant avifauna which includes many piscivorous species. Among mammals the semi-aquatic species *Aonyx capensis, Atilax paludinosus, Hippopotamus amphibius* and *Lutra maculicollis* are present, together with the swamp dwelling *Tragelaphus spekei.*

**Human Impact & Utilisation:** The lakes of the complex support important commercial fisheries, in which *Lates niloticus* comprises 60 -70% of the total annual catch, which amounted to 48 900 tonnes on Lake Kyoga in 1969. The small lakes are however, fished only by artisans. Crocodiles have long been shot for their skins and are in consequence now on the point of extinction in the large lakes.

**Conservation Status:** Protected.

**Wetland Name:** Lake George
**Country:** Uganda
**Coordinates:** 0°05'N-0°05'S/30°02'-30°18'E
**Area:** 22 850 ha (including islands)
**Altitude:** 914 m asl
**Nearest Towns:** Fort Portal (64 km N); Kampala (255 km E)
**General:** This lake, which straddles the equator, is situated on the floor of the Western Rift Valley. It has a maximum E-W length of 30 km, a N-S width of 16 km, a maximum depth of 7 m and a mean depth of 2.4 m. It is fed by several rivers and drains from the southwestern end by the Kazinga Channel which leads to Lake Edward. This is 36 km long with a mean width of about 1 km. The principal affluent streams (Nyamwamba, Rukoki, Mubuku, Ruimi Rivers) drain the eastern slopes of the Ruwenzori Mountains and enter the lake through extensive swamps (0°03 '- 0 °16'/%1130°09'-30°19'E) on the north shore. These swamps are 21 km long, up to 14 km deep, and occupy some 26 00 ha. The Mpanga also enters these swamps from the eastern edge of the Rift Valley Escarpment, while two other affluents enter on the southern shore, from the Virunga Massif, and the westward flowing section of the Katonga River enters the eastern extremity of the lake. Other swamps occur to north and south of the small western basin of the lake, and another is situated on the central southern lakeshore. There are three large islands close

to the western shore, one of which almost blocks the channel connecting the main basin with a smaller basin in the northwest.

The Lake George area has seen much volcanic activity over the past 12 000 years and a small crater lake is connected to the main lake by a narrow channel just south of the beginning of the Kazinga Channel. There are 4 isolated crater lakes north of the Kazinga Channel and a dozen south of it.

**Hydrology & Water Quality:** Direct precipitation over the lake is about 820 mm/yr and produces 12% (240 million $m^3$) of the annual influx. Rainfall over the Virunga and Ruwenzori catchments is much higher, exceeding 2000 mm/yr in the latter. The total catchment is 9705 $km^2$ yielding an estimated 1948 million $m^3$ water to the lake each year. Evaporation is estimated as 456 million $m^3$ and discharge via the Kazinga Channel at 1697 million $m^3$/yr (Burgis, 1987). The Kazinga Channel is essentially lacustrine in character, there being only 1 m difference in altitude between Lakes George and Edward.

Lake George is fresh, and its water chemistry is known to have remained fairly constant over the last 40 years, suggesting that the residence time of water in the lake is short, and that evaporation does not lead to the concentration of solutes. The surface water temperature of the lake varies considerably with a range conceivably in excess of 25-36°C, but the bottom water is always close to 25.5°C. The water is quite turbid with Secchi depths of only 24-46 cms. The pH range is 8.5-9.5, but an extreme reading of 10.4 has been obtained, and conductivities range from 210-240 iiSiemens/cm through the year, being highest in the dry seasons. The lake water exhibits a diurnal pattern of stratification, but is generally very well oxygenated. When mixing fails to occur during occasional periods of exceptionally calm weather the bottom water becomes deoxygenated, which may result in fish mortalities. Viner (1969) gives an account of the water chemistry.

**Flora & Fauna:** The phytoplankton is dominated by *cyanophytes*, 29 out of 58 species and 70-80% of the biomass, but diatoms (11 *spp*.) and *chlorophytes* (18 *spp*.) are important. The greatest phytoplankton density is in the centre of the lake. The zooplankton is dominated by a *cyclopoid copepod*, *Thermocyclops hyalinus,* but *cladocerans* (3 *spp*.) and rotifers (15 *spp*.) are present.

The peripheral swamps are dominated by *Cyperus papyrus,* rich in climbers such as *Cayratia ibuensis, Ipomoea rubens* and *Melanthera scandens,* but there are dense patches of arborescent species including *Ficus verruculosa* and *Phoenix reclinata. Vossia cuspidata* is common along the outer fringe of *papyrus,* and the lake surface supports dense carpets of floating vegetation containing much *Pistia stratiotes.* Some muddy shallowly flooded shores sustain communities of *Cyperus articulatus* and C. *latifolius* with sprawling *Commelina diffusa* and *Spilanthes oleracea.* Elsewhere, *Hydrocotyle ranunculoides* is common in shallow water. Submerged aquatics occur at the mouths of affluent streams where the incoming water sweeps floating vegetation away. *Paspalidium geminatum* occurs on the sandy eastern shores of the islands.

Some 32 species of fish have been identified to date. Of these 21 are cichlids and 17 belong to the genus *Haplochromis. Oreochromis niloticus* comprises 20% of the fish biomass and is the basis of the commercial fishery. Other common species include *Aplocheilichthys* spp., *Bagrus docmac, Clarias lazera, Haplochromis angustifrons, H. spamipinnis* and *Protopterus aethiopicus.* Crocodiles survive in the affluent rivers and there are large numbers of piscivorous birds including *Haliaeetus vocifer, Pelecanus onocrotalus, Phalacrocorax carbo* and various herons and kingfishers. There are also many storks and ibises. Important mammals include *Atilax paludinosus, Hippopotamus amphibius, Kobus ellipsiprymnus, Loxodonta africana, Lutra maculicollis, Redunca arundinum, Syncerus caffer* and *Tragelaphus spekei.*

**Human Impact & Utilisation:** The lake supports an important fishery which produced 4264 tonnes in 1970. Fish were both frozen and salted at Kasenyi by the Uganda Fish Marketing Corporation until

1973, which exported frozen fish to Zaire or sent frozen or salted fish by road to Kampala. Although this operation has ceased, the fishery continues, fish being sold directly to buyers with lorries that cart the fish to market. There is a ferry service across the lake from Kasenyi to Mayhoro, and a road runs down to Kasenyi, where there is also an airstrip. The railway crosses the swamp on the north side of the lake, and since the embankment inhibits drainage, it has led to the development of open water areas in the swamp on the north side, with *Cladium mariscus* and *Nymphaea* sp.

**Conservation Status:** The Ruwenzori National Park abuts most of the western and northern shores of the lake, while the south shore is included in the Kyambura Game Reserve. The Kazinga Channel is protected in the Kazinga Sanctuary. The Ruwenzori Park was established as the Queen Elizabeth National Park in 1952 with an area of 198 600 ha, encompassing all the land between Lakes Edward and George. Heavy poaching has occurred in the park, reducing the elephant population to 150 in 1981.

**Wetland Name:** Lake Edward
**Country:** Uganda
**Coordinates:** 0°05'- 0°56' S/29°16'-29°56'E
**Area:** c. 234 200 ha (63 750 ha in Uganda)
**Altitude:** 912 m asl
**Nearest Towns:** Fort Portal (100 km NNE); Kampala (305 km E)
**General:** Lake Edward is 76 km long with a maximum width of 39 km. Just over 29% of its surface is situated in Uganda. It is connected to Lake George, effectively a bay of Lake Edward, by the Kazinga Channel, 36 km long and about 1.5 km wide. Lake Edward reaches a maximum depth of 112 m, just 5 km from the western shore, above which the land rises precipitously to a high plateaux, over 2000 m asl, carrying mountain peaks over 3000 m. By contrast the lake floor slopes up gradually to the Ugandan shore. There are extensive swamps at the mouths of the Ishasha and Chiruruma Rivers covering about 14 000 ha.

**Hydrology & Water Quality:** Lake Edward has numerous affluent streams, the most important being the Nyamugasani River from the Ruwenzori Mountains and the Ishasha, Rutshuru and Rwindi Rivers from the Virunga Massif and the Rwanda Highlands. Further inflow, estimated at 1650 million $m^3$/yr, comes from Lake George, which also drains the Ruwenzori Range, and to the east shares *a* watershed with Lake Victoria. However, flow through the Kazinga Channel is very sluggish, along a gradient of 1:80 000 over the first 24 km. The junction of the waters between Lakes Edward and George is indicated by a change in colour and chemistry, and can usually be seen in the Kazinga Channel. The position of this boundary oscillates up and down the channel over a distance of about 3 km. Precipitation over Lake Edward is only 500-650 mm/yr, but is much higher in the adjacent mountains, e.g. approaching 3000 mm/yr on the western slopes of the Ruwenzori Massif. Lake Edward discharges into the Semliki River, and thence to Lake Albert and the Nile. Water spills over a rock shelf at the northern extremity of the lake, which functions as a natural weir.

Water leaving the lake has a temperature of 25-26°C and a pH close to 9.1. The concentrations of the major ions are sodium 110 mg/l; potassium 9 mg/1; calcium 12 mg/1; magnesium 48 mg/l; carbonates 9 meq/1; chloride 36 mg/1; sulphate 31 mg/l; silicate 6 mg/1 (falling & Talling, 1965). Total dissolved solids amount to 521 mg/l.

**Flora & Fauna:** *Potanzogeton pectinatus* is the dominant submerged macrophyte, in association with *Najas marina* and *Vallisneria aethiopica.* Some *Potanzogeton schweinfurthii* and *Najas pectinata* occur along the Ugandan shores. *Vallisneria* and *Najas* are best developed in the vicinity of river mouths where waters are better aerated. *Cyperus papyrus and Phragnzites mauritianus* form swamps at the mouths of the Ishasha, Chiruruma and Nchwera Rivers in Uganda on the northeastern shore.

The present fish fauna comprises about 23 cichlids and 30 non-cichlid species. However, the fauna is impoverished, with certain widespread families being entirely absent, e.g. Centropomidae, Characidae, Malapturidae, Mastacembalidae, Mochoki- dae and Schilbeidae. Further, *Citharinus, Distichodus, Hydrocynus, Polypterus* and *Lates* which are found in Lake Albert and the Nile are also absent, although both *Hydrocynus* and *Lates* are known to have been present in the middle Pleistocene. From palaeontological studies a picture emerges of Lake Edward being in a phase of recolonisation, its fauna having been partially eliminated at least twice during the late Pleistocene. Although the lake once contained crocodiles, as well as the Nile fish cited, they are also now absent. The rapids prevented their re-introduction from the lower Semliki where they persisted until the middle of this century, before they were finally eliminated by hunters. However, it appears that fish have entered from the east, where there is now a watershed with Lake Victoria, and these have begun speciating. Among the cichlids there are several species with close relatives in Lake Victoria, e.g. *Haplochromis guiarti, H. ishmaeli* and *H. ntacrops,* and two common species, *Astatoreochromis alluaudi* and *Haplochromis nubilis.* Two species present in the Nile have either re-entered or survived, *Bagrus docmac* and *Oreochromis niloticus*. *Oreochromis leucostictus* is confined to Lakes Edward and Albert, per- haps having originated in Lake Edward and passed downstream. Considering the history of the lake the invertebrate fauna is surprisingly rich.

The avifauna of the lake and associated river valleys and swamps is very diverse and includes herons, ibises, egrets, bitterns, ducks, geese, darters, cormorants, skimmers, shoebills, openbills, ospreys, gulls, francolins, warblers and weavers. Species of interest include *Acrocephalus schoenobaenus, A. scirpaceus, Anas querquedula, Ardeola ralloides, Calidris ferruginea, C. minuta, Charadrius hiaticula, Chlidonias leucoptera, Gelochelidon nilotica, Hirundo rustica, Philomachus pugnax, Riparia riparia, Tringa glareola, T. nebularia* and T *stagnatilis.*

**Human Impact:** The area is sparsely populated and there has been relatively little disturbance since the proclamation of the Ruwenzori National Park in Uganda in 1959 and the Virunga National Park in Zaire in 1969, but illegal fishing and poaching are chronic problems. Growing tourism could prove a threat, and the proposal to dam the Rutshuru River (in Zaire) would almost certainly have a major, and adverse, impact upon the riverine wetland ecosystem.

**Conservation Status:** Almost the entire Ugandan shore of the lake is protected in the Ruwenzori National Park, as is the lower course of the Rutshuru and several other tributary rivers.

**Wetland Name:** Lake Albert
**Country:** Uganda
**Coordinates:** 1°01 ' -2°20 'N/30°23 ' -31°26 'E
**Area**: 565 915 ha (318 570 ha in Uganda)
**Altitude:** 619 m asl
**Nearest Towns:** Masindi (45 km E); Kampala (220 km SE)
**General:** Lake Albert lies between two parallel escarpments in the Western Rift Valley, at an altitude of 619 m, with an extreme length of 180 km and a maximum width of 43 km. Just over 56% of its surface is in Uganda. Its deepest point, 56 m, lies 7 km off the western shore, from where the land rises steeply to a high plateaux more than 2000 m asl. The lake floor slopes gently upwards towards the east, but the eastern escarpment rises abruptly just a few km from the east bank in Uganda. The lake is subject to violent windstorms which cause the upwelling of bottom waters, but even without these happenings, the lake is generally well mixed. During calm periods, which frequently occur between November and February, a degree of stratification develops and dissolved oxygen levels fall, but not deleteriously for the fauna.

**Hydrology & Water Quality:** The principal affluent streams are the Semliki, which enters at the southern end from Zaire, and the Victoria Nile, which enters in Uganda very close to the northern

end. Both rivers have built deltas into the lake, that of the Semliki is the larger and 90% of it is in Uganda. Although the Nile carries more water than the Semliki, it has little influence on the ecology of the lake, other than to maintain water levels. The Nile water is fresh, with a salinity of 0.1‰, while the main body of the lake water, up to 10 km from the delta which the Victoria Nile has built into the lake, has a salinity of *6‰.* Lesser streams entering the lake from Uganda are, from south to north, the Waiga, Waisoke, Wald, Waisembe, Wambabya, Nkusi, Muzizi and Wasa Rivers. However, all these, and numerous small streams from Zaire, are highly seasonal and of only minor importance to the hydrology of the lake. Much periodically inundated land occurs around the southern margin of the lake in the Semliki Delta, and also at isolated sites along the eastern shore, most notably in the delta of the the Victoria Nile.

The surface temperature is usually within the range 26-29°C and the pH between 8.4 and 9.5. Total dissolved solids amount to 565 mg/1 and the concentrations of the principal ions are sodium 96 mg/1; potassium 65 mg/1; calcium 10 mg/1; magnesium 32 mg/1; carbonates 7.3 meq/l; chloride 31 mg/l; sulphate 32 mg/1 and silicate below 1 mg/1 (Tailing & Tailing, 1965). The results of detailed hydrobiological surveys were published by the Institut Royal des Sciences Naturelles de Belgique (Brussels) between 1957-1962. General information is provided by Bishop (1965; 1969) and Livingstone (1976).

**Flora & Fauna:** *Potamogeton schweinfurthii* is the dominant submerged macrophyte over most of the lake, by contrast with Lakes Kivu and Edward where *P. pectinatus* is most common. However, the latter species is present in Lake Albert. The principal associate species are *Najas marina* and *Vallisneria aethiopica,* and as in the other lakes, they are most abundant in the vicinities of river mouths, but this phenomenon is not so pronounced as it is in the two other lakes, possibly because Lake Albert is shallower and its waters are generally well oxygenated. There are extensive stands of *Cyperus papyrus* and *Phragmites mauritianus* in the river deltas, with flowering culms up to 5 m high. Aquatic meadows of *Vossia cuspidata* flourish on the lakeward side of the papyrus swamp, with twining thickets of *Cyclosorus striatus* on the landward side. In ponds in the swamps, and in sheltered coves around the lake, there are floating-leaved and free floating associations, notably a *Lemna paucicosta-Pistia stratiotes-Azolla nilotica* asso- ciation, and a *Nymphaea calliandra* association. In the latter, *Najas marina, Nymphaea lotus* and *Vallisneria aethiopica* are usually to be found, together with free floating plants of *Ceratophyllum demersum* and *Utricularia thoningii.* Species of *Nitzschia* and *Stepha- notis* are the chief planktonic diatoms, undergoing periodic fluctuations in density. Blooms of the blue-green alga, *Anabaena* sp., occur from time to time, and lead to the mass mortality of fish, especially *Lates niloticus.*

The fish fauna comprises 46 species, of which 22 are also found in the Nile. Some genera, e.g. *Bagrus, Heterobranchus* and *Lates,* have long histories in the lake, having been recognised from mid-Pleistocene sediments, while *Clarotes,* which was present in the Pleistocene, is no longer there. *Alestes baremose, Citharinus citharus, Lates niloticus* and *Oreochromis niloticus* form the basis of the present fishery. Two distinct populations of *Lates niloticus* are present, one which breeds in the lake, and another which migrates into rivers to spawn. In Lake Albert this species is an inshore form, and is largely piscivorous, whereas another species, *Lates microphthalmus,* is pelagic and feeds mainly on *Caradina* (a freshwater prawn). Among the other piscivores, both *Hydrocynus vittatus* and the smaller *H. forskalii* occur in the lake, but the latter, here, tends to be pelagic and also feeds very largely upon *Caradina.* Of 36 non-cichlid species, 3 are endemic, while of 10 cichlids, 4 are endemic. These are all species of *Haplochromis.* The cichlid fauna is poor compared with that of most other East African lakes, including some other Ánilotic' lakes, such as Lake Edward. Accounts of the fish fauna are given by Worthington (1929) and Holden (1967; 1970). The invertebrate fauna is discussed by Green (1967a,b, 1971) and Verbeke (1957).

*Crocodylus niloticus* survives on the affluent streams, and is quite dense on the Albert Nile below the lake in the Kabalega National Park. Birds of interest found along the lakeshore are *Buteo buteo,*

*Chlidonias leucoptera, Ciconia ciconia, Crex crex, Cuculus canorus, Gallinago media, Gelochelidon nilotica, Lanius collurio, L. minor, Lynznocryptes minimus, Merops apiaster, Muscicapa striata, Pernis aprivorus, Phylloscopus trochilus, Porzana porzana, Riparia riparia, Tringa glareola* and *T. ochropus.* Many of the mammals cited in the regional introduction are present around the lake and in its swamps, including *Atilax paludinosus, Hippopotamus amphibius, Kobus ellipsiprymnus, K. kob, Loxodonta africana, Lutra maculicollis, Phacochoerus aethiopicus* and *Syncerus caffer.*

**Human Impact & Utilisation:** There are important fisheries on the lake, which by 1970 were producing some 28 000 tonnes fish/yr, the Ugandan catch amounting to 17 530 tonnes in 1970.

**Conservation Status:** The northern extremity of the lake on the Ugandan side is protected in the Kabalega (Murchison Falls) National Park. The park is bisected by the Victoria Nile and the river delta and the Kabalega Falls (where the Albert Nile leaves the lake) are included. About 25 km of the lakeshore is included in the Bugundu Game Reserve, a buffer zone on the south side of the national park. A similar stretch is included in the Toro Game Reserve at the southern extremity of the lake, where there are grassy lakeshore flats, lacustrine swamps, and heavily wooded affluent streams.

**Wetland Name:** The Bunyoni Lake/Swamp Complex
**Country:** Uganda
**Coordinates:** 1°05'-1°28'S/29°39'-30°02'E
**Area:** 18 000 ha (total wetland)
**Altitude:** 1798-1990 m asl
**Nearest Towns:** Mbarara (112 km NE); Kampala (340 km NE)
**General:** Lake Bunyoni (1°13'-1°24'S/29°49'-29°58'E) was formed when a steep-sided dendritic valley system was blocked by volcanic activity about 18 000 BP. It covers about 6100 ha, 1974 m asl, and is fed at its southern end by the Kabirita River from Rwanda, and by numerous affluents from the surrounding hills which rise to heights of 2200-2478 m asl. The lake is 25 km long, 7 km wide at maximum, and oriented roughly SE-NW. It has a maximum depth of 44 m and contains 23 small islands. Swamps extend back up the Kabirita for 8 km, and are present at the heads of 25 of the little arms of the lake. In total these cover about 1500 ha. Upwarping in the area has led to the curious situation where streams in steep-sided mountain valleys flow very sluggishly, sometimes with the creation of watersheds midway along rivers. Thus Lake Bunyoni drains sluggishly from its northern end to the Ruhuhuma (Ruvuma) Swamp (1°07 '-1°12 'S/ 29°48'-29°52'E) which lies on a watershed from where streams flow both east and west. The Ruhuhuma Swamp is 10 km long from E-W and covers a little more than 4000 ha at an altitude of 1940 m asl. The eastern part of the swamp drains by a short stream to the swampy upper course of the Ishasha River, which rises in Rwanda and flows north and northwest to Lake Edward and the Nile. A strip of permanent swamp, 40 km long and about 1 km wide, accompanies the Ishasha from the Rwanda border northwards to a point just beyond the confluence with the effluent from the Ruhuhuma Swamp, so that a permanent wetland of 4000 ha is situated here. The western part of the swamp drains to Lake Mutanda (1°10'-1°16'S/29°39'-29°42'E), 1798 m asl. This lake is 9 km long and 2.5 km wide and contains one large island. It has an open water surface of 1600 ha and is fed by short streams which enter the northern end. It discharges from the southwestern corner via the Kako River and the Tshengere Swamp (1°14'S/29°32'E) in Zaire, to the Rutshuru River and thence to Lake Edward and the Nile.

Lake Muanga or Muhele (1°13'S/29°44'E) is situated about 1800 m asl, just to the east of Lake Mutanda. It has a maximum depth of 7.5 m, a length of 3 km and a width of 1 km. It is ringed by high hills, but drains to Lake Mutanda through a papyrus swamp at its southwestern corner.

**Hydrology & Water Quality:** The water level of Lake Bunyoni fluctuates about 75 cm during the course of a year, but the mean level rose some 2 m after the 1962-63 season, c.f. Lake Victoria. Lake Bunyoni is stratified and apparently remains so for many years at a time without mixing. The bottom

temperature remains close to 19°C, but the surface temperature rises to 25°C. Oxygen concentrations reach 8 mg/1, but the bottom water is anoxic, while pH values range from 7.4 at the bottom to 8.6 at the surface. The water is clear with Secchi depths of up to 2.9 m. Denny (1972) gives an account of the chemistry of this lake.

**Flora & Fauna**: There are floating swamps of *Cyperus papyrus* and *Cladium mariscus* in the shallow sheltered bays of Lake Bunyoni, with *Phragmites australis* present in a narrow strip on steep exposed shores. *Potamogeton* and *Nymphaea* spp. dominate the floating leaved vegetation in front of the papyrus swamps, and *Ceratophyllum demersum* is the commonest submerged species, often with *Hydrilla verticillata.* Floating islands of papyrus have as associates *Hydrocotyle ranunculoides, Polygonum salicifolium, Pycnostachys coerulea, Thelypteris squalnigera* and *Utricularia* sp. *Typha domingensis* is present along affluent streams. Denny (1973) gives an account of the vegetation of this lake. *Oreochromis niloticus* was introduced and still persists in the lake. The most common fish however, is a species of *Haplochromis* and local fishermen take a species of *Clarias.*

**Human Impact & Utilisation:** The lake was stocked with fish earlier this century, but recently there have been mass fish mortalities. These have been attributed to violent mixing. There is an artisanal fishery.

**Conservation Status:** Protected.

**Wetland Name:** The Kijanebalola Lake/Swamp Complex
**Country:** Uganda
**Coordinates:** 1°10 ' -1°34 'N/30°50 '-31°25 'E 5
**Area:** 25 950 ha
**Altitude:** 1226-1250 m asl
**Nearest Towns:** Mbarara (33 km WNW); Kampala (180 km ENE)
**General:** This complex has, as its principal affluent, the Ruizi River which rises from a headwater swamp (0°46'S/30°11'E) and flows eastwards to a central swamp (0°32'-0°45'S/ 30°51'-31°16'E) oriented E-W, which has a number of peripheral lakes. These latter are situated at the lower ends of valleys which run down to the swamp from both north and south. The largest are from west to east, Lakes Nakivali (0°45'-0°50'S/30°53'E), Mburo (0°39 ' S/30°55 'E), Kachira (0°30 ' -0°40 ' S/31°06 'E) and Kijanebalola (0°43 ' S/31°19 'E). Other small lakes, also from W-E, are Lakes Kiretwa, Kasasa, Mutukura, Kazuma, Mishera, Ruma, Karitima, Bwara and Karunga. The swamp drains from Lake Kijanebalola at the eastern end of the system to Lake Victoria via the Kibale River which reaches the lake in an extensive swamp at Sango Bay, north of the mouth of the Kagera River.

The central swamp occupies a tract of land 44 km long and up to 15 km wide, covering 15 000 ha. Lake Nakivali is 14 km long and 3 km wide, and has an area of 3080 ha at high water, when the maximum depth is 3.5 m. Lake Mbura, to the north, is 6.2 km long and 3 km wide at maximum, and has a mean area of 1190 ha at high water. Lake Kachira is the largest lake, 22.8 km long and up to 3.4 km wide, with a maximum depth of 4.1 m. It has an area of 3960 ha. However, Lake Kajanebalola is the best known lake of the complex. It is 17 km long and up to 4.3 km wide, and has a maximum depth of 4.8 m. It contains two large islands at its western end.

**Hydrology & Water Quality:** The chief inputs are from the Ruizi River and from direct precipitation. There is little information as to water quality, but lake water temperatures generally range from 23-26°C, with pH values of 7.5-8.5. The pH of Lake Kachira is close to 8.4 and that of Kijanebalola is usually 8.3. The waters of the lakes are turbid with Secchi depths of 40-50 cm. The depth and size of the lakes varies considerably from year to year. Lake Kijanebalola overflows into the Kibale River about once every decade, otherwise the system is endorheic.

**Flora & Fauna:** The central swamp is a papyrus swamp, but with some *Ficus verruculosa* and other woody species, and prairies of aquatic grasses. There are extensive grasslands subject to seasonal inundation on the periphery of the swamp and around parts of the lakes which support much free-floating and floating-leaved vegetation. Among fishes *Clarias mossambicus, C. werneri, Haplochromis* spp., and *Protopterus aethiopicus* are indigenous, while *Oreochromis* spp. have been introduced. There are crocodiles and many piscivorous birds, and almost all the small semi-aquatic mammals cited in the regional introduction. Among the larger mammals using the wetlands are *Damaliscus lunatus, Hippopotamus amphibius, Panthera pardus, Phacochoerus aethiopicus, Redunca redunca, Syncerus caffer* and *Tragelaphus spekei.*

**Human Impact & Utilisation:** The lakes were first stocked with commercial species of fish in 1935, but catches, which include *Clarias mossatnbicus, Haplochromis* spp., *Protopterus aethiopicus, Oreochromis esculentus, 0. niloticus* and *0. variabilis* have declined since 1971. About 1000 canoes are employed on the four major lakes, almost 500 on Lake Kijanebalola. The area is heavily grazed by domestic cattle.

**Conservation Status:** An area including Lake Mburo, some small lakes, and much of the western shore of Lake Kachira are protected in the Mburo National Park, gazetted in 1983.

**Wetland Name:** Lakes Bisina & Opeta
**Country:** Uganda
**Coordinates:** 1°28'-2°01'N/33°49'-34°26'E
**Area:** 120 000 ha (25 000 ha open water)
**Altitude:** c. 1040-1060 m asl
**Nearest Towns:** Jinja (150 km SSW); Kampala (205 km SW)
**General:** These lakes are situated on drainage lines leading from the Karasuk Hills in Kenya, and from Mts. Elgon and Kadam, to the Okere Valley and Lake Kyoga. The Ukutat, Muchilmakat and Kelim Rivers all enter Lake Opeta (1°39 'N/34°09 '-34°14 'E) through a zone of permanent swamps east of the lake, above which each river has a seasonal floodplain. Lake Opeta is 10 km long, 5 km wide and has an open water area of 4000 ha. The entire lake is fringed by wide swamps, except along parts of the southern shore. The Kamirya and Siroko Rivers from Mt. Elgon also enter Lake Opeta, but do so through the swamps on the southern shore, and neither stream has an important floodplain. Water then passes west for 5 km from Lake Opeta, through a dense swamp, to Lake Bisina (1°35'-1°44'N/33°49'-34°06'E). This lake (formerly Lake Salisbury) has few affluents, the largest being the seasonal Apedura River which rises to the north on the slopes of Mt. Akim. Lake Bisina is oriented E-W and is 30 km long and up to 9 km wide, with a maximum surface area of 21 000 ha at high water. It drains from its western end through swamps, to the Okere system which leads in diffuse fashion to the swamps at the head of the Mpologoma Arm of Lake Kyoga.

The permanent swamps around Lake Opeta cover about 30 000 ha. The floodplain on the Ukutat is 40 km long and up to 7 km wide with an area of 20 000 ha at high water, that on the Muchilmakat is 25 km long and about 5 km wide with an area of 11 000 ha, while that on the Kelim is 25 km long and up to 10 km wide with a high water area of 17 500 ha. The Apedura River has a floodplain 30 km long and up to 6.5 km wide, which at high water covers 16 500 ha.

**Flora & Fauna:** Permanent swamps are dominated by papyrus, but there are areas of *Typha* and *Phragmites,* and strips of swamp forest. The fish fauna of the lakes is essentially nilotic, but with some species characteristic of the Lake Victoria Basin. *Clarias* spp., *Haplochromis* spp., *Labeo victorianus, Mornzyrus macrocephalus, Ore- ochromis esculentus, 0. variabilis, Protopterus aethiopicus* and *Schilbe mystus* are important species. However, *Barbus* and *Bagrus* spp. are absent and probably have not been able to cross the swamp barrier from Lake Kyoga. There is an abundance of piscivorous birds and almost all the semi-aquatic mammals cited in the regional introduction are present.

**Human Impact & Utilisation:** There was a thriving crocodile skin industry on Lake Bisina up until the late 1950s, with the result that these animals are now very scarce. A gill net fishery was started on Lake Bisina in 1950 for *Oreochromis* spp., but the state of this is not clear. Both lakes are still fished by artisans however, using long lines and baskets, and the floodplains are grazed and cultivated locally.

**Conservation Status:** The Pian-Upe National Reserve includes the western ends of the floodplains on the Muchilmakat and Kelim Rivers, immediately above Lake Opeta.

**Wetland Name:** Lake Wamala
**Country:** Uganda
**Coordinates:** 0°12 '- 0 °25 'N/31°41 '-32°02 'E
**Area:** 51 000 ha (25 000 ha open water)
**Altitude:** c. 1290 m asl
**Nearest Towns:** Kampala (58 km E); Masindi (138 km N)
**General:** Lake Wamala is surrounded by swampland, the whole system occupying some 51 000 ha. The lake has a mean length of 27 km and a mean maximum width of 10 km. It has a variable area of 16-25 000 ha. The peripheral swamp is 44 km long, oriented WSW- ENE, and has a maximum width of 16 km. The system receives numerous minor affluent watercourses and drains via the Kibimba River to the Katonga River. However, the Kibimba is almost permanently dry and only occasionally does it carry overspill from Lake Wamala, and when it does, this may not be sufficient to reach the Katonga. The Wamala Basin (2654 km$^{'}$) is therefore usually quite separate from the Katonga Basin. Direct precipitation over the lake is estimated as 1200 mm/yr, and this, plus the contribution of the affluents, is lost by evapo-transpiration. The inflow of the largest affluent, the Mpamujugu, is 97 million m3/yr.

**Flora & Fauna:** The swamps throughout the system are dominated by *Cyperus papyrus,* but there is much swamp forest and riverine forest along the Katonga. The fish fauna has many species common to the shallow waters and inlets of Lake Victoria. Bird life is prolific, and the river and its swamps are important to a range of mammals, including *Hippopotamus amphibius, Kobus ellipsiprymnus, Loxodonta africana, Redunca redunca* and *Syncerus caffer.*

**Human Impact & Utilisation:** Lake Wamala supports an important fishery. 250 canoes were licensed in 1975, at which time no outboard motors were permitted. *Oreochromis niloticus,* which was introduced in the 1950s, provides the bulk of the catch, but other important species are *Clarias mossambicus, Protopterus aethiopicus, Oreochromis leucostictus* and *Tilapia zillii.*

**Conservation Status:** A section of the north bank of the river is protected in the Katonga Game Reserve.

**Minor Lakes**
**General**: Several small lakes are situated high in the hills near Bunyoni Lake, but are not in connection with that system. The largest are Lakes Mugisha (1°20'S/29°47'E), 1894 m asl, and Tshahafi (1°21'S/29°46'E), 1894 m asl. These lakes are swamp-fringed. A dozen small crater lakes are situated immediately south of Lake George in an area 0°06'-0 °19'S/30°01'- 30°11'E. They are, from N-S, Lakes Moseche, Bagusa, Mshenyi, Chibera, Kyamwiga (0°11'S/30°08'S), Bugwagi, Katinda, Mirambi, Niamsigeri (0°17'S/30°01'E), the largest, Mugogo, Kyasanduka and Murunuli. Four other crater lakes, Kikorongo, Kitagata, Murunuli and Nyamunuka, are situated west of Lake George, just north of the Kazinga Channel and between Lakes George and Edward. There are said to be no less than 87 crater lakes in the Rift Valley south of the Ruwenzori Mountains, many of which are saline and shallow.

**B. Riverine Swamps & Floodplains**

**The Kafu System**
**General:** The Kafu River flows east from a swampy watershed to the Nile, and west from the same watershed as the Nkusi to Lake Albert. Along the eastward flowing section it receives two tributaries on its right (southeastern) bank, both of which flow through extensive permanent swamp systems. These are the Mayanja, which traverses a 30 km papyrus swamp (1°45 '-1°57'N/31°59'-32°15'E) with an area of 13 500 ha, and the Lugogo which flows through a continuous strip swamp (1°00 ' -1°29 'N/31°57 ' -32°24 'E) for 82 km above its confluence with the Kafu. This latter swamp has an area of 24 600 ha.

**The Nile**
General: Along the Nile in Uganda, the Okole River, a right bank tributary of the Victoria Nile, traverses a continuous swamp belt (2°03'-2°19'N/32°19'-32°45'E) of 16 000 ha for 52 km above its confluence. Farther downstream the delta swamps in Lake Albert occupy some 6500 ha, and below Murchison Falls the Albert Nile traverses a swamp 115 km long and some 5-10 km wide (2°30'-3°35'N/31°16'-31°58'E), with an area of about 52 000 ha.

## 3.9 DEMOCRATIC REPUBLIC OF THE CONGO (ZAIRE)

**Wetlands**
With the vast majority of wetlands being located within the Zaire River Basin, also a number of large lakes lie along the eastern border of Zaire in the trough of the Great Rift Valley, which are, from south to north, Lakes Tanganyika, Kivu, Edward and Albert. Hard against the eastern border between Lakes Kivu and Tanganyika, the valley of the Ruzizi River contains extensive wetlands, as does the plain to the south of Lake Edward, and the valley of the Semliki River draining Lake Edward to Lake Albert. Wet swampy plateauxs occur at intervals all along the high watershed immediately to the west of the lakes of the Rift Valley system. In the extreme southeast, part of Lake Mweru is situated in Zaire, and there is an extensive floodplain along the Luapula River to the south of this lake, where that river forms the border with Zambia. There are also wetlands associated with the mountains of the Shaba Plateaux to the west. Here are the two principal reservoirs of Zaire, Lake Tshangalele, on the Lufira River, over 1000 m asl, and Lake Delcommune, where the Lualaba River is dammed. Some 20 substantial lakes occur farther downstream on the Lualaba where it traverses the Kamolondo Depression. Extensive swamps and floodplain systems occur around Lake Tshangalele and the Upemba Lakes.

The following sections describe wetlands that are located within the Nile Basin

**Flora & Fauna**
Zaire is greater in area than the other five countries of the region combined, and judged by mean annual precipitation intensity, which is close to 1700 mm, it is among the wettest of countries in Africa. It contains more wetland than any other African country and presents a wider range of edaphic, climatic and topographical conditions than the other countries of the region, except perhaps Cameroon. In consequence there is a greater floristic and faunistic variation within each wetland type than is observed in the other countries, apart from that which arises simply from differing inundation regimes. In consequence, the floras and faunas of the wetlands and lakes are described separately for each of the areas or systems discussed below.

**List of Wetlands Described**

A. Lake Edward
B. The Semliki River Valley

C. Lake Albert

**A. Lake Edward**

**Wetland Name:** Lake Edward
**Country:** Zaire
**Coordinates:** 0°05'- 0°56'S/29° 16'-29°56'E
**Area:** c. 234 200 ha (170 450 ha in Zaire)
**Altitude:** 912 m asl
**Nearest Towns:** Lubero (28 km W); Bukavu (225 km SSW)
**General:** Lake Edward is 76 km long with a maximum width of 39 km. It is connected to Lake George, effectively a bay of Lake Edward, by the Kazinga Channel, 40 km long and less than 1 km wide. Lake Edward reaches a maximum depth of 112 m, just 5 km from the western shore, above which the land rises precipitously to a high plateaux over 2000 m asl carrying mountain peaks over 3000 m. By contrast the lake floor slopes up gradually to the Uganda shore.

**Hydrology & Water Quality:** Lake Edward has numerous affluent streams, the most important being the Nyamugasani River from the Ruwenzori Mountains and the Ishasha, Rutshuru and Rwindi Rivers from the Virunga Volcanoes and the Rwanda Highlands. Further inflow comes from Lake George, which also drains the Ruwenzori Range and to the east shares a watershed with Lake Victoria. However, flow through the Kazinga Channel is very sluggish, along a remarkably gentle gradient of 1:80 000 over the first 24 km. The junction of the waters between Lakes Edward and George, indicated by a change in colour, but also in chemistry, can usually be seen in the Kazinga Channel. The position of this boundary oscillates up and down the channel over a distance of about 3 km seasonally. Lake George is fresh, and its water chemistry is known to have remained fairly constant over the last 40 years, suggesting that the residence time of water in the lake is short, and that evaporation does not lead to the concentration of solutes. However, no subterranean outlets are known, yet the flow into Lake Edward appears minimal. Precipitation over Lake Edward is only 500-650 mm/yr, the lowest in Zaire, but is much higher in the adjacent mountains, e.g. approaching 3000 mm/yr on the western slopes of the Ruwenzori Massif, the highest in Zaire. Lake Edward discharges into the Semliki River, and thence to Lake Albert and the Nile. Water spills over a rock shelf at the northern extremity of the lake, which functions as a natural weir. Water leaving the lake has a temperature of 25-26°C and a pH close to 9.1. The lake is more saline than Lake Albert and less saline than Lake Kivu.

**Wetland Flora:** *Potamogeton pectinatus* is the dominant submerged macrophyte, in association with *Najas marina* and *Vallisneria aethiopica.* Some *Potamogeton schweinfizrthii* and *Najas pectinata* occur along the eastern shores. *Vallisneria* and *Najas* are best developed in the vicinity of river mouths where waters are better aerated. *Cyperus papyrus* and *Phragmites mauritianus* form swamps at the mouths of effluent streams, which are especially well developed along the southern shore. Riverine swamps extend back from the lake up all three principal rivers entering the southern end of the lake for distances of several kilometres.

**Wetland Fauna:** The present fish fauna comprises about 23 cichlids and 30 non-cichlid species. However, the fauna is impoverished, with certain widespread families being entirely absent, e.g. Centropomidae, Characidae, Malapturidae, Mastacembalidae, Mochokidae and Schilbeidae. Further, *Citharinus, Distichodus, Hydrocynus, Polypterus* and *Lates,* which are found in Lake Albert and the Nile, are also absent, although both *Hydrocynus* and *Lates* are known to have been present in the middle Pleistocene. From palaeontological studies a picture emerges of Lake Edward being in a phase of recolonisation, its fauna having been partially eliminated at least twice during the late Pleistocene. Although the lake once contained crocodiles, as well as the Nile fish cited, they are also now absent. The rapids prevented their re-introduction from the lower Semliki where they persisted until the middle of this century before they were finally eliminated by hunters. However, it appears that fish have entered from the east, where there is now a watershed with Lake Victoria, and have

begun speciating. In the cichlid fauna there are several species with close relatives in Lake Victoria, e.g. *Haplochromis guiarti, H. ishmaeli* and *H. macrops* and two common species, *Astatoreochromis alluaudi* and *Haplochromis nubilis.* Two species present in the Nile have either re-entered or survived, *Bagrus docmac* and *Oreochromis niloticus. Oreochronzis leucostictus* is confined to Lakes Edward and Albert, perhaps having originated in Lake Edward, and passed downstream. Considering the history of the lake the invertebrate fauna is surprisingly rich.

The avifauna of the lake and associated river valleys and swamps is very diverse and includes herons, ibises, egrets, bitterns, ducks, geese, darters, cormorants, skimmers, shoebills, openbills, ospreys, gulls, francolins, warblers and weavers. Large numbers of pelicans frequent the lower Rutshuru River. Species of interest include *Acrocephalus schoenobaenus, A. scirpaceus, Anas querquedula, Ardeola ralloides, Calidris ferruginea, C. minuta, Charadrius hiaticula, Chlidonias leucoptera, Gelochelidon nilotica, Hirundo rustica, Philornachus pugnax, Riparia riparia, Tringa glareola, T. nebularia* and T *stagnatilis.*

**Human Impact & Utilisation:** Relatively little since the proclamation of the national park in 1969, but illegal fishing and poaching on the lower Rutshuru are chronic problems. Growing tourism could prove a threat, and the proposal to dam the Rutshuru River would almost certainly have a major, and adverse, impact upon the riverine wetland ecosystem.

**Conservation Status:** The entire Zairean section of the lake is protected in the Virungas National Park, as is the lower course of the Rutshuru and several other tributary rivers.

**B. The Semliki River Valley**

**Wetland Name:** Semliki River
**Country:** Zaire
**Coordinates:** 1°20'N- 0°11 ' S/29°30 ' -30°30 'E
**Area:** c. 375 000 ha
**Altitude:** 619-912 m asl
**Nearest Towns:** Bunia (25 km N); Bukavu (300 km SSW)
**General:** The Semliki loses 293 m of altitude over its 150 km course from Lake Edward to Lake Albert. The upper course is swift, rocky and boulder strewn, 30-40 m wide, and enclosed by the dense Ituri Forest. Most of the descent is made over two rapids sections in this part of the river. In places the river is confined to a narrow channel, 10 m wide, between sheer rock walls. On emerging onto the savanna covered, lower Semliki Plain, the river flows slowly, eventually meandering to its delta in Lake Albert. A chain of oxbow lakes to the west of the present lower course, and deltaic deposits in Lake Albert, indicates that the river bed has been moving eastwards over the lower plain. Swamps occupy an area 15 km wide and 3.5 km deep along the southern shore of Lake Albert astride the delta of the Semliki, which projects a further 3 km into the lake. Upstream, seasonally inundated land extends back from these swamps in a belt 3-7 km wide for many kilometres, and a large area, centred upon the oxbows of the abandoned river course, is poorly drained and comprises hydromorphic soils. Farther back upstream, smaller swamps occur along the Semliki at numerous isolated sites, mostly where tributaries enter the mainstream.

**Wetland Flora:** *Cyperus papyrus* and *Phragmites mauritianus* dominate the riverine and delta swamps, reaching heights of 5 m. Much of the unflooded lower valley floor is covered by *Themeda* savanna, and in this, saline hydrornorphic soils support vast swards of *Sporobolus spicatus.* Elsewhere, seasonally inundated soils are covered by species of *Hyparrhenia, Loudetia* and *Pennisetum,* with *Pennisetum purpureum* and *Imperata cylindrica* representing post-cultivation grasses. The former occurs on the wettest soils, the latter on drier fringes subject to fires. Gallery forests contain a spectrum of typical Zaire species, together with some of more East African affinity.

**Wetland Fauna:** The fish fauna is alluded to in later sections. Among the reptiles, crocodiles are believed to have become extinct in the region as a consequence of intensive hunting, but varanid lizards are common, as are snakes. These include *Dromphis lineatus, Limnophis bicolor, Naja* sp., *Natriciteres olivacea, Philothamnus irregularis* and *Psammophis olivacea* in the swamps, and various arborescent species, including *Dasypeltis scabra, Dispholidus typus, Dendroaspis angusticeps* and *Thelotornis kirtlandii.*

Birds are prolific and diverse, the spectrum changing abruptly at the transition from tropical closed forest to savanna, and finally to marshland at the delta. The range of piscivores from the latter sites includes pelicans, herons, ibises, egrets, gulls, fishing eagles, ospreys, skimmers, darters, cormorants and kingfishers, while the rare yellow papyrus warbler, *Chloropeta gracilirostris,* has been recorded from the lower Semliki, together with ducks, geese, moorhens, weavers and a variety of other warblers. Species of interest include *Buteo buteo, Chlidonias leucoptera, Ciconia ciconia, Crex crex, Cuculus canorus, Falco subbuteo, Gallinago media, Gelochelidon nilotica, Lanius collurio, L. minor, Lymnocryptes mininius, Merops apiaster, Pernis aprivorus, Phylloscopus trochilus, Porzana porzana, P. pusilla, Riparia riparia, Tringa glareola* and *T ochropus.*

Mammalian populations along the Semliki River are large and species found in these areas include *Aonyx capensis , Atilax paludinosus , Ce phalo phus* sp., *Damaliscus lunatus, Dasymys* sp., *Herpestes ichneumon, Hippopotamus amphibius, Kobus ellipsiprymnus, K kob, Loxodonta africana, Lutra maculicollis, Osbornictis piscivora, Phacochoerus aethiopicus* and *Syncerus caffer.*

**Human Impact & Utilisation:** Of recent years this has been slight, but poaching of elephants continues, and fishing and tourism are potential threats. The proposal to dam the Semliki River will, if implemented, have a major adverse impact upon the riverine ecosystems, possibly compounding damage done by impounding the Rutshuru above Lake Edward.

**Conservation Status: A** great deal of the Zairean part of the Semliki Valley, including the entire upper forested section, is protected in the Virungas National Park. This was established in 1925 as Albert National Park, and became the Virungas National Park in 1969. It was designated a World Heritage Site in 1979. The park is contiguous with national parks and wildlife sanctuaries in Uganda and Rwanda.

**C. Lake Albert**

**Wetland Name:** Lake Albert
**Country:** Zaire
**Coordinates:** 1°01'-2°07'N/30°23'-31°26'E
**Area:** 565 915 ha (247 345 ha in Zaire)
**Altitude:** 619 m asl
**Nearest Towns:** Kisangani (575 km WSW); Bukavu (450 km SSW)
**General:** Lake Albert lies between two parallel escarpments in the Western Rift Valley, at an altitude of 619 m, with an extreme length of 180 km and a maximum width of 43 km. Just under 44% of its surface is in Zaire. Its deepest point, 56 m, lies 7 km off the western shore, from where the land rises steeply to a high plateaux more than 2000 m asl. The lake floor slopes gently upwards towards the east, but the eastern escarpment rises abruptly just a few km from the east bank in Uganda. The lake is subject to violent windstorms which cause the upwelling of bottom waters, but even without these happenings, the lake is generally well mixed. During calm periods, which frequently occur between November and February, a degree of stratification develops and dissolved oxygen levels fall, but not deleteriously for the fauna.

**Hydrology & Water Quality:** The principal affluent streams are the Semliki, which enters at the southern end, and the Victoria Nile, which enters very close to the northern end. Both rivers have

built deltas into the lake. While the Nile carries more water than the Semliki, it has little influence on the ecology of the lake, other than to maintain water levels. The Nile water is fresh, with a salinity of 0.1700, while the main body of lake water, up to 10 km from the delta which the Victoria Nile has built into the lake, has a salinity of 6‰ and a pH close to 9.0. Lesser streams entering the lake from Zaire are, from south to north, the Kisege, Ndrigge, Muita, Nyamusiki, Kilowir and Mboge Rivers. However, all these, and other small rivers entering from the Ugandan side, are highly seasonal and of only secondary importance to the two major rivers. Some periodically inundated land occurs around the southern margin of the lake in the vicinity of the Semliki River Delta, and also along the eastern shore at some isolated spots, notably the Victoria Nile Delta. The results of detailed hydrobiological surveys were published by the Institut Royal des Sciences Naturelles de Belgique (Brussels) between 1957-1962. General information is provided by Bishop (1965; 1969) and Livingstone (1976).

**Wetland Flora:** *Potamogeton schweinfurthii* is the dominant submerged macrophyte over most of the lake, by contrast with Lakes Kivu and Edward where *P. pectinatus* is most common. However, this latter species is also present in Lake Albert. The principal associate species are *Najas marina* and *Vallisneria aethiopica,* and as in the other lakes, they are most abundant in the vicinities of river mouths, but this phenomenon is not so pronounced as it is in the two other lakes, possibly because Lake Albert is shallower and its waters are generally well oxygenated. In the river deltas, there are extensive stands of *Cyperus papyrus* and *Phragmites mauritianus,* the flowering cuims of which reach 4.5 m in height, with aquatic meadows of *Vossia cuspidata* on the lakeward side, and twining thickets of *Cyclosorus striatus* on the landward side. In ponds in the swamps, and in sheltered coves around the lake, there are floating-leaved and free-floating associations, notably a *Lemna paucicosta-Pistia stratiotes-Azolla nilotica* association, and a *Nymphaea calliandra* association. In the latter, *Najas marina, Nymphaea lotus* and *Vallisneria aethiopica* are usually to be found, together with free-floating plants of *Ceratophyllum dentersunt* and *Utricularia thoningii.* Species of *Nitzschia* and *Stephanotis* are the chief planktonic diatoms, undergoing periodic fluctuations in density. Blooms of the blue-green alga, *Anabaena* sp., occur locally from time to time, and lead to the mass mortality of fish, especially *Lates niloticus.*

**Wetland Fauna:** The fish fauna comprises 46 species, of which 22 are also found in the Nile. Some genera, e.g. *Bagrus, Heterobranchus* and *Lates,* have long histories in the lake, having been recognised from mid- Pleistocene sediments, while *Clarotes,* which was present in the Pleistocene, is no longer there. *Alestes baremose, Citharinus citharus, Lates niloticus* and *Oreochromis niloticus* form the basis of the present fishery. Two distinct populations of *Lates niloticus* are present, one which breeds in the lake, and another which migrates into rivers to spawn. In Lake Albert this species is an inshore form and is largely piscivorous, whereas another species, *Lates microphthalmus,* is pelagic and feeds mainly on *Caradina* (a freshwater prawn). Among the other piscivores both *Hydrocynus vittatus* and the smaller *H. forskalii* occur in the lake, but the latter, here, tends to be pelagic and also feeds very largely upon *Caradina.* Of 36 non-cichlid species, 3 are endemic, while of 10 cichlids, 4 are endemic. These are all species of *Haplochromis.* The cichlid fauna is poor compared with that of most other East African Lakes, including some other `nilotic' lakes, such as Lake Edward. Accounts of the fish fauna are given by Worthington (1929) and Holden (1967; 1970). The invertebrate fauna is discussed by Green (1967a,b; 1971) and Verbeke (1957a,b).

Birds of interest found along the lakeshore *are Buteo buteo, Chlidonias leucoptera, Ciconia ciconia, Crex crex, Cuculus canorus, Gallinago media, Gelochelidon nilotica, Lanius collurio, L. minor, Lymnocryptes minimus, Merops apiaster, Muscicapa striata, Pernis aprivorus, Phylloscopus trochilus, Porzana porzana, Riparia riparia, Tringa glareola* and *T. ochropus***.**

# *Appendix 3 Species Lists for the Lake Tana Wetland Complex*

Table A3-1 List of bird species recorded from Lake Tana Sub-basin, Nov. 21 to Dec. 2, 2007 (Wambura and NBI in press)

Categories used to indicate the status of species of birds in this list for threat category of species are: CR -critically endangered; EN -endangered, VU -vulnerable; habitat category are: F -forest; A -aquatic, S -savannah, U -ubiquitous; R -rocky; SG -short grassland, HH -human habitation; G -gorge, and FE -forest edge; for migrants are: AM -African migrant (Intra -African/Ethiopian migrant); AM/NM -both African and or Northern, Palearctic migrant); OM -Oriental migrant.

Nomenclature follows Mlingwa, 2000 (National Kiswahili Checklist of Birds of Tanzania) adopted from the Birds of Africa. Any further deviation is from Ver Perlo, 1995.

| **Family/species** | **Scientific name** | **Threat Category (CR, EN, VU, etc** | **Habitat category F, FE, A, U,S,R etc,** | **Migratory status** |
|---|---|---|---|---|
| **Podicipedidae** | | | | |
| Little Grebe | *Tachybaptus ruficollis* | | A | NM |
| **Pharacrocoracidae** | | | | |
| Long-tailed Cormorant | *Pharacrocorax africanus* | | A | AM |
| White-breasted Cormorant | *Pharacrocorax lucidus* | | A | AM |
| **Anhingidae** | | | | |
| African Darter | *Anhinga rufa* | | A | AM |
| **Pelecanidae** | | | | |
| Great White Pelican | *Pelecanus onocrotalus* | | A | NM |
| Pink-backed Pelican | *Pelecanus rufescens* | | A | |
| **Ardeidae** | | | | |
| Black-headed Heron | *Ardea melanocephala* | | A | AM |
| Purple Heron | *Ardea Purpurea* | | A | AM/NM |
| Squacco Heron | *Ardeola ralloides* | | A | AM/NM |
| Grey Heron | *Ardea cinerea* | | A, S | NM |
| Common Bittern* | *Botaurus stellaris* | | A | NM |
| Goliath Heron* | *Ardea goliath* | | A, S | |
| Green-backed Heron* | *Butorides striatus* | | A | |
| Western Reef (Egret) Heron* | *Egretta gularis* | | A | |
| Cattle Egret | *Bubulcus ibis* | | A, S | AM |
| Great White Egret | *Egretta alba* | | A | AM/NM |
| Little Egret | *Egretta garzetta* | | A | NM |
| Yellow-billed Egret | *Mesophoyx intermedia* | | A | NM |
| **Scopidae** | | | | |
| Hamerkop | *Scopus umbretta* | | U, F | |
| **Ciconiidae** | | | | |
| Woolly-necked Stork | *Ciconia episcopus* | | S | |
| Open-billed Stork | *Anastomus lamelligerus* | | S | AM |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Yellow-billed Stork | *Mycteria ibis* | | A | |
| **Balaenicipitidae*** | | | | |
| Shoebill* | *Balaeniceps rex* | | A | |
| **Threskiornithidae** | | | | |
| Hadada Ibis | *Bostrychia hagedash* | | A | |
| Glossy Ibis | *Plegadis falcinellus* | | A | NM |
| Sacred Ibis | *Threskiornis aethiopicus* | | A, S | AM |
| **Phoenicopteridae*** | | | | |
| Lesser Flamingo* | *Phoeniconaias minor* | | A | AM |
| **Anatidae** | | | | |
| Egyptian Goose | *Alopochen aegyptiacus* | | A | AM |
| Yellow-billed Duck | *Anas undulata* | | A | |
| White-faced Whistling (Tree) Duck | *Dendrocygna viduata* | | A | |
| Spur-winged Goose | *Plectropterus gambensis* | | A | |
| Knob-billed Duck | *Sarkidiornis melanotus* | | A | AM |
| Blue-winged Goose | *Cyanochen cyanopterus* | | A | |
| Garganey* | *Anas querquedula* | | A | NM |
| Northern Shoveler* | *Anas clypeata* | | A | NM |
| Common Teal* | *Anas crecca* | | A | |
| Northern Pintail* | *Anas acuta* | | A | NM |
| Southern Pochard* | *Netta erythrophthalma* | | A | |
| **Accipitridae** | | | | |
| African White – backed Vulture | *Gyps Africanus* | | HH, S | |
| Rueppell's Vulture | *Gyps rueppellii* | | S, HH | |
| Hooded Vulture | *Necrosyrtes monachus* | | HH | |
| Egyptian Vulture | *Neophron perconopterus* | | S, HH | NM |
| White-headed Vulture | *Trigonoceps occipitalis* | | S, HH | |
| Pallid Harrier | *Circus macrourus* | | S | NM |
| Montagu's Harrier | *Circus pygargus* | | S | NM |
| Twany Eagle | *Aquila rapax* | | S | NM |
| Imperial Eagle | *Aquila heliaca* | | S | |
| Great Spotted Eagle | *Aquila clanga* | | S | NM |
| Augur Buzzard | *Buteo augur* | | S | |
| Long-crested Eagle | *Lophaetus occipitalis* | | | |
| Pale Chanting Goshawk | *Metabates canorus* | | U | |
| African Fish Eagle | *Haliaeetus vocifer* | | A | |
| Black (Yellow-billed) Kite | *Milvus migrans* | | HH, S, U | |
| Little Sparrow-hawk* | *Accipiter minullus* | | | |
| Twany Eagle* | *Aquila rapax* | | S | |
| Black shouldered Kite* | *Elanus caeruleus* | | S | |
| Lappet-faced Vulture* | *Torgos tracheliotus* | | S | |
| Eurasian Marsh Harrier* | *Circus aeruginosus* | | | |
| Booted Eagle* | *Hieraaetus pennatus* | | | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| **Pandionidae*** | | | | |
| Osprey* | *Pandion haliaeetus* | | | |
| **Falconidae** | | | | |
| Sooty Falcon | *Falco concolor* | | S | |
| Lesser Kestrel | *Falco naumanni* | | | |
| Common Kestrel | *Falco tinnunculus* | | S | NM |
| Peregrine Falcon* | *Falco peregrinus* | | | NM |
| **Phasianidae*** | | | | |
| Common Quail* | *Coturnix cortunix* | | S | |
| **Numididae*** | | | | |
| Helmeted Guineafowl* | *Numida meleagris* | | S, F | |
| **Rallidae*** | | | | |
| Red-chested Fufftail* | *Sarothrura rufa* | | A | |
| **Gruidae** | | | | |
| Grey-crowned Crane | *Balearica regulorum* | | U | |
| Common crane | *Grus grus* | | A | |
| Black-crowned Crane | *Balearica pavonina* | | A | |
| Wattled Crane | *Bugeranus carunculatus* | | A | |
| **Heliornithidae*** | | | | |
| African Finfoot* | *Podica senegalensis* | | A | |
| **Jacanidae** | | | | |
| African Jacana | *Actophilornis africanus* | | A | |
| Lesser Jacana | *Microparra capensis* | | A | |
| **Rostratulidae*** | | | | |
| Common Snipe* | *Gallinago Gallinago* | | A | NM |
| Great Snipe* | *Gallinago media* | | A | NM |
| **Recurvirostridae** | | | | |
| Black-winged Stilt | *Himantopus ostralegus* | | A | NM |
| Avocet* | *Recurvirosta avosetta* | | A | |
| **Burhinidae** | | | | |
| Spotted Thicknee | *Burhinus capensis* | | A | NM |
| Stone Curlew* | *Burhinus oedicnemus* | | A | NM |
| **Charadriidae** | | | | |
| Kittlitz's Sandplover | *Charadrius pecuarius* | | A | AM |
| Spur-winged Plover | *Vanellus spinosus* | | A | AM |
| Wattled Plover | *Vanellus senegallus* | | A | |
| Little Ringed Plover | *Charadrius dubius* | | A | NM |
| Ringed Plover | *Charadrius hiaticula* | | A | NM |
| Three banded Plover* | *Charadrius tricollaris* | | A | |
| **Scolopacidae** | | | | |
| Common Sandpiper | *Actitis hypoleucos* | | A | NM |
| Wood Sandpiper | *Tringa glareola* | | A | NM |
| Green Shank | *Tringa nebularia* | | A | NM |
| Green Sandpiper | *Tringa ochropus* | | A | NM |
| Curlew Sandpiper | *Calidris ferruginea* | | A | NM |
| Pectoral Sandpiper | *Calidris melanotos* | | A | OM |
| Little Stint | *Calidris minuta* | | A | NM |
| Black-tailed Godwit* | *Limosa limosa* | | A | NM |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Spotted Red Shank* | *Tringa erythropus* | | A | NM |
| Marsh sandpiper* | *Tringa stagnatilis* | | A | NM |
| Temminck's Stint* | *Calidris temminckii* | | A | NM |
| Ruff* | *Philomachus pugnax* | | A | NM |
| Red Shank* | *Tringa tetanus* | | A | NM |
| **Laridae** | | | | |
| Great Black-headed Gull | *Larus ichthyaetus* | | A | NM |
| Lesser Black-backed Gull | *Larus fuscus* | | A | NM |
| Sooty Gull | Larus hemprichii | | A | |
| Herring Gull* | *Larus argentatus* | | A | NM |
| Grey-headed Gull* | *Larus cynocephalus* | | A | NM |
| Yellow-legged Herring Gull* | | | A | |
| **Sternidae** | | | | |
| Black-napped Tern | *Sterna sumatrana* | | A | NM |
| White-winged Black Tern | *Chlidonias leucopterus* | | A | NM |
| Gull-billed Tern | *Sterna nilotica* | | A | NM |
| Whiskered Tern | *Chlidonias hybridus* | | A | NM |
| Little Tern | *Sterna albifrons* | | A | AM/NM |
| Black Tern* | *Chlidonias niger* | | A | NM |
| **Columbidae** | | | | |
| Lemon Dove | *Aplopelia larvata* | | HH | |
| Speckled Pigeon | *Columba guinea* | | HH, S | |
| Namaqua Dove | *Oena capensis* | | S | AM |
| Ring-necked Dove | *Streptopelia capicola* | | S, F | |
| Mourning Dove | *Streptopelia decipiens* | | S | |
| Red-eyed Dove | *Streptopelia semitorquata* | | F | |
| Laughing Dove | *Streptopelia senegalensis* | | S | AM |
| Emerald-spotted Wood Dove | *Turtur chalcospilos* | | F | |
| Tambourine Dove | *Turtur tympanistria* | | F | |
| Vinaceous (Pink-breasted) Dove | *Streptopelia vinacea* | | HH | |
| Bruce's Green Pigeon | *Treron waalia* | | F | |
| **Psittacidae** | | | | |
| Black-winged Lovebird | *Agapornis taranta* | | F, U, HH | |
| Black-collared Lovebird* | *Agapornis swinderniana* | | | |
| **Musophagidae** | | | | |
| White-bellied Go-away Bird | *Corythaixoides leucogaster* | | F | |
| Easter Grey Plantain Eater | *Crinifer zonurus* | | F | |
| White-cheeked Turaco | *Tauraco leucotis* | | F | |
| **Cuculidae** | | | | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Levaillant's Cuckoo | *Clamator levaillantii* | | S | |
| Black and White Cuckoo | *Clamator jacobinus* | | S | NM |
| Striped Crested Cuckoo* | ? | | | AM |
| Great Spotted Cuckoo* | *Clamator glandrius* | | F, S | AM/NM |
| **Centropidae** | | | | |
| White-browed Coucal | *Centropus superciliosus* | | S | |
| **Strigidae** | | | | |
| Spotted Eagle Owl | *Bubo africanus* | | F | AM |
| Long-eared Owl* | *Asio otus* | | | |
| **Apodidae** | | | | |
| Little Swift | *Apus affinis* | | | AM |
| Nyanza Swift* | *Apus niansae* | | | |
| **Coliidae** | | | | |
| Speckled Mousebird | *Colius striatus* | | U, F | |
| **Alcedinidae** | | | | |
| Pied Kingfisher | *Ceryle rudis* | | A | AM |
| Malachite Kingfisher | *Alcedo cristata* | | A | |
| Brown-hooded Kingfisher | *Halcyon albiventris* | | S | |
| Striped Kingfisher | *Halcyon chelicuti* | | U | |
| Chestnut-bellied Kingfisher | *Halcyon leucocephala* | | U | AM |
| Pygmy Kingfisher | *Ceryx picta* | | A | |
| **Meropidae** | | | | |
| Northern Carmine Bee-eater | *Merops nubicus* | | S | AM |
| Cinnamon-chested Bee-eater | *Merops oreobates* | | S | |
| Little Bee-eater | *Merops pusillus* | | S | |
| Red-throated Bee-eater* | *Merops bullocki* | | S | |
| White-throated Bee-eater* | *Merops albicollis* | | S | |
| **Coracidae** | | | | |
| Eurasian Roller | *Coracias garrulous* | | S | NM |
| Abyssinian Roller | *Coracias abyssinica* | | S | AM |
| **Phoeniculidae** | | | | |
| Black-billed Wood Hoopoe | *Phoeniculus somaliensis* | | S | |
| **Upupidae** | | | | |
| Eurasian Hoopoe | *Upupa epops* | | S | NM |
| African Hoopoe | *Upupa Africana* | | S | AM |
| **Bucerotidae** | | | | |
| Silvery-cheeked Hornbill | *Bycanistes brevis* | | F | |
| Crowned Hornbill | *Tockus alboterminatus* | | F | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Grey Hornbill | *Tockus nasutus* | | S | |
| Hemprich's Hornbill | *Tockus hemprichii* | | U,F | |
| **Lybiidae (Capitonidae)** | | | | |
| Black-billed Barbet | *Lybius guifsobalito* | | F | |
| Brown-breasted Barbet | *Lybius melanopterus* | | U | |
| Banded Barbet | *Lybius undatus* | | U | |
| **Indicatoridae** | | | | |
| Greater Honeyguide | *Indicator indicator* | | F | |
| **Picidae** | | | | |
| Cardinal Woodpecker | *Campethera fuscescens* | | F | |
| Brown-backed Woodpecker* | *Picoides obsoletus* | | F | |
| Nubian Woodpecker* | *Campethera nubica* | | F | |
| **Alaudidae** | | | | |
| Fischer's Sparrow Lark | *Eremopterix leucopareia* | | SG | |
| **Hirundinidae** | | | | |
| Lesser striped Swallow | *Hirundo abyssinica* | | | |
| Ethiopian Swallow | *Hirundo aethiopica* | | | |
| Wire-tailed Swallow | *Hirundo smithii* | | | AM |
| African Sand Martin | *Riparia paludicola* | | | |
| Brown-throated Sand Martin | *Riparia paludicola* | | | |
| Eurasian Swallow | *Hirundo rustica* | | | NM |
| Black-roughwing Swallow | *Psalidoprocne holomelas* | | | |
| European Sand Martin* | *Riparia riparia* | | | NM |
| Red-rumped Swallow* | *Hirundo daurica* | | | NM |
| **Motacilidae** | | | | |
| African Pied Wagtail | *Macronyx aguimp* | | HH | |
| Grey Wagtail | *Motacilla cinerea* | | A | NM |
| Yellow Wagtail | *Motacilla flava* | | A | NM |
| Golden Pipit | *Tmetothylacus tenellus* | | A | |
| Richard's Pipit | *Anthus novaeseelandiae* | | SG | NM |
| Well's Wagtail* | *Motacila capensis* | | A | |
| White Wagtail* | *Motacilla alba* | | A | NM |
| Tree Pipit* | *Anthus trivialis* | | SG | NM |
| Red-throated Pipit* | *Anthus cervinus* | | SG | NM |
| **Campephagidae*** | | | | |
| Black Cuckoo Shrike* | *Campephaga flava* | | | AM |
| **Pycnonotidae** | | | | |
| White-vented (Common) Bulbul | *Pycnonotus dodsoni* | | U | AM |
| **Turdidae** | | | | |
| White-browed scrub | *Cercotrichas leucophrys* | | F | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Robin | | | | |
| Isabelline Wheatear | *Oenanthe isabellina* | | SG | NM |
| Northern Wheatear | *Oenanthe oenanthe* | | SG | NM |
| Redstart | *Pheonicurus phoenicurus* | | | NM |
| Whinchat | *Saxicola rubetra* | | | NM |
| Nightingale | *Luscinia megarhynchos* | | F | NM |
| Stonechat | *Saxicola torquata* | | | NM |
| Groundscraper Thrush | *Psophocichla litsipsirupa* | | F | |
| Northern Olive Thrush | *Turdus olivaceus* | | F | |
| White-winged Cliff chat | *Myrmecocichla semirufa* | | F,SG | |
| Rueppell's Robin Chat | *Cossypha semirufa* | | F | |
| African Thrush | *Turdus pelios* | | F | |
| Pied Wheater* | *Oenanthe pleschanka* | | SG | NM |
| Blue Throat* | *Luscinia svecica* | | F | NM |
| **Sylviidae** | | | | |
| Green-backed Camaroptera | *Camaroptera brevicaudata* | | F, | |
| Grey-backed Camaroptera | *Camaroptera brachyura* | | F | |
| Black-backed Cisticola | *Cisticola eximia* | | SG, S | |
| Tawny-flanked Prinia | *Prinia subflava* | | | AM |
| Black Cap | *Sylvia atricapilla* | | | NM |
| Green-backed Eremomela | *Eremomela canescens* | | | |
| Sedge Warbler* | *Acrocephalus schoenobaenus* | | S | NM |
| Reed Warbler * | *Acrocephalus* scirpaceus | | S | NM |
| Olivaceous Warbler* | *Hippolais pallida* | | S | NM |
| Willow Warbler* | *Phylloscopus trochilus* | | S | NM |
| Chiffchaff* | *Phylloscopus collybita* | | S | NM |
| **Muscicapidae** | | | | |
| Southern Black Flycatcher | *Melaenornis pammelaina* | | FE | |
| Dusky Flycatcher | *Muscicapa adusta* | | FE | |
| Northern Black Flycatcher | *Melaenornis edolioides* | | FE | |
| Abyssinian Slaty Flycatcher | *Melaenornis chocolatina* | | FE | |
| **Platysteiridae** | | | | |
| Forest Batis | *Batis mixta* | | F | |
| White-backed Black Tit* | *Parus leuconotus* | | F | |
| **Monarchidae** | | | | |
| Paradise Flycatcher | *Terpsiphone viridis* | | F | |
| White-tailed Crested | *Elminia albonotata* | | FE | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Flycatcher | | | | |
| **Timaliidae** | | | | |
| Abyssinian catbird | *Parophasma galinieri* | | F | |
| **Nectariniidae** | | | | |
| Collard Sunbird | *Anthreptes collaris* | | | |
| Malachite Sunbird | *Nectarinia famosa* | | | |
| Scarlet-chested Sunbird | *Nectarinia senegalensis* | | | |
| Bronze Sunbird | *Nectarinia kilimensis* | | | |
| Beautiful Sunbird | *Nectarinia pulchella* | | | AM |
| Varriable Sunbird | *Nectarinia venusta* | | | |
| Tacazze Sunbird* | *Nectarinia tacazze* | | | |
| Amani Sunbird* | *Anthreptes pallidigaster* | | F | |
| **Zosteropidae*** | | | | |
| Montane White-eye* | *Zosterops poliogaster* | | F | |
| **Oriolidae** | | | | |
| Black-headed Forest Oriole | *Oriolus monacha* | | F | |
| African Golden Oriole | *Oriolus auratus* | | F | AM |
| **Laniidae** | | | | |
| Magpie Shrike | *Corvinella melanoleuca* | | S | |
| Common Fiscal | *Lanius collaris* | | S | |
| Red-backed Shrike | *Lanius colluris* | | S | NM |
| Taita Fiscal | *Lanius dorsalis* | | S | |
| Grey-backed Shrike | *Lanius excubitorius* | | S | |
| Woodchat Shrike* | *Lanius senator* | | S | NM |
| Red-tailed shrike* | *Lanius mackinnoni* | | S | NM |
| **Malaconotidae** | | | | |
| Tropical Boubou | *Laniarius aethiopicus* | | F | |
| Black–crowned Tchagra | *Tchagra senegala* | | S | |
| **Dicruridae** | | | | |
| Fork-tailed Drongo | *Dicrurus adsimilis* | | S | |
| **Corvidae** | | | | |
| Pied Crow | *Corvus albus* | | HH | |
| Cape Rook | *Corvus capensis* | | S | |
| Fan-tailed Raven | *Corvus rhipidurus* | | HH, S | AM |
| **Sturnidae** | | | | |
| Blue-eared Starling | *Lumprotornis chalybaeus* | | HH, S | |
| Lesser Blue-eared Starling | *Lamprotornis chloropterus* | | HH, S | |
| Slender-billed Starling | *Onychognanthus tenuirostris* | | G, | |
| Shelley's Starling | *Lamprotornis shelleyi* | | F | AM |
| Wattled Starling | *Creatophora cinerea* | | HH, S | AM |
| Fischer's Starling | *Spreo fischeri* | | S | |
| Red-billed Ox-pecker | *Buphagus* | | S | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| | *erythrorhynchus* | | | |
| Violate-backed Starling* | *Cinnyricinclus leucogaster* | | F, S | AM |
| **Passeridae** | | | | |
| Grey-headed Sparrow | *Passer griseus* | | HH | AM |
| Parrot-billed Sparrow | *Passer gongonensis* | | HH | |
| Bush Petronia | *Petronia dentata* | | S | |
| Swainson's Sparrow* | *Passer swainsonii* | | HH | |
| Chestnut-crowned Sparrow weaver* | *Plocepasser superciliosus* | | S | |
| **Ploceidae** | | | | |
| Baglafecht Weaver | *Ploceus baglafecht* | | HH, S | |
| Village (Black-headed) Weaver | *Ploceus cucullatus* | | HH, S | |
| Spectacled Weaver | *Plceus ocularis* | | S | |
| Red-headed Quelea | *Quelea erythrops* | | S | AM |
| Red-Billed Quelea* | *Quelea quelea* | | S | AM |
| Yellow Bishop | *Euplectes capensis* | | S | |
| Fan-tailed Widowbird | *Euplectes axillaris* | | S | |
| White-winged Widowbird | *Euplectes albnonotatus* | | S | |
| **Viduidae** | | | | |
| Village Indigobird | *Vidua chalybeata* | | S,HH | |
| Pin-tailed Whydah | *Vidua macroura* | | S | |
| **Estrildidae** | | | | |
| Common Waxbill | *Estrilda astrild* | | | |
| African Firefinch | *Lagonosticta rubricata* | | HH | |
| Red-billed Firefinch | *Lagonosticta senegala* | | HH | |
| Bar-breasted Firefinch | *Lagonosticta nitidula* | | HH | |
| Jameson's Firefinch | *Lagonosticta rhodopareia* | | HH | |
| Red-cheeked Cordonbleu | *Uraeginthus bengalus* | | HH, S | |
| Blue-capped Cordonbleu | *Uraeginthus cyanocephalus* | | S | |
| Purple Grenadier | *Uraeginthus ianthinogaster* | | S | |
| Cut-throat | *Amadina fasciata* | | S | |
| Black and White Mannikin | *Lonchura bicolar* | | HH, S | |
| Bronze Mannikin | *Lonchura cucullata* | | HH, S | |
| Grey-headed Silverbill | Lonchura griseicapilla | | R, S | |
| **Emberizidae** | | | | |
| Cinnamon-breasted Rock Bunting | *Emberiza tahapisi* | | R,S | |
| Ortolan Bunting* | *Emberiza hortulana* | | R, S | NM |
| **Fringeridae** | | | | |
| East Africa Citril | Serinus hypostictus | | S | |

Table A3-1 (Cont'd)

| Family/species | Scientific name | Threat Category (CR, EN, VU, etc | Habitat category F, FE, A, U,S,R etc, | Migratory status |
|---|---|---|---|---|
| Brimstone Canary | *Serinus sulphuratus* | | S | |
| Brown-rumped Serin (Streaky Seed-eater) | *Serinus tristriatus* | | S | |
| Yellow-fronted Canary (Serin) | *Serinus mozambicus* | | S | |
| Grosbeak Canary (Serin) | *Serinus donaldsoni* | | S | |
| White-rumped Canary (Serin) | *Serinus leucopygius* | | S | |
| Reichenow's Canary (Serin) | *Serinus reichenowi* | | S | |

**Keys: *** Family birds and species not recorded in this Survey but previously recorded and documented in Lake Tana Sub-basin

Birds – Globally Threatened and Biome Restricted

Table A3-2 Globally threatened (A1) and Biome-restricted (A3) birds recorded from Bahir Dar – Lake Tana IBA (ET007) (source: BirdLife International 2009a)

| **Species** | **Season** | **Year** | **Criteria** |
|---|---|---|---|
| Lesser Flamingo (*Phoeniconaias minor*) | winter | 0 | A1 |
| Wattled Ibis (*Bostrychia carunculata*) | resident | 1996 | A3 |
| Pallid Harrier (*Circus macrourus*) | passage | 0 | A1 |
| Rouget's Rail (*Rougetius rougetii*) | resident | 1996 | A1, A3 |
| Wattled Crane (*Grus carunculatus*) | resident | 0 | A1 |
| White-collared Pigeon (*Columba albitorques*) | resident | 1996 | A3 |
| Black-winged Lovebird (*Agapornis taranta*) | resident | 1996 | A3 |
| White-cheeked Turaco (*Tauraco leucotis*) | resident | 1996 | A3 |
| Abyssinian Owl (*Asio abyssinicus*) | resident | 1996 | A3 |
| Nyanza Swift (*Apus niansae*) | resident | 1996 | A3 |
| Banded Barbet (*Lybius undatus*) | resident | 1996 | A3 |
| Dark-headed Oriole (*Oriolus monacha*) | resident | 1996 | A3 |
| White-backed Tit (*Parus leuconotus*) | resident | 1996 | A3 |
| Montane White-eye (*Zosterops poliogastrus*) | resident | 1996 | A3 |
| Slender-billed Starling (*Onychognathus tenuirostris*) | resident | 1996 | A3 |
| Rueppell's Robin-chat (*Cossypha semirufa*) | resident | 1996 | A3 |
| Rueppell's Chat (*Myrmecocichla melaena*) | resident | 1996 | A3 |
| Tacazze Sunbird (*Nectarinia tacazze*) | resident | 1996 | A3 |
| Swainson's Sparrow (*Passer swainsonii*) | resident | 1996 | A3 |
| Baglafecht Weaver (*Ploceus baglafecht*) | resident | 1996 | A3 |
| Abyssinian Citril (*Serinus citrinelloides*) | resident | 1996 | A3 |
| Yellow-rumped Seedeater (*Serinus xanthopygius*) | resident | 1996 | A3 |

PLANT

Table A3-3 Species, families and habits of plants encountered in Lake Tana Sub-basin

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 1 | *Acacia abyssinica* Hochst. ex Benth. | Fabaceae | Tree | NE | LC |
| 2 | *Acacia albida* Delile | Fabaceae | Tree | NE | LC |
| 3 | *Acacia brevispica* Harms | Fabaceae | Scrambler | NE | LC |
| 4 | *Acacia hockii* De Willd. | Fabaceae | Shrub | NE | LC |
| 5 | *Acacia seyal* Del. var. seyal Delile | Fabaceae | Tree | NE | LC |
| 6 | *Acanthus arboreus* Forssk. var. ruber Engl. | Acanthaceae | Shrub | NE | LC |
| 7 | *Acanthus polystachyus* Delile | Acanthaceae | Shrub | NE | LC |
| 8 | *Acanthus senni* Chiov. | Acanthaceae | Shrub | E | NT |
| 9 | *Achyranthes aspera* L. | Amaranthaceae | Herb | NE | LC |
| 10 | *Acokanthera schimperi* (A. DC.) Schweinf | Apocynaceae | Shrub | NE | LC |
| 11 | *Aeschynomene schimperi* Hochst. ex A. Rich. | Fabaceae | Herb | NE | LC |
| 12 | *Ageratum conyzoides* L. | Asteraceae | Herb | NE | LC |
| 13 | *Albizia gummifera* (J.F. Gmel.) C.A.Sm. | Fabaceae | Tree | NE | LC |
| 14 | *Albizia malacophylla* (A. Rich.) Walp. | Fabaceae | Tree | NE | LC |
| 15 | *Albizia schimperiana* Oliv. | Fabaceae | Tree | NE | LC |
| 16 | *Alisma plantago-aquatica* L. | Alismataceae | Herb | NE | LC |
| 17 | *Allophylus abyssinicus* (Hochst.) | Sapindaceae | Tree | NE | LC |
| 18 | *Aloe trigonantha* Christian | Asphodelaceae | Herb | NE | LC |
| 19 | *Amaranthus caudatus* L. | Amaranthaceae | Herb | NE | LC |
| 20 | *Amaranthus hybridus* L. | Amaranthaceae | Herb | NE | LC |
| 21 | *Amaranthus spinosus* L. | Amaranthaceae | Herb | NE | LC |
| 22 | *Amorphophallus abyssinicus* (A. Rich.) NE. Br. | Araceae | Herb | NE | LC |
| 23 | *Anagallis serpensis* Hochst. ex DC | Scrophulariaceae | Herb | NE | LC |
| 24 | *Andropogon* abyssinicus L. | Poaceae | Grass | NE | LC |
| 25 | *Apodytes dimidiata* Arn. | Icacinaceae | Tree | NE | LC |
| 26 | *Asparagus racemosus* Willd. | Asparagaceae | Herb | NE | LC |
| 27 | *Bersama abyssinica* Fresen. | Melinthaceae | Tree | NE | LC |
| 28 | *Bidens pillosa* L. | Asteraceae | Herb | NE | LC |
| 29 | *Bracharia brizantha* (A. Rich.) Stapf | Poaceae | Grass | NE | LC |
| 30 | *Bracharia eruciformis* (J. E. Smith) Griseb. | Poaceae | Grass | NE | LC |
| 31 | *Bracharia jubuta* (Fig. & De Not.) Stapf | Poaceae | Grass | NE | LC |
| 32 | *Bracharia scalaris* Pilg. | Poaceae | Grass | NE | LC |
| 33 | *Bridelia micrantha* (Hochst.) Baill. | Euphorbiaceae | Tree | NE | LC |
| 34 | *Buddleja polystachya* Fresen. | Loganiaceae | Tree | NE | LC |
| 35 | *Calotropis procera* (Ait.) Ait. f. | Asclepiadaceae | Shrub | NE | LC |
| 36 | *Calpurnea aurea* (Ait.) Benth. | Fabaceae | Shrub | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 37 | *Carex peregrine* Link | Cyperaceae | Herb | NE | LC |
| 38 | *Carissa spinarum* L. | Apocynaceae | Shrub | NE | LC |
| 39 | *Cassia petersiana* Bolle in Peters | Fabaceae | Shrub | NE | LC |
| 40 | *Cayratia gracilis* (Guill. & Perr) Suesseng | Vitaceae | Herb | NE | LC |
| 41 | *Celosia trigyna* L. | Amaranthaceae | Herb | NE | LC |
| 42 | *Celtis africana* Burm. f. | Ulmaceae | Tree | NE | LC |
| 43 | *Centella asiatica* (Linn.) Urb. | Apiaceae | Herb | NE | LC |
| 44 | *Centrostachys aquatica* (R.Br.) Wall. ex Moq. | Amaranthaceae | Herb | NE | LC |
| 45 | *Chionanthus mildbraedii* (Gilg.) | Oleaceae | Tree | NE | LC |
| 46 | *Chloris gayana* Kunth | Poaceae | Grass | NE | LC |
| 47 | *Citrus auranteus* L. | Rutaceae | Shrub | NE | LC |
| 48 | *Clausena anisata* (Willd.) Benth. | Rutaceae | Shrub | NE | LC |
| 49 | *Clematis simensis* Fres. | Ranunculaceae | Climber | NE | LC |
| 50 | *Clerodendrum myricoides (*Hochst.) | Lamiaceae | Shrub | NE | LC |
| 51 | *Clutia abyssinica* Jaub. & Spach. | Euphorbiaceae | Shrub | NE | LC |
| 52 | *Coccinia grandis* (L) Voigt | Cucurbitaceae | Herb | NE | LC |
| 53 | *Coffea arabica* L. | Rubiaceae | Tree | NE | LC |
| 54 | *Combretum collinum* Fresen. | Combretaceae | Tree | NE | LC |
| 55 | *Combretum molle* R. Br. ex G. Don | Combteraceae | Tree | NE | LC |
| 56 | *Commelina benghalensis* L. | Commelinaceae | Herb | NE | LC |
| 57 | *Commiphora africana* (A. Rich.) Engl. | Burseraceae | Shrub | NE | LC |
| 58 | *Cordia africana* Lam. | Boraginaceae | Tree | NE | LC |
| 59 | *Crinum abyssinicum* A. Rich. | Amaryllidaceae | Herb | NE | LC |
| 60 | *Crotalaria spinosa* Hochst. ex Benth. | Fabaceae | Herb | NE | LC |
| 61 | *Croton macrostachyus* Del. | Euphorbiaceae | Tree | NE | LC |
| 62 | *Cynodon dactylon* (L) Pers. | Poaceae | Grass | NE | LC |
| 63 | *Cyperus atronervatus* Bock. | Cyperaceae | Herb | E | LC |
| 64 | *Cyperus bulbosus* Vahl | Cyperaceae | Herb | NE | VU |
| 65 | *Cyperus dereilema* Steud. | Cyperaceae | Herb | NE | LC |
| 66 | *Cyperus digitatus* Roxb. | Cyperaceae | Herb | NE | LC |
| 67 | *Cyperus distans* L. f. | Cyperaceae | Herb | NE | LC |
| 68 | *Cyperus dives* Del. | Cyperaceae | Herb | NE | LC |
| 69 | *Cyperus flavescens* L. | Cyperaceae | Herb | NE | LC |
| 70 | *Cyperus latifolius* Poir. | Cyperaceae | Herb | NE | LC |
| 71 | *Cyperus munditii* (Nees) Kunth | Cyperaceae | Herb | NE | LC |
| 72 | *Cyperus nitidus* Lam. | Cyperaceae | Herb | NE | LC |
| 73 | *Cyperus papyrus* L. | Cyperaceae | Herb | NE | LC |
| 74 | *Cyperus rotundus* L. | Cyperaceae | Herb | NE | LC |
| 75 | *Cyperus sanguinolentus* Vahl | Cyperaceae | Herb | NE | LC |
| 76 | *Cyperus schimperianus* Steud. | Cyperaceae | Herb | NE | LC |
| 77 | *Datura stramonium* (Hoc1st. ex A. Rich.) Stapf | Solanaceae | Herb | NE | LC |
| 78 | *Dichrostachys cinerea* L. | Fabaceae | Shrub | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 79 | *Digitaria abyssinica* (A. Rich.) Stapf | Poaceae | Grass | NE | LC |
| 80 | *Digitaria velutina* (Forssk.) P. Beauv. | Poaceae | Grass | NE | LC |
| 81 | *Dinebera retroflexa* (Vahl) Panzer | Poaceae | Grass | NE | LC |
| 82 | *Diospyros abyssinica* (Hiern) P. White | Ebenaceae | Tree | NE | LC |
| 83 | *Diospyros mespiliformis* A. DC. | Ebenaceae | Tree | NE | LC |
| 84 | *Dodonaea angustifolia* L. f. | Sapindaceae | Shrub | NE | LC |
| 85 | *Dombeya torrida* (J.F. Gmel.) Bamps | Sterculaceae | Tree | NE | LC |
| 86 | *Dovyalis abyssinica* (A. Rich.) Warb. | Flacourtiaceae | Shrub | NE | LC |
| 87 | *Dracaena steudneri* Engl. | Dracaenaceae | Tree | NE | LC |
| 88 | *Dyschoriste radicans* Hochst. | Acanthaceae | Herb | NE | LC |
| 89 | *Echinochloa colona* (L.) Link | Poaceae | Grass | NE | LC |
| 90 | *Echinochloa haploclada* (Stapf) Stapf | Poaceae | Grass | NE | LC |
| 91 | *Echinochloa stagnina* (Retz.) P. Beauv. Eckl. & Zeyh. | Poaceae | Grass | NE | LC |
| 92 | *Ehretia cymosa* Thonn | Boraginaceae | Tree | NE | LC |
| 93 | *Eleusine floccifolia* (Forssk.) Spreng. | Poaceae | Grass | NE | LC |
| 94 | *Embelia schimpri* Vatke | Myrsinaceae | Shrub | NE | LC |
| 95 | *Emilia abyssinica* (L.) Vahl | Asteraceae | Herb | NE | LC |
| 96 | *Ensete ventricosum* (Welw.) Cheesman | Musaceae | Herb | NE | LC |
| 97 | *Eriochloa nubica* (Steud.) Thell | Poaceae | Grass | NE | LC |
| 98 | *Erythrina abyssinica* Lam. ex DC. | Fabaceae | Tree | NE | LC |
| 99 | *Erythrina brucei* Schweinf | Fabaceae | Tree | E | LC |
| 100 | *Eucalvptus* camaldulensis Dehnh | Myrtaceae | Tree | NE | LC |
| 101 | *Eucalyptus globulus* Labill. | Myrtaceae | Tree | NE | LC |
| 102 | *Euclea racemosa* subsp. *schimperi* (A. DC.) P. White | Ebenaceae | Shrub | NE | LC |
| 103 | *Eulophia* spp. | Orchidaceae | Orchid | NE | LC |
| 104 | *Euphorbia ampliphylla* Pax | Euphorbiaceae | Tree | NE | LC |
| 105 | *Euphorbia tirucalli* L. | Euphorbiaceae | Tree | NE | LC |
| 106 | *Ficus ovata* Vahl | Moraceae | Tree | NE | LC |
| 107 | *Ficus sur* Forssk. | Moraceae | Tree | NE | LC |
| 108 | *Ficus sycomorus* L. | Moraceae | Tree | NE | LC |
| 109 | *Ficus thonningii* Blume | Moraceae | Tree | NE | LC |
| 110 | *Ficus vasta* Forssk. | Moraceae | Tree | NE | LC |
| 111 | *Fimbristylis dichotoma* (L.) Vahl | Cyperaceae | Herb | NE | LC |
| 112 | *Flacourtia indica* (Burm. f.) Merrill | Flacourtiaceae | Shrub | NE | LC |
| 113 | *Fluggea virosa* (Willd.) Voigt. | Euphorbiaceae | Shrub | NE | LC |
| 114 | *Galiniera saxifraga* (Hochst.) Bridson | Rubiaceae | Shrub | NE | LC |
| 115 | *Gardenia volkensii* K. Schum. | Rubiaceae | Shrub | NE | LC |
| 116 | *Girardinia bulosa* (Steud.) Engl. | Urticaceae | Herb | NE | LC |
| 117 | *Grewia bicolor* Juss. | Tiliaceae | Shrub | NE | LC |
| 118 | *Grewia vilosa* Willd. | Tiliaceae | Shrub | NE | LC |
| 119 | *Guzotia scabra* (Vis.) Chiov. | Asteraceae | Herb | NE | LC |
| 120 | *Hagenia abyssinica* (Bruce) J.F. Gmel. | Rosaceae | Tree | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 121 | *Harpachne schimperi* Hochst. ex A. Rich. | Poaceae | Grass | NE | LC |
| 122 | *Heteromorpha trifoliata* (Wendl.) | Apiaceae | Shrub | NE | LC |
| 123 | *Hibiscus cannabinus* L. | Malvaceae | Herb | NE | LC |
| 124 | *Hibiscus macranthus* Hochst. ex A. Rich. | Malvaceae | Herb | NE | LC |
| 125 | *Hydrocharis haesas* L. | Hydrocharitaceae | Herb | NE | LC |
| 126 | *Hygrophila schulii* (Schum.) Almeida & Almeida | Acanthaceae | Herb | NE | LC |
| 127 | *Hyparrhenia antihisroides* (Hochst. ex A. Rich.) | Poaceae | Grass | NE | LC |
| 128 | *Hyparrhenia hirta* (L) Stapf. | Poaceae | Grass | NE | LC |
| 129 | *Hyparrhenia ruffa* (Nees) Stapf. | Poaceae | Grass | NE | LC |
| 130 | *Hypericum revolutum* Vahl | Hypericaceae | Shrub | NE | LC |
| 131 | *Hypoestes forskalii* (Vahl.) R. Br. | Acanthaceae | Herb | NE | LC |
| 132 | *Ipomoea aquatica* Forssk. | Convolvulaceae | Herb | NE | LC |
| 133 | *Ipomoea tricolor Cav.* | Convolvulaceae | Strangler | NE | LC |
| 134 | *Juniperus procera* Hochst. ex Endl. | Cupressaceae | Tree | NE | LC |
| 135 | *Justicia flava (Forssk.)* Vahl | Acanthaceae | Herb | NE | LC |
| 136 | *Justicia ladanoides* Lam. | Acanthaceae | Shrub | NE | LC |
| 137 | *Justicia schimperiana* (Hochst. ex Nees) T. Anders. | Acanthaceae | Herb | NE | LC |
| 138 | *Lagarosiphon cordofanus* Casp. | Hydrocharitaceae | Herb | NE | LC |
| 139 | *Lagarosiphon steudneri* Casp. | Hydrocharitaceae | Herb | NE | LC |
| 140 | *Lagenaria siceraria* (Molina) Stand. | Cucurbitaceae | Herb | NE | LC |
| 141 | *Lantana camara* L. | Verbenaceae | Shrub | NE | LC |
| 142 | *Lepidotrochilia volkensii* (Guerke) | Meliaceae | Tree | NE | LC |
| 143 | *Leucas martinicensis* (Jacq.) R.Br | Lamiaceae | Herb | NE | LC |
| 144 | *Maesa lanceolata* Forssk. | Anacardiaceae | Tree | NE | LC |
| 145 | *Maytenus arbutifolia* (A. Rich.) Wilczek | Celastraceae | Shrub | NE | LC |
| 146 | *Maytenus obscura* (A. Rich.) Cufod. | Celastraceae | Shrub | NE | LC |
| 147 | *Maytenus serrata* (A. Rich.) Wilczek | Celastraceae | Shrub | E | LC |
| 148 | *Medicago polymorpha* L. | Poaceae | Herb | NE | LC |
| 149 | *Melinus repens* (Willd.) Zizka | Poaceae | Grass | NE | LC |
| 150 | *Microchloa kunthii* Desv. | Poaceae | Tree | NE | LC |
| 151 | *Millettia ferruginea* (Hochst.) Bak | Fabaceae | Tree | E | LC |
| 152 | *Mimusops kummel* A. DC. | Sapotaceae | Tree | NE | LC |
| 153 | *Myrsine africana* L. | Myrsinaceae | Shrub | NE | LC |
| 154 | *Nuxia congesta* R. Br. ex Fresen. | Loganiaceae | Tree | NE | LC |
| 155 | *Nymphaea caerulea* Savizny | Nymphaceae | Herb | NE | LC |
| 156 | *Ocimum lamiifolium* Hochst. ex Benth. | Lamiaceae | Herb | NE | LC |
| 157 | *Olea europaea* subsp. cuspidata (Wall. ex. DC) Cifferri | Oleaceae | Tree | NE | LC |
| 158 | *Olinia rochetiana* Juss. | Olinaceae | Tree | NE | LC |
| 159 | *Oplismenus* compositus (Retz.) P. Beauv. | Poaceae | Grass | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 160 | *Opuntia ficus-indica* (L.) Mill. | Cactaceae | Succulent shrub | NE | LC |
| 161 | *Oryza longistaminatata* A. Cheval. & Roehr. | Poaceae | Grass | NE | LC |
| 162 | *Osyris quadripartita* Salzm. ex Decne. | Santalaceae | Shrub | NE | LC |
| 163 | *Otostegia integriflia* Benth. | Lamiaceae | Shrub | NE | LC |
| 164 | *Ottelia ulvifolia* (Planch.) Walp. | Hydrocharitaceae | Herb | NE | LC |
| 165 | *Oxyanthus speciosus* DC. | Rubiaceae | Shrub | NE | LC |
| 166 | *Panicum coloratum* L. | Poaceae | Grass | NE | LC |
| 167 | *Pavetta abyssinica* Fresen. | Rubiaceae | Shrub | NE | LC |
| 168 | *Pennisetum mezianun* Leeke | Poaceae | Grass | NE | LC |
| 169 | *Pennisetum thunbergii* Kunth | Poaceae | Grass | NE | LC |
| 170 | *Persicaria glabra* (Willd.) Gomez de la Maza | Polygonaceae | Herb | NE | LC |
| 171 | *Persicaria senegalensis* (Meisn.) Sojak | Polygonaceae | Herb | NE | LC |
| 172 | *Persicaria setulosa* (A. Rich.) K.L. | Polygonaceae | Herb | NE | LC |
| 173 | *Phoenix reclinata* Jacq. | Palmaceae | Tree | NE | LC |
| 174 | *Physalis peruviana* L. | Solanaceae | Herb | NE | LC |
| 175 | *Phytolacca dodecandra* L' Herit | Phytolaccaceae | Shrub | NE | LC |
| 176 | *Pistia stratiotes* L. | Araceae | Floating herb | NE | LC |
| 177 | *Pittosporum viridiflorum* Sims | pittosporaceae | Tree | NE | LC |
| 178 | *Plantago lanceolata* L. | Plantaginaceae | Herb | NE | LC |
| 179 | *Podocarpus falcatus* Thunb. R. Br. ex Mirb. | Podocarpaceae | Tree | NE | LC |
| 180 | *Potamogeton schweinfurthii* A. Benn. | Potamogetonaceae | Herb | NE | LC |
| 181 | *Potamogeton thunbergii* Cham. & Schlecht. | Potamogetonaceae | Herb | NE | LC |
| 182 | *Premna schimperi* Engl. | Lamiaceae | Shrub | NE | LC |
| 183 | *Prunus africana* Hook. f. Kalkm. | Rosaceae | Tree | NE | LC |
| 184 | *Rhamnus staddo* A. Rich. | Rhamnaceae | Shrub | NE | LC |
| 185 | *Ranunculus volkensii* Engl. | Ranunculaceae | Herb | NE | LC |
| 186 | *Rhus glutinosa* A. Rich. | Anacardiaceae | Shrub | NE | LC |
| 187 | *Rhus retinorrhea* Steud ex Oliv. | Anacardiaceae | Shrub | NE | LC |
| 188 | *Rhynchosia totta* (Thunb.) DC. | Fabaceae | Herb | NE | LC |
| 189 | *Ricinus communis* L. | Euphorbiaceae | Tree | NE | LC |
| 190 | *Rosa abyssinica* R. Br. ex Lindl | Rosaceae | Shrub | NE | LC |
| 191 | *Ritchiea albersii* Gilg. | Capparidaceae | Herb | NE | LC |
| 192 | *Rothmannia urcelliformis* (Hiern) Robyns | Rubiaceae | Tree | NE | LC |
| 193 | *Rumex abyssinicus* Jacq. | Polygonaceae | Herb | NE | LC |
| 194 | *Rumex nepalensis* Spreng. | Polygonaceae | Herb | NE | LC |
| 195 | *Rumex nervosus* Vahl. | Polygonaceae | Shrub | NE | LC |
| 196 | *Ruttya speciosa* (Hochst.) Engl. | Acanthaceae | Shrub | E | VU |
| 197 | *Salix subserrata* Willd. | Salicaceae | Tree | NE | LC |
| 198 | *Sapium ellipticum* (Hochst.) Pax (Schellenb.) Stearn | Euphorbiaceae | Tree | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 199 | *Schefflera abyssinica* A. Rich. | Araliaceae | Tree | NE | LC |
| 200 | *Schoenoplectus* sp. | Cyperaceae | Herb | NE | LC |
| 201 | *Scolopia theifolia* Gilg. | Flacourtiaceae | Shrub | NE | LC |
| 202 | *Senna didymobotrya* Fresen. | Fabaceae | Shrub | NE | LC |
| 203 | *Senna occidentalis* (L.) Link | Fabaceae | Shrub | NE | LC |
| 204 | *Senna petersiana* (Bolle) Lock | Fabaceae | Shrub | NE | LC |
| 205 | *Senna singueana* (Del.) Lock | Fabaceae | Shrub | NE | LC |
| 206 | *Sesbania sesban* (L.) Merr. | Fabaceae | Shrub | NE | LC |
| 207 | *Setaria atrata* Hack. | Poaceae | Shrub | NE | LC |
| 208 | *Setaria incrasata* (Hochst.) Hack. | Poaceae | Grass | NE | LC |
| 209 | *Setaria pumila* (Poir.) & Roem. & Schult. | Poaceae | Grass | NE | LC |
| 210 | *Sicyos polyacanthus* Cogn. | Cucurbitaceae | Herb | NE | LC |
| 211 | *Sida schimperiana* Hochst. ex. A. Rich. | Malvaceae | Herb | NE | LC |
| 212 | *Sideroxylon oxyacanthus* Hutch. & Bruce | Sapotaceae | Shrub | E | NT |
| 213 | *Snowdenia polystachya* (Fresen.) Pilg | Poaceae | Grass | NE | LC |
| 214 | *Solanum giganteum* Jacq. | Solanaceae | Shrub | NE | LC |
| 215 | *Solanum marginatum* L. f. | Solanaceae | Herb | E | LC |
| 216 | *Solanum nigrum* L. | Solanaceae | Herb | NE | LC |
| 217 | *Sorghum verticilliflorum* (Steud.) Stapf | Poaceae | Grass | NE | LC |
| 218 | *Spirodella polyrrhiza* (L.) Schleiden | Lemnaceae | Herb | NE | LC |
| 219 | *Sphaeranthus suaveolens* (Forrsk.) DC. | Asteraceae | Herb | NE | LC |
| 220 | *Stereospermum kunthianum* Cham. | Bignoniaceae | Tree | NE | LC |
| 221 | *Syzygium guineense* (Willd.) DC. | Myrtaceae | Tree | NE | LC |
| 222 | *Tagetus minuta* L. | Asteraceae | Herb | NE | LC |
| 223 | *Tapinanthus globiferus* (A Rich) Tieghem | Loranthaceae | Epiphyte | NE | LC |
| 224 | *Teclea nobilis* Del. | Rutaceae | Tree | NE | LC |
| 225 | *Terminalia brownii* Fresen. | Combretaceae | Tree | NE | LC |
| 226 | *Tephrosia pumila* (Lam.) Pers. | Fabaceae | Herb | NE | LC |
| 227 | *Trifolium quartinianum* A. Rich. | Fabaceae | Herb | NE | LC |
| 228 | *Trifolium rueppellianum* Fresen. | Fabaceae | Herb | NE | LC |
| 229 | *Triumfetta annua* L. | Tiliaceae | Herb | NE | LC |
| 230 | *Turraea holstii* Guerke | Meliaceae | Tree | NE | LC |
| 231 | *Typha domingensis* Pers. | Typhaceae | Herb | NE | LC |
| 232 | *Urera hypselodendron* (A. Rich.) Wedd. | Urticaceae | Liana | NE | LC |
| 233 | *Vepris dainellii* (Pich.-Serm.) kokwaro | Rutaceae | Tree | E | LC |
| 234 | *Verbena officinalis* L. | Verbenaceae | Shrub | NE | LC |
| 235 | *Vernonia amygdalina* Del. | Asteraceae | Tree | NE | LC |
| 236 | *Vernonia leopoldii* Sch. Bip | Asteraceae | Shrub | E | LC |
| 237 | *Vernonia auriculifolia* Hiern.V. sp. | Asteraceae | Shrub | NE | LC |
| 238 | *Vigna luteola* (Jacq.) Benth. | Fabaceae | Herb | NE | LC |
| 239 | *Vigna vexillata* (L.) A. Rich. | Fabaceae | Herb | NE | LC |

Table A3-3 (Cont'd)

| N | *Species name* | Family | Habit | Endemi-city | IUCN Categ. |
|---|---|---|---|---|---|
| 240 | *Xanthium strumarium* L. | Asteraceae | Herb | NE | LC |
| 241 | *Ximenia americana* L. | Olacaceae | Shrub | NE | LC |
| 242 | *Zannichellia pailistris* L. | Zannichelliaceae | Herb | NE | LC |

NT = not threatened

VU = Vulnerable

LC = Least concern

MAMMAL

Table A3-4 List of mammal species recorded in Lake Tana Sub-basin (adapted from NBI in press)

| **Species** | **Zeiger** | **Tera Gedam** | **Kunzila** | **Delgi** | **Gorgora** | **Bahir Dar Univ.** | **Gerima wetland** | **SNP** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| Vervet monkey | 25 | 8 | 4 | 2 | 15 | 18 | 9 | 5 | 86 |
| *Colobus guereza* | 1 | | 2 | | 3 | | | | 6 |
| Olive Baboon | | 2 | | | 8 | | | | 10 |
| Gelada Baboon | | | | | | | | 375 | 375 |
| Anubis Baboon | | | | | | 3 | 1 | | 4 |
| Bushpig | 2 | | | | 1 | | | | 3 |
| Dik-dik | 1 | | | | 2 | | | | 3 |
| Bushbuck | 1 | | | | | | | 5 | 6 |
| Bush Duiker | | 1 | | 1 | | | | | 2 |
| African Civet | 1 | | | 1 | 1 | | | | 3 |
| Porcupine | | | 2 | | 2 | | | | 4 |
| Hyaena (+) | 1 | | 1 | 1 | 1 | | | | 4 |
| Leopard (+) | 1 | | | 1 | 1 | | | | 3 |
| Tree Hyrax | 1 | | | | 1 | | | | 2 |
| Rock Hyrax | | 1 | | | 2 | | | | 3 |
| Hippo | 4 | | 3 | 2 | 2 | 3 | 1 | | 15 |
| B. mongoose | | 1 | | 2 | 1 | | | | 4 |
| Marsh Mongoose | 1 | | | 1 | 2 | | | | 4 |
| W.B. Hedgehog | | 1 | | | 3 | | | | 4 |
| Common Jackal | | | | | 2 | | | | 2 |
| Abyssinian Hare | | 4 | 1 | | 2 | 1 | | | 8 |
| Honey Badger | | | 1 | | 1 | | | | 2 |
| Oribi | | | | | 2 | | | | 2 |
| Bats | | 2 | | 10 | 5 | | | | 8 |
| Wild Cat | | | | | | 1 | | | 1 |
| C. Porcupine | 1 | | | | | | | | 1 |
| Ethiopian Wolf | | | | | | | | 2 | 2 |
| Walia ibex | | | | | | | | 25 | 25 |
| Klipspringer | | | | | | | | 15 | 15 |
| Mole Rat | | | | | | | | 13 | 13 |
| **Total** | **41** | **20** | **14** | **21** | **57** | **26** | **11** | **440** | **143** |

Legend: (+) identification from tracks. **SNP**: Simien National Park

Note: **Zeiger:** site dominated by forest habitat (prev. primary forest, now degraded); papyrus swamps are also present; **Tera Gedam:** dominated by woodland; **Kunzila:** mixed woodlands and wetland patches; **Delgi:** site showed the highest signs of human encroachment; **Gorgora**: mixed forest, woodland and wetland habitats (highest diversity); **Bahir Dar University** has forests and wetlands (and a population of Hippo, 1 individual).

AQUATIC INVERTEBRATE

Table A3-5 List of aquatic invertebrates recorded in Lake Tana (adapted from: Abrha in press)

| N | Group | Species name (higher group) | Remarks |
|---|---|---|---|
| 1 | Cladocerans | *Bosominia longrostris* | Most abundant zooplankton |
| | | *Ceriodophnia cornuta* | Benthos |
| | | *Ceriodophnia dubia* | Id |
| | | *Daphnia similis* | Id |
| | | *Daphnia longispina* | Id |
| | | *Diaphanosoma excisum* | Most abundant zooplankton |
| | | *Juvenile cladocera* | Benthos |
| | | *Monia micrara* | Id |
| 2 | Cyclops | *Copepodite* spp. | Id |
| | | *Mesocylop* spp. | Id |
| | | *Naupli* spp. | Common zooplankton |
| | | *Thermocyclop* spp. | Id |
| | | *Thermodiptmous galbei* | Id |
| 3 | Rotifers | *Brachionus caudatus* | Id |
| | | *Filina terminalis* | Id |
| | | *Keratella crassa* | Id |
| | | *Keratella quadrata* | Id |
| | | *Lecane* spp. | Id |
| | | *Trichocerca* spp. | Id |
| 4 | Bivalve | *Aspatharia rubens* | Benthos |
| | | *Corbicula fluminalis* | Id |
| | | *Unio abyssinica* | Id |
| 5 | Chironomidae (family) | *Chironomus* spp. | Id |
| 6 | Ephemeroptera (order) | Mayflies | Insect larvae |
| 7 | Gastropods (class) | *Bellamya unicolor abyssinica* | Endemic subspecies |
| | | *Lymnaea natalensis* | Intermediate host of *Fascioliasis* sp. |
| | | Lymnaeidae (family) | |
| 8 | Mosquitoes | Viviparidae (family) | |
| | | *Anopheles* spp. | Vector of Malaria |
| | | *Chaoborus* spp. | |
| | | *Lulex* spp. | |
| | | Chaoboridae (family) | Common midges |
| 9 | Planorbidae | *Anisus natalensis* | Host of Schistosomahaematobium |
| | | *Bulinus* spp. | Small tropical freshwater snails |
| 10 | Plecoptera (order) | Stoneflies | Larval stage |
| 11 | Trichoptera (order) | Caddisflies | Most abundant insect larvae |
| 12 | Odonata (order) | Dragonflies | 14 species |

Sources: MoWR 2007 and Norplan et al. 2006.

# *Appendix 4 List of Working Group Members*

**The following regional wetlands working group members have been involved in the consultation process for establishing the Nile Basin wetland inventory**

| Country | Name | Position | Institution | Contact |
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| 12. | Ms Judith Nyunja | | Kenya Wildlife Service | P. O. Box 913, Nairobi, Kenya.<br>fomengo@yahoo.com |

| Country | Name | Position | Institution | Contact |
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ISBN 978-9970-148-25-7


NBI Vision: ***to achieve sustainable socioeconomic development through the equitable utilization of, and benefit from the common Nile Basin water resources.***