Information Sheet on Ramsar Wetlands (RIS) – 2006-2008 version

Available for download from http://www.ramsar.org/ris/key_ris_index.htm.

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

1. Name and address of the compiler of this form:

FOR OFFICE USE ONLY.

DD MM YY

Designation date

Site Reference Number

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2. Date this sheet was completed/updated:

19 January 2009

3. Country:

Mozambique

4. Name of the Ramsar site:

The precise name of the designated site in one of the three official languages (English, French or Spanish) of the Convention. Alternative names, including in local language(s), should be given in parentheses after the precise name.

Lake Niassa and its Coastal Zone (Lago Niassa e Zona Costeira)

5. Designation of new Ramsar site or update of existing site:

This RIS is for (tick one box only)**:**
a) Designation of a new Ramsar site X; or

b) Updated information on an existing Ramsar site ❑

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6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area

The Ramsar site boundary and site area are unchanged: ❑

or
If the site boundary has changed:
i) the boundary has been delineated more accurately ❑; or
ii) the boundary has been extended ❑; or
iii) the boundary has been restricted** ❑

and/or

If the site area has changed:
i) the area has been measured more accurately ❑; or
ii) the area has been extended ❑; or
iii) the area has been reduced** ❑

** **Important note**: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

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7. Map of site:
Refer to Annex III of the *Explanatory Note and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:
i**) a hard copy** (required for inclusion of site in the Ramsar List): X;

ii**) an electronic format** (e.g. a JPEG or ArcView image) X;

iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** X.

b) Describe briefly the type of boundary delineation applied:
e.g. the boundary is the same as an existing protected area (nature reserve, national park, etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The outer (Western) limit of the proposed Ramsar site is the international boundary between Mozambique and Malawi, which defines the Mozambique's total territorial waters in Lake Malawi/Niassa. The borders geographical coordinates points in the Lake are according to the Government entity in charge of the border demarcation. In the terrestrial side of the proposed Ramsar site, the limits are defined by the border with the Republic of Tanzania in the North, the border with Malawi in the South and topographic features – which include the river basins of Messinge, Lungula and Luchimua rivers - in the Eastern side of the Ramsar site.

The Ramsar site excludes the two islands of Chisumulu and Likoma and the Malawian territorial waters around them.

8. Geographical coordinates (latitude/longitude, in degrees and minutes):
Provide the coordinates of the approximate centre of the site and/or the limits of the site. If the site is composed of more than one separate area, provide coordinates for each of these areas.

Please see Point Reference in the map. Points A to I are the limits of the proposed Ramsar site inland.

Point Reference	Coordinates	
	Lat	Lon
A	11º 34" 21.34 S"	35º 25" 03.61 E"
B	11º 57" 35.12 S"	35º 00" 39.77 E"
C	12º 13" 45.30 S"	35º 18" 00.02 E"
D	12º 30" 9.14 S"	35º 12" 45.73 E"
E	12º 38" 34.73 S"	35º 20" 30.32 E"
F	12º 56" 06.90 S"	35º 15" 02.38 E"
G	13º 01" 21.18 S"	35º 24" 08.96 E"
H	13º 17" 17.76 S"	35º 12" 04.74 E"
I	13º 29" 08.25 S"	34º 56" 21.89 E"
COC	12º 30" 28.50 S"	34º 51" 28.50 E"

Please, see Point Reference in the map. Points Reference 1 to 17 (note, these are official numbers) are the limits in the border between Malawi and Mozambique, in the Lake.

Point Reference	Coordinates	
	Lat	Lon
1	11º 34" 27.4 S"	34º 40" 0.10 E"
2	11º 57" 58.2 S"	34º 31" 55.97 E"
3	12º 11" 18.09 S"	34º 20" 48.22 E"
4	12º 33" 47.65 S"	34º 28" 25.10 E"
5	12º 50" 59.51 S"	34º 29" 56.48 E"
6	13º 04" 11.51 S"	34º 33" 13.29 E"
7	13º 20" 55.41 S"	34º 31" 48.94 E"
8	13º 29" 00.40 S"	34º 35" 54.95 E"
9	11º 34" 25.90 S"	34º 58" 14.40 E"
17	13º 41" 58.00 S"	34º 52" 01.03 E"

9. General location:
Include in which part of the country and which large administrative region(s) the site lies and the location of the nearest large town.

The Lake Niassa and its Coast is located in the Niassa Province, in the Northeast of Mozambique. The waters of the Lake border the District of Lichinga (Administrative Post of Meponda), and the District of Lago (Administrative Posts of Lichinga, Lunho and Cobue). The coast on the Mozambique portion of the Lake is 254 Km long and represents 20% of the total coast line of the Lake. It lies on the border with Tanzania at the north, and with Malawi at the east and south.

The nearest large town is the capital of Niassa Province – Lichinga – at a distance of about 62.15 Km (from Meponda), 105.22 Km (from Metangula), 113 Km (from Lunho) and 176 Km (from Cobue), in a south-east direction. Lichinga has a population of 142,253 inhabitants (http//: www.ine.gov.mz).

10. Elevation: (in metres: average and/or maximum & minimum)
554 m (average), 319 (min.), 1,413 (max)

11. Area: (in hectares)
1,363,700 ha, including the water body

12. General overview of the site:
Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

Lake Niassa (also known as Lake Malawi/Nyasa in Malawi and Tanzania, respectively) , referred hereafter to as Lake Niassa, with a total surface area of 18,720 Km^2 is the third largest lake in Africa, after Lake Victoria and Tanganyika, and it is a shared natural resource among three countries: Mozambique, Malawi and Tanzania. This lake is the world's third deepest lake with a depth just over 700 m, and it's the southernmost of the Western Rift Valley lakes (Twombly, 1983, Konings, 1995, Ribbink, 2001). It is home to more than 600 fish species, 90% of which are endemic to the lake. The highest number of fish species makes this lake unique in the world.

Lake Niassa constitutes the largest portion of inland waters in Mozambique. The Lake plays an important role in the livelihoods of the people living in its surrounding. Fishing is the most relevant activity all along the coast. Most of the population depends on this activity to provide for their food needs and to generate income. Together with agriculture, forestry, mining and the ever increasing tourism industry, the Lake contributes substantially to the local and national economies. This makes it very relevant from the point of view of management and conservation of micro and macro ecological regions, as is the case with the Eco-Region of the Lake Malawi/ Niassa/Nyasa Catchment Area altogether.

13. Ramsar Criteria:
Tick the box under each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11). All Criteria which apply should be ticked.

1	2	3	4	5	6	7	8	9
☑	☑	☑	☑	❑	❑	☑	❑	❑

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Criterion 1:
Lake Malawi-Niassa-Nyssa is a large, long and narrow freshwater lake in southern Africa covering the territories of Tanzania, Malawi and Mozambique. It is the southernmost of the Western Rift Valley lakes located between 9° 30' – 14° 40'S, 33°50' – 33°36'E. The lake is the ninth largest in the world, the third deepest, and has a surface area of 31,000 km^2. The lake depression consists of a series of grabens and half grabens, and this pattern of rift faulting results in the boundary of the lake varying from extensive plains, particularly in the south, to steep-sided mountains in the north. The lake's catchment covers about 130,000 km^2 and includes much of Malawi, the south-western corner of Tanzania and the north-western corner of Mozambique. Lake Malawi was formed millions of years ago as a part of the development of the Great Rift Valley system of Africa. It is termed an 'ancient' lake in global terms, and has a high biological importance (Chafota *et al.* 2005)

Criterion 2:
A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.

Although no exact number of the status of the mammal population in the Lake region is known, the following highly endangered to vulnerable are known to occur in the area such as Wilddog (*Lycaon Pictus*) (IUCN:endangered), Leopard (*Panthera pardus)* (CITES Appendix 1*),* Lion (*Panthera leo*) (IUCN: vulnerable), Elephant (*Loxodonta africana*) (CITES Appendix 1), Sable antilope (*Hippotragus niger variani*) (CITES appendix 1).

Criterion 3:
A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.

The most outstanding biological feature of Lake Malawi/Niassa/Nyasa is the presence of large number of endemic fish species, with the lake having the highest number of endemics of any of the Rift Valley Lakes. Although fourteen families of fish are represented in the lake's catchment, the family Cichlidae dominates in terms of species richness. Formal scientific description and naming of many cichlids remains to be completed as professional systematists cannot keep pace with the rate at which new species are being discovered. It is certain that further new species of fish will be discovered as research continues. Lake Malawi also supports populations of mammals, birds, amphibians, reptiles and plants. None of these groups contain high rates of endemism in the lake, although there are also some endemic aquatic invertebrates (Chafota *et al.* 2005). The principal focus of attention with regard to scientific exploration, management and conservation has always been the spectacular lake and its remarkable endemic species flocks, principally the cichlids and catfish of the genus *Bathyclarias*. The lake basin ecosystem and hence ecoregion, also has an exceedingly important riverine component with its own unique, but largely overlooked biodiversity. Included among these are fishes that spend their entire life history in rivers (riverine or potamicolous species), swamps and temporary waters and others that spend part of their life history in the lake and the other part in rivers (potamodromous species). Most of the latter group spend the adult part of their lives in the lake and migrate up river to spawn, usually in the rainy season. As a group it is these fishes that spend all or part of their life history in rivers that are most threatened, perhaps facing extinction. A fair proportion of these fishes are endemic and their extinction would therefore constitute a total and irreversible loss. Others

have a broader distribution in southern and central Africa, but do nevertheless constitute valuable components of the lake basin ecosystem and biodiversity (Ribbink, 2001).

The continental area of the lake is predominantly covred by Miombo woodland that covers about 2.8 mill km2 of the southern subhumid tropical zone from Tanzania and Zaire in the north, through Zambia, Malawi and eastern Angola to Zimbabwe and Mozambique in the south. The vegetation types in the proposed Ramsar area include: Forest vegetation that benefits from added humidity of the soil, Riverine forest, Deciduous Forests, Wetlands with short tree's, inselbergs, and outcrops with soil little able to absorb humidity. This includes evergreen vegetation, deciduous as well as inundated. Tree species include *Brachystegia spp., Julbarnardia globiflora, Pterocarpus rotundiflolius, Pterocarpus angolensis, Vitex payos, Albizia Dombeya rotunidfolia,* amongst many others. The soils are predominantly infertile, most of the nutrient richness lies within the vegetation and is recycled through the nutrient cycles that passes through the soil. Woody plants make up more then 95% of plant biomass. Miombo woodlands do not only provide an immensely large range of goods and services to the human population that depend on it but is also home to a highly diverse fauna community, including antelopes (bushbuck, buffalo, sable, kudu, Nyala, dikers, etc), carnivores (Leopard, Lion, medium and small cats) as well as many reptiles, amphibians, birds and insects characteristic for this extensive habitat type in Southern Africa.

The main habitats and zones of the Lake Niassa and its immediate coastal zone are Riverine, sandy areas (Beaches), Sand and rocky mixture, rocks and stony areas, Grasslands, Reeds, Rocky areas with tree cover and small islands, reef's and aquatic habitat.

The reefs of the Niassa Lake can be divided in various habitats, most of them home to specific cichlid populations. These reef's are located between 10 to 90 meters with highly diverse biodiversity. The most common species found at around 70 m depth of the Cichlids: *Copadichromis lomomae,* The Minos Reef presents mainly rocky habitats with cichlid species that feed on the plankton and occur in various habitats. However some variations in coloring exist between populations in different habitats. In habitats with more then 6 meters depth but rocky surfaces, slightly other compositions can be found . The Minos Reef, about 1.5 miles from the continent, between 16 and 23 m depth. Minos reef is one the areas especialliy rich in fish species, particularly small ornamental fish, including the zebra fish (*Pseudotrpheus (Metriaclima)* sp.. , in other areas of the same reef species such as *Copadichromis chrysonotus and C. jacksoni,* both feed on Plankton, *Labeotropheus fuelleborni, L. vellicans, Petrotilapia sp, Protomelas spilonotus, Tropheops marcophthalamus*.

Criterion 4:
The Lake also lies within flyways of migratory birds that use the lake margins for feeding on their way between Africa and Europe (Chafota *et al.* 2005).
However bird records for the eastern shores are poor and reliance has been placed on those obtained through studies on the Malawian portion of the shared waters. Benson & Benson (1977), and Newman, et al. (1992) give the bird count for Malawi at precisely 620 species. The most recent checklist (Dowsett-Lemaire and Dowsett, in press; from Duthie pers. comm.) gives 648 species from 78 families, comprising 456 residents, 94 intra-African migrants of regular occurrence, most of which probably breed in Malawi, and 77 regular and 12 vagrant Palaearctic species. Over one third of all bird species in Malawi are considered to be uncommon or rare, and of long-term conservation concern (Newman et al. 1992), although for many of these species,

little is known of their exact population status. As with the fishes, naturally rare species may not necessarily be threatened unless activities such as harvesting are making inroads into their population size. The species richness of the birds is only slightly lower than that of the fishes of the region. However, the fishes are represented by only 14 families, whereas 78 families represent the birds, indicating a broader diversity of birds at the higher taxonomic level. Ninety-four birds in Malawi are restricted-range species, found in only one or a few biomes as used by the Endemic Bird Areas project of Birdlife International (Stattersfield et al. 1998). Nine species of bird that are listed in the 1996 Red List of Threatened Animals are known to occur in Malawi. However, many of the biome-restricted and endemic birds that are area-restricted may be considered to be under conservation threat since their distribution is now restricted to a small number of sites, and habitat degradation is leading to diminution of their habitat patches. Those species whose main distribution lies outside of existing large protected areas may be especially vulnerable to local extinction in the short term. Newman et al. (1992) show that a high proportion of the birds have strong affinities for aquatic habitats. Many of the birds associated with water are valuable ecological components and are attractive to ornithologists (Ribbink 2001a).

Criterion 7:
Internationally, the main significance of Lake Malawi-Niassa-Nyassa is in terms of it values for the conservation of species narrowly restricted to that lake. Lake Malawi is home to 15% of the world's freshwater fish species, with more than 600 endemic species in total.

Fourteen families are represented in the rivers and lake within the catchment (see Table 1). The family Cichlidae dominates in terms of species richness, diversity and numerical abundance. The high degree of cichlid endemicity (99.5%) indicates that nearly all members of the family evolved in the lake.

Table 1. *The riverine and lacustrine fishes of the Lake Malawi/Niassa/Nyasa system, and the percentage endemicity. Endemicity is lower in rivers than in the lake. All families in the lake also have riverine representatives, but not all riverine families have representatives in the lake (Data from the systematics team of the SADC/GEF Project). R =present in rivers; L = present in lake.*

Family	**In rivers (R) or in lake (L)**	**Genera**		**Species**	**Endemic %**
		Total	**Endemic**		
1. Protopteridae	R	1	0	1	0
2. Anguillidae	R&L	1	0	1	0
3. Mormyridae	R&L	6	0	7	0
4. Salmonidae	R	1	0	1	0
5. Characidae	R&L	2	0	2	0
6. Cyprinidae	R&L	5	1	26	35
7. Bagridae	R&L	1	0	1	100
8. Amphilidae	R	1	0	6	40
9. Clariidae	R&L	2	1	17	71
10. Mochokidae	R&L	2	0	3	33
11. Cyprinodontidae	R&L	1	0	1	0
12. Aplocheilidae	R	1	0	2	50
13. Mastacembelidae	R&L	1	0	2	100
14. Cichlidae	R&L	56	51	Ca 750	99.5

(source: Ribbink, 2001)

Amongst the most common in the fisheries in Mozambique are the (locally named) *chambo* (*Oreochromis* sp.), *usipa* (*Engraulicypris sardella*) and *utaka* (*Copadichromis* sp.) (Halafo, 2008). Others species include *Labeo mesops*, *Labeo cylindricus*, *Opsaridium microcephalus* and *Opsaridium microlepis*, *Barbus litamba* and *Engraulicypris sardella*. Potamodromous fishes (already referred as fish which spend part of its life cycle in rivers) from the Family Ciprinidae, such as *Opsaridium microlepis* are considered to be endangered (Halafo, 2008).

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15. Biogeography (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation):

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:

Eco-Region of the Lake Malawi/ Niassa/Nyasa Catchment Area

b) biogeographic regionalisation scheme (include reference citation):

For freshwater ecoregions such as Lake Malawi/Niassa/Nyasa, the catchment serves as a logical unit for delineating freshwater Ecoregions.

Accordingly, the lake, all inflowing streams and rivers, and the slopes from which land-based activities might impact on the lake would define the boundaries of the Lake Malawi/Niassa/Nyasa Ecoregion. Boundaries to the upstream components of the lake are defined by the catchment. It is more difficult to define the lower limits of the system. Water draining from Lake Malawi/Niassa/Nyasa flows via a single exit, the Upper Shire River, into Lake Malombe, then into the Middle Shire, the Lower Shire River, and ultimately to the Zambezi River and the Indian Ocean. The Ecoregion definition calls for systems to be linked as a collective entity unified by the sharing of a large majority of their species and ecological dynamics. Lake Malombe shares with Lake Malawi/Niassa/Nyasa the majority of its species, though the larger lake has many times the number of species that are found in Lake Malombe. The Upper Shire River, that links the two lakes, is the corridor through which exchanges and sharing take place. Therefore, Lake Malawi/Niassa/Nyasa, the Upper Shire River and Lake Malombe constitute the Ecoregion as they are 1) an integral part of the basin, 2) they contain geographically distinct assemblages of natural communities, sharing many species and ecological dynamics; 3) they share similar environmental conditions; and 4) they interact ecologically in ways that are critical for their long-term persistence. As Lake Malombe has occasionally dried up during its history, including an early part of the twentieth century, the last point applies to it rather than to Lake Malawi/Niassa/Nyasa, because the restocking of Lake Malombe depended upon the main lake and the middle Shire River (Chafota *et al.*, 2005).

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16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Hydrology

The climate of the area where the lake is located is strongly influenced by altitude (ranging from less than 100 m in the lakeshore to 1500 m in the mountains of Maniamba-Amaramba) and winds accompanied by rains. Annual precipitation varies from 1000 mm to 1400 mm Niassa province. The lake area is characterized by a high surface drainage in February-March (summer), and insignificant runoff in September-October (winter). Coastal plains around the lake are subject to floods in the periods of high water levels.

Lake Niassa drains to the Indian Ocean through Chire River and Zambezi system. It is estimated that 16% of the annual losses of water from the lake is through Chire River, and the remaining (reaching up to 1.6 meters per year), through evaporation. A consequence of higher proportion of evaporation in a larger volume of water is that the lake is characterized by a longer flushing time (lake volume/annual outflow) estimated at 750 years. This lake is the world's third deepest lake with a depth just over 700 m. Its origin is natural.

The long flushing time has important implications in water quality management. Any nutrients or other chemicals that enter into the lake are practically retained within it and can only be removed through sedimentation to the bottom lake, loss to the atmosphere (if the chemical has a gaseous phase), or by the very slow process of outflow through Chire River. Therefore, the lake acts as a deposit of many pollutants, which have a long residual time, once within the lake system. Residence time taking in account the evaporation is estimated to be 140 years.

Another consequence of the dominance of precipitation and evaporation in the hydrological cycle of the lake is that it is susceptible to climate changes. A small increase in the ratio precipitation/evaporation can result in floods, as happened in 1979-80; while a decrease in that ration, can result in the closing of the lake basin, without any outflow, as was the case in the period 1915-35. The lake level varies normally ± 1 meter within a year.

Hydrographical Network

The hydrographical network of the lacustrine coast under consideration belongs to the Sub-Basin of the Niassa Lake, which in turn is part of the great Catchment Basin of the Zambezi River.

The Sub-Basin of the Niassa Lake is structurally conditioned by the nature and orientation of the relief, besides the climatic regime. There are a large number of rivers, rivulets and torrents, and in general they flow quickly, with East-West orientation; with small volumes and periodic regimes, they dry and disappear during the winter, except for river Lunho, which is the most important stream of the sub-basin. The lake is the depository of those water streams.

There is an infinity of rivers in this sub-basin, and besides the already mentioned Lunho, others that deserve reference are Chiwindi, Metumbe, Cóbuè, Unga, Wikihi, Fugue, Nalgo, Luile, Tumbucubire, Micala, Luchimange, Meluluca, Lusefa, Urunga, Timba, Latambe, Meponda, i.a..

Inflow
The total catchment area is small for a lake of this magnitude: 126 500km^2, of which 97 750 km^2 is land catchment. Consequently, the ionic composition of the river water reflects this and is dominated by calcium, magnesium and bicarbonate ions; together with sodium these form the main ions in the lake water. The inflows are mostly rather short from the escarpments and nearby mountains, and their volume depends directly on the rainfall in the catchment of each stream or river. The hydrology is delicately balanced. The existence of raised beaches at least 100m above the present lake level indicates that the level was once much higher than it is now, and has since subsided, probably in response to tectonic events, rather than climate change.

Outflow
The outlet via the Shire River to the Zambezi is intermittent, with seasonally dependent flow rates. The rise and fall of the lake is seasonal but also exhibits longer-term trends.

Outflow may increase or decrease quite substantially, depending on the annual rainfall. In a little more than a century there have been fluctuations of considerable magnitude. For example, from 1896 there was a progressive fall to a minimum in 1915, at which time the outflow ceased. From then on the level rose steadily to a maximum in 1935 when, in the wet season, it was about 6m above the maximum of 1915. At this point the outflow was resumed once the sand bar that had been built up during the low period was breached. The overall lake level continued to rise, reaching a peak in the 1979/80 wet season; thereafter, it began to fall with periodic rises in particularly wet seasons. Indeed, the level dropped so low in 1997, that the hydro-electric plant on the Shire River was threatened by the possibility of not having sufficient water to drive it. As Malawi is heavily dependent on this electricity source, great concern was engendered (Ribbink, 2001).

Lake level
With an elevation of 471m above sea level and a maximum depth of more than 700m it is clear that the deeper parts of the lake are about 230m below sea level.

Changes in surface area
The overall surface area of the lake is not greatly affected by the **annual** fluctuations in lake level despite the inundation and drying of adjacent floodplains in flat areas. Primary reasons for this are a) the steep slope of much of the lakeshore, sometimes almost vertical, means that overall the change in the surface area of inundation in response to seasonal changes in lake level is minimal, and b) relative to the permanent surface area of the lake, the area covered by the flood plains is minuscule.

Historical changes in level
Although annual changes in lake level are quite small, over historical periods, changes to lake level have both increased and decreased substantially the volume and area of the lake. There is evidence to suggest, for example, that the lake was almost 400m lower than present a mere 25000 years ago. As recently as several hundred years ago, much of the South Eastern and South Western Arm were dry as were the northern-most sandy-shores; the lake at that time is believed to have been 50m shallower than it has been for more than the last 150 years (records from Livingstone and other missionaries of about 1860 to the present suggest fairly high lake levels on average).

17. Physical features of the catchment area:
Describe the surface area, general geology and geomorphological features, general soil types, and climate (including climate type).

Geomorphology

According to the Geomorphological Map of Mozambique 1:1.000.000 (DNG, 1983, the coastal zone under study is part of the mountains that surround the Rift Valley, in an area of folded mountain which include geomorphological units known as Mountainous Region of Niassa; Region of the Sanga Mountain Range; Region of the Messinge Syncline Depression ("Depressão Sinclinar Entre-escarpas") and Tchissango Anticline Mountains. Structurally, the already mentioned document refers the occurrence of erosive massifs (from the south of Meponda to Metangula), in the form of Inselbergs, with heights that may reach 1,200 metres; gentle relief in the Karoo formations (extending from the valley of the river Lunho up to the Rovuma).

In fact, although some flat zones do occur, the area under study is characterized by very irregular relief, marked by mountains and valleys, within which three important parts may be distinguished: the strip of coastal lowlands, the sub-coastal high mountains and the zone of hills sloping to the East.

The strip of coastal lowlands, starting from the lake's continental platform, is located next to the shore, following its shape and bordering the slopes of the high mountains. The beaches are located on that part (Meponda, Chiuanga, Seli, Tungo, etc.), in extents of not more than four kilometres into the land, except for the valleys of rivers Lunho, Micala, Tumbucubire and Luchimange.

Altogether this area is slightly undulating, it is almost flat, without great variation in altitude, except for the peninsular part, which constitutes an actual hill, probably of consolidated lacustrine dunes, since the present sediments are mainly lacustrine alluvia. The vital activities of the population are centred on this area.

The sub-coastal high mountains are located immediately to the East next to the strip of coastal lowlands, occupying most of the administrative surface of the village of Cóbue. They denote large gneisse-granitic mountainous elevations, with steep escarpments, where now and then circular granitic structures appear as the highest points. It is in this area that the highest point of the Province is located - Mount Txissongo, with 1,848 metres of altitude.

The hills sloping to the East constitute a kind of basis for the high mountains on the sunny part of the coastal zone and from them come the flow of mountain sediments, through numerous valleys.

Thus, as regards the outline of the coast, the topographic features and landscape vary in morphological terms along its shores, enabling the distinction of two basic forms at the points of contact between the lake and the continent: (1) low and sandy areas, associated to beaches and reedy marshes, the latter when close to river deltas or estuaries; (2) tracts of high, sloping, rocky, stony terrain, with little vegetation.

Geology

According to some studies by Afonso (1976) and the National Directorate of Geology (DNG), on the coastal zone of Lake Niassa there are two geological complexes, namely the gneiss-migmatite complex and the Karroo sedimentary complex.

The gneiss-migmatite complex traces back to the Upper Precambrian and is composed of metamorphic rocks. It covers the whole coastal stretch from north to south and is only interrupted by the Lunho basin, where sedimentary rocks occur. The gneiss-migmatite complex is part of the so-called " Mozambique Belt" and within this system it is integrated in the stratigraphic unit of the Niassa Province, where gneisses, migmatites, calcareous amphibolites, quartzites, gneisse nephelinites and gneisse pyroxenites prevail (Afonso, 1976: pp 9, 35 and 41).

The Karroo sedimentary complex is a formation of the post-Cambrian, which occupies the river Lunho basin and is composed of sediments of continental origin, which have filled a void caused by a structural fault. It stretches in the direction NE-SW, from Metangula to Mazoco. It has particular characteristics that have earned it the designation of "lake spot" amidst all the spots of the Karroo. The rocks are mainly composed of argillaceous sandstones of various textures, sandstone conglomerates and mudstones (idem, pp 75-77).

In tectonic and structural terms, the eastern coastal zone of Lake Niassa denotes many faults and is said to be unstable, that is, prone to seismic activity.

In fact, this coast shows many faults on the graben of the lake and the horst of the eastern coastal mountains in the framework of the Rift Valley, with orientation North–South, and on the other hand the zone is prone to tectonic movements, as mentioned by Afonso (1976):

"The Rift zone of lakes Niassa and Chire must have been unstable since ancient geological times and there are signs that the area's instability still exists at present" (idem, p. 48).

From various mineral resources believed to exist in the area under study, it is at present known that red granite deposits and coal deposits exist in Meponda and in the basin of river Lunho, respectively (Afonso and Marques, 1993: pp. 103 e 122).

Climate

The coastal zone of Lake Niassa is known as the warmest area of the Niassa Province, and is classified in the Koppen system as tropical humid climate. It exhibits two distinct seasons: rainy and humid summers and dry winters.

Due to lack of updated meteorological records it was not possible to assess the dynamics of the essential climatic elements (temperature, rainfall and atmospheric humidity), neither of the influence of micro-climatic factors which are clear there, such as its continental character, general and micro-circulation of the atmosphere, relief, inter alia. However, it is known beforehand that Lake Niassa's coast constitutes the warmest and less rainy area of the Province of Niassa, and the indicated factors have great influence on that.

In spite of the lack of data, the Geographical Atlas (vol. I) states that the average annual temperature varies from 22 to 24ºC; the average annual rainfall fluctuates between 1,000 and 1,400 mm (MINED, 1986: pp. 16-17.)

On the other hand, the experience of residents in the area indicates that the rainy season takes place between the months of November and April, during which rains fall torrentially, associated to the Mwera and Lilinga winds. The dry season takes place from May to October and the weather is then generally good, although occasionally storms may occur.

Soils

The soils of the eastern coast of Lake Niassa originate from gneisse-granitic rocks of the Precambrian and sedimentary-alluvial rocks of the Quaternary. In general these are brown and reddish soils, deep, with medium to coarse texture, clay, of varied fertility from moderate to excellent, suitable for agricultural activities including irrigation. The main limitations, in some of the types, are related to their great exposure to erosion and crust formation, which hamper seed germination.

All along the coast and from the point of view of spatial distribution, three soil complexes occur, with the centre in the river Lunho catchment basin, central part of the area we are analysing

North of the river Lunho catchment basin: from the border area with Tanzania to the mouth of the river Lumbue (Ngoo), parallel to the coast, red soils may be found and in inner zones there are lithic soils, equally prevailing between the south of river Lumbue to the basin of the Lunho.

The reddish brown soils are deep over the altered parent material; with texture from loamy clay to clay loam, good drainage, good content of organic matter, they are neither salted nor sodic, they are excellent for agriculture, but very susceptible to erosion, they hamper seed germination due to the formation of superficial crusts. They resulted from Precambrian rocks.

Lithic soils are brown, formed over a Precambrian rock of granite and gneiss. Many of them are associated to steep slopes and inselbergs, eroded zones and rocky outcrops, where the depth does not go beyond 30 cm. These are soils of sandy texture, clay loams, moderately acid, with low content of organic matter, moderate fertility, not salted neither sodic. Their main limitation for agriculture is scarce depth.

Basin of the river Lunho: next to the river's basin and valley, soils are brown, composed of sediments from the Quaternary, subdivided into two groups: brown soils and greyish-brown, deep soils, in isolated areas.
Brown soils (whose spatial distribution has the form of a parabola facing the lake and cut at the centre by soils of the Lunho river valley) have low depth, moderate drainage; they are slightly acid, with low content of organic matter, suitable for agriculture, very sensitive to erosion.

The greyish brown soils that cover the valley of the Lunho river are composed of stratified alluvia, with medium texture, deep, with high content of organic matter and silt, good drainage, they are neither salted nor acid, they are slightly sodic, associated to riverine forest and thickets, and are suitable for agriculture. Fertility and sodicity are the typical limitations.

South of the Lunho basin: All over the coast to the south of the Lunho basin, up to the border benchmark 17 in the area of Meponda there are associations of reddish-brown and lithic soils.

The reddish-brown soils result from sediments over the Precambrian period. They exhibit depths of over 100 cm, excellent suitability for agriculture, good drainage, low content of organic

matter, low fertility, they are neither salted nor sodic and are exposed to erosion and crust formation, thus limiting germination. Lithic soils conform to the above description.

18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

There is a distinct lack of quantifiable information on the hydrological values of Lake Niassa; however of course generally one can always say that all Lakes have these features of sediment stabilization, erosion control, ground water replenishment, water purification and nutrient cycling.

Nutrients

Rivers bring a small proportion of nutrients and therefore, nutrients within the lake are primarily from internal mixture. Recent measurements indicate that the deposition of atmospheric nitrogen in the lake is similar, in terms of magnitude, to the inflow of nitrogen through the rivers. In the same way, the largest source of phosphorous is from the atmosphere. Although it is difficult to confirm the main source of this phosphorous, it seems that it is from combustion of vegetal biomass around the lake. Global analysis of biomass burnt indicates that East-Central Africa experiences the highest frequency of combustion of vegetal biomass on earth. The survey showed that during biomass burning more than 96% of nitrogen from the surface and 56% of phosphorous are lost from the soil. Therefore these fires have not only impact on the lake, but result also in the loss of soil fertility.

There is not enough historical data to confirm whether the influx of nutrients has increased, but analysis of sediments suggests that the influx of nutrients increased in the last 40 years. However, so far there are no signs of eutrophication in Lake Niassa, which in other lakes, like Victoria, are one of the main threats for maintenance of diversity of fish communities. Offshore waters are clear during the major part of the year. (Moved from 16)

19. Wetland Types

a) presence:

Circle or underline the applicable codes for the wetland types of the Ramsar "Classification System for Wetland Type" present in the Ramsar site. Descriptions of each wetland type code are provided in Annex I of the *Explanatory Notes & Guidelines*.

Marine/coastal: A • B • C • D • E • F • G • H • I • J • K • Zk(a)

Inland: L • <u>M</u> • <u>N</u> • <u>O</u> • P • Q • R • Sp • Ss • Tp Ts • U • Va •
Vt • W • Xf • Xp • Y • Zg • Zk(b)

Human-made: 1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • Zk(c)

b) dominance:

List the wetland types identified in a) above in order of their dominance (by area) in the Ramsar site, starting with the wetland type with the largest area.

"O", as a permanent lake, with an area of around 577,000 ha (5,770 Km^2)

"M" and "N", because of permanent and seasonal streams/rivers coming in and out the larger Lake, with an estimated area of around 200 ha

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

Natural vegetation in the catchment area is Deciduous- Miombo Woodland. The dominant tree species are *Brachystegia spiciformis* often mixed with *Julbernardia globiflora*. Associated tree species include *Pterocarpus rotundifolius*, *Vitex payos*, *V. doniana*, *Dombeya rotundifolia*, *Albizia adianthifolia*, *Pteleopsis myrtifolia*, *Cussonia spicata*, *Piliostigma thonningii* and *Parinari curatellifolia*. Where drainage is particularly good *Uapaca sansibarica* and *U. kirkiana* may replace *Brachystegia spiciformis*.

The vegetation in the Ramsar site has officially been called **Miombo** (MINED, 1986, p.19), a plant formation composed mainly by woody species, mainly *Brachystegia sp.* and *Strychnos spinosa* in its pure condition or associated to *Julbernardia globiflora*, *Pterocarpus angolensis*, *Burkea africana, Bridelia micrantha, Cynometra sp., Dalbergia melanoxylon, Millettia stuhlmannii sp., Pteleopsis myrtifolia*, amongst others (Saket, 1994, p. 8).

With another perspective, the Forestry Map of the Province of Niassa (DNFFB, 1995) depicts the eastern coastal zone of Niassa lake as consisting of vegetation sections singled out in the form of prairies with trees, thickets (low, medium and high) and forests, which may be divided into zones as follows:

Northern zone: between the northern border and the south of Cóbuè, the vegetation is low thicket and prairies;

Central zone: from the Mala Point to the south of Metangula, the main vegetation is prairies with trees near the banks, while the inner land is dominated by low thicket;

Southern zone: between the Timba River and the bench mark no.17 there is an association of prairies with trees and a section of low thicket in the area bordering the lake.

In our opinion, the two types of vegetation, even if they exhibit the different vegetation formations in the study area, have a generic character, as they do not present dominant or frequent species in each section.

However, Pedro and Barbosa (1954) had considered, in a detailed work, that the coast was composed of a "vegetation complex of the Niassa lake margins", a series of various vegetal formations different from one another (in terms of flora composition, biological forms, structures and habitat) in view of variations in altitude, topography, lithology, groundwater and others.

According to those researchers, the complex of the lake's marginal areas is located between the beach and the 500 metres bench mark, in gneisse-granitic formations of the Karroo and in alluvial formations, which may exhibit high deciduous woody forests; open thickets.

Fauna

The fact that it constitutes an area of confluence of two distinct physical / natural environments (terrestrial and lakeshore), the coastal strip exhibited species from both, as may be seen from the massive presence of amphibious animals, mainly crocodiles, hippopotamuses, toads, salamandras, crabs, etc.

There are no official updated and systematized data on the animal species to be found there, but presently there are quite deserted areas while others are still intact. Oral tradition refers to rich and diverse wildlife, including various categories of terrestrial, aquatic and amphibious animals: fish, molluscs, insects, crustaceans, reptiles, birds, and mammals.

In an assessment of coastal resource management in the study area (districts of Lichinga and Lago) and on the basis of interviews, Omar (1999: pp. 54-56) refers the existence of diverse wildlife varieties: lakeshore (fishes, hippopotamuses, crocodiles, toads, turtles, snails, cockles and others), terrestrial (wildebeest, wild dogs, buffaloes, elephants, monkeys, hyenas, leopards, various snakes and lizards, wide variety of birds, etc.) These species have been seen as single animals as well as in groups of various animals.

Lake Niassa has the highest number of fish species of any lake in the world, most of which are endemic, and hence it is a true centre of biodiversity (Ribbink, 2001) . There are estimated to be between 600 and 1000 species and are distributed among 12 families; the family Cichlidae contains the largest number of fish species many of which have distinct geographical colour varieties and some of which are polymorphic (Ribbink, 2001). At present, about 300 species from the lake have been scientifically investigated mostly from the southern end, due to the concentration of sampling effort at that part of the lake.

In Mozambican side, the isobaths of 100 meters is on average 1.4 km from the coast. This fact and the small influx of nutrients are responsible for low productivity of this area of the lake. Although offshore pelagic resources with potentialities for fisheries have been identified, no initiative has been carried out so far to test the viability of exploiting these resources.

Habitat

The level of the lake and the volume of the outflow react rapidly to changes in local rainfall between wet and dry seasons as well as to longer term fluctuations. These changes may transform certain inshore habitats. Except where the escarpments drop directly into the lake, there are coastal plains of varying width, which are alternately flooded or exposed. The water level changes can have marked impacts on fish catches because the floodplains act as very productive nursery areas. Large changes in lake level over protracted periods are likely to have had considerable effects on speciation (Ribbink, 2001).

Substantial changes in the lake level can modify the geography, hydrology, limnology and habitats in the lake and are believed to have had major consequences for speciation and extinction (Ribbink, 2001).

The annual changes, plus incremental trends over a number of years may cause significant changes in level of several metres leading to losses or gains of habitat. It is notable that for several years after a really wet year, when additional areas of the floodplains are inundated, there are good catches in the fisheries. Whether this is because of the enhanced use of vegetated

nursery areas in which fry can grow and remain well protected, or whether it is because of an enhanced near-shore productivity, or both, is unknown. The effect of increasing and decreasing nursery areas needs assessment as a possible means to improve reproductive success of the fishes to enhance biodiversity conservation, recruitment into the fishery and, hence, fisheries production (Ribbink, 2001).

In addition to flood plain effects, annual and longer changes in level modify the area of habitat available to shallow water habitat specialists, increasing or decreasing this area and in so doing affecting carrying capacity so that the population supported is constricted or expanded. In the case of specialists, that are endemic to specific sites, these changes can influence their conservation status. If the habitat is increased in area the population grows and becomes healthy. Conversely, if the habitat shrinks, the carrying capacity decreases and the population diminishes to become vulnerable. A rise in level can be an advantage to some habitat specialists and a disadvantage to others. Equally, the same species in different localities can be affected differently in each location. Changes in lake level can also force fishes that are adapted to a particular depth range and substrate type into another habitat (Ribbink, 2001).

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21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 14, Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS*.

Submerged macrophytes

The distribution of these vegetated areas around the lake is unknown, but they are particularly vulnerable to being removed by seine netting. In addition, the vegetated areas are threatened by lakeshore settlements, notably the development of hotel and holiday resorts, which results in clearing of macrophytes on the fringes of the lake in order to create beaches.

The habitat provides physical, structural and biological habitat for invertebrates, a large surface area for epiphytes, nursery grounds and refuges for fishes, as well as detritus. It is clear from the number of fishes (and perhaps other organisms too) that show close anatomical, behavioural and ecological adaptations to these vegetated areas that they represent the products of a long co-evolutionary association. The evolutionary association also reflects tight ecological interrelationships, suggesting that the vegetated areas represent a complex, but dynamic web of intricate activities. However, the ecological role and value of submerged macrophytes in the lake seems not to have been studied (Ribbink, 2001). The importance of submerged macrophytes was considered extremely high by all authors during the discussion of aquatic habitats, even though quantitative information is lacking. The need for biodiversity surveys in vegetated regions was seen as a priority.

Emergent and floating macrophytes

Fully documented analyses of the distribution, ecology and diversity of these plants along the fringes of the lake and the rivers that enter and leave the system have not been found. Nevertheless, the following picture does emerge. These plants are always in shallow fringe areas, along the lakeshore, in associated waters including rivers and swamps. They include the *Phragmites mauritianus* and *Phragmites australis* (reeds), *Typha domingensis* (bulrush), *Cyperus papyrus* (papyrus) and *Vossia cuspidata* (hippo-grass) stands. A characteristic of most aquatic plants is that

they are able to grow and propagate very rapidly in the correct environment. In the case of the rooted emergent macrophytes (reeds, bulrushes, papyrus and hippo-grass) this rapid development and propagation results in dense, monospecific stands where conditions suit them. Within the centre of such stands no other macrophytic plants have an opportunity to succeed, but in the peripheral areas of these stands, habitats that suit other plants develop and mixed plant communities are found. Therefore the relationships of these rooted emergent macrophytes to other plants and to the physical environment can be instructive with respect to understanding biodiversity. A number of aquatic plant species are of conservation interest because of the threat they pose to natural ecosystems and species. Amongst the most significant to the aquatic environment are: *Azolla nilotica* (Azollaceae); *Eichornia crassipes* (Pontederiaceae); *Myriophyllum aquaticaum* (Haloragidaceae); *Salvinia molesta* (Salviniaceae) and *Pistia stratiotes* (Araceae) (Ribbink, 2001). It should be noted that species succession of vegetation in swamps and floodplains depends on seasonal inundation. In addition, anthropogenic influence on vegetation in these areas is enormous due to seasonal cultivation during low water level, especially evident along the shores of Lake Malombe and the Linthipe River. It is important that the impact of seasonal variation in water level and cultivation on emergent macrophytes is assessed.

Algae

The filamentous algae mat harbours a rich diversity of benthic fauna, including insect larvae, crustaceans (ostracods, copepods, and *Caradina),* and a myriad of other small invertebrates (Abdallah 2000). Nowadays it is recognised that the filamentous algae comprises at least 50 species, but their taxonomy is very poorly understood, as is their ecology. These certainly warrant a thorough assessment. The algal mat forms the mainstay of the communities of rocky habitats, being largely responsible for supporting the rich diversity of rock frequenting fishes. Trophic adaptations of fishes support a variety of feeding behaviours to utilise the algae. Some species pluck, mow or cut the filamentous species from the rock, ingesting and digesting it. Others (e.g. members of the genus *Labeotropheus*) ingest it, but do not digest it. These fishes collect the filamentous algae simply to obtain and digest the animals and unicellular algae that live among the filaments or grow on the filaments. Other fishes also feed on the epiphytes, but have numerous long-flexible teeth that are adapted to comb or brush them from the filaments (e.g. members of the genus *Petrotilapia* and the *Pseudotropheus zebra* species complex) (Ribbink, 2001).

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22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in 12. Justification for the application of the Criteria) indicating, e.g., which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

An important and distinctive characteristic of Lake Niassa is the great number of endemic fish species, which is the highest of all freshwater communities in the world. More than 90% of fish species present are endemic to the lake. The diversity, jointly with the fascinating feeding and reproductive behaviour of many species is of great importance to the scientific community. Of particular interest are the 600 cichlid species of which only five are not endemic to the lake. *Tilapia*, a genus of cichlids, is the main source of food for the population living around the lake and is the main catch of commercial fishery. Definitive information on the 600 cichlid species, is currently unavailable but will be provided as soon as it is possible.

Of the 139 species, including lizards, snakes and aquatic turtles, approximately 13 of those occurring in the area of the Lake are endemic.

Approximately 648 species of birds from 78 families occur in the region, of which 456 are native and 94 migratory. About 1/3 of the bird species are considered rare and little common in the area.

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23. Social and cultural values:

a) Describe if the site has any general social and/or cultural values e.g., fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values:

Lake Niassa and its Coastal Zone wetland is important for education and scientific research, and for economic activities with impact on the livelihoods of local residents. Amongst others, the wetland provides for activities such as grazing, fisheries and agriculture production, animal rearing, hunting, trade and handicrafts. Fisheries play probably the most important role, impacting on almost all families residing in the coastal zone.

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning?

If Yes, tick the box **X** and describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

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24. Land tenure/ownership:
a) within the Ramsar site:

According to the Land Law in Mozambique, all the land belongs to the State but in case of Metangula as Municipality has administrative, financial and patrimonial autonomy.

b) in the surrounding area:

The surrounding area is also State owned.

25. Current land (including water) use:
a) within the Ramsar site:

The total number of inhabitants living in the terrestrial side of the proposed Ramsar site is estimated to be around 100,000, being 75,000 from Lago District, including 17,000 living in the municipality of Metangula, and 25,000 people from the Liching District, Administrative Post of Meponda (http://www.ine.gov.mz).

Fisheries
It is the most relevant activity all along the coast. It is carried out by men of every age, including boys. At present it is undertaken in a family framework, individually or in groups, or even co-operatives. It aims mainly at family subsistence and if there are surpluses, these are sold. Many of the fishermen are not registered and do not provide information for the control of catches. Fisheries are carried out throughout the year, without any closed season. The exact number of active fishermen is not known at present. Various types of fishes are caught. Most of the population depends on this activity to provide for their food needs and to generate income.

Agriculture
It is the second most important activity of the populations. It is undertaken only in family terms, in land plots of about 1.5 hectares. The fields may be located on the coastal lowlands, by the valleys, or on the mountainous slopes; the yields are low. Depending on the soils and their location, various products may be grown, such as cassava (manioc), maize, rice, bean varieties, sesame, sweet-potato, sorghum, millet, horticultural crops, potato, groundnut, etc. Due to the low yields, over recent years agriculture is carried out by an ever-decreasing number of families.

Animal Rearing
It consists mainly of the rearing of large and small animals and poultry. The animals include domestic species such as goats, sheep, rabbits, hens, ducks, pigeons, etc. Animals are reared in family exploitations and are mainly used as food supplies in festive occasions, as well as for sale or barter for other food products.

Hunting
It consists of the hunting and catch of wild animals, mainly the species that may be eaten. It is undertaken by almost all the communities, more or less frequently, individually or in groups. It is particularly undertaken during the dry season, when the lake provides little fish.

Trade
It is predominantly informal, due to the lack of shops or canteens in most of the territory. Families sell their produce and in exchange try to obtain industrial or processed products. Normally each settlement has a place for trading activities. In addition, the big distances, access difficulties and local poverty motivate the low commercialisation.

Handicrafts
Craftsmen carry out these activities, individually or in groups. They involve the production of implements to assist in other economic and family activities, such as hoes, machetes, hunting nets, beds, doors, pots, baskets, chairs and others, on the basis of forest and soil resources or metal scrap.

b) in the surroundings/catchment:

Like in the rest of the province, the majority of the population depends on agriculture. Artisanal fishing is traditionally a complementary activity and, in many cases, it constitutes the primary economic activity for many families that live along the coast of LN. In fact, the natural resource with greatest economic importance and protein rich for the coastal communities is fish. Agriculture is complemented in the highlands by hunting particularly in the dry season, and by artisanal fishing on the coast along Lake Niassa.

The livestock sector mainly cattle raising is not so much developed on the one hand due to cultural/traditional reasons and the other due to the prevalence of the tsetse fly in the region. Nonetheless, there is a significant activity of goat and bird breeding, particularly for their own consumption and sale of surpluses.

The industrial sector consists essentially of light industries such as mills, bakeries and artisanal soap production. The formal trade network is evolving positively, although its coverage remains weak and in some districts such as Lago and in the Administrative Post of Meponda in Lichinga district, its presence cannot yet be felt. In the face of this, the informal sector is playing a greater role in the supply of various goods in the region, acquired mostly in Malawi.

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26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

a) within the Ramsar site:
Since there is no control of the statistical data, nor monitoring studies regarding the various coastal resources, it is difficult to assess the change of level in relation to natural resource harvesting, which is aggravated by the prevailingly traditional character of those exploitations.

The only reference on the matter is what is indicated by local reports:

- Soil depletion, discouraging farming families, which causes further erosion and sedimentation into the Lake
- Fish depletion in some areas, such as Metangula and Meponda; All fish catches in Mozambique are obtained from artisanal fishery, within 2 km from the coast, which is the habitat for the majority of endemic species of Cichlid Family. Cichlids, due to their sedentary nature, have a localized distribution within the lake. Consequently, they are vulnerable to extinction by excessive fishing pressure in shallow waters; localized effects of pollution; and other environmental problems. Other fish species migrate to the rivers to reproduce and some of these species suffered a decline in their numbers. There are vulnerable to fishing around river mouths and within the rivers. They can also be sensible to an increase on sediments and siltation of rivers
- Scarcity of fuelwood near the larger settlements, which is caused by deforestation and further exacerbates erosion and sedimentation
- Scarcity of wildlife previously in large number due to changes in habitat and overhunting;
- Reduction of the level of agricultural yields, due to the overuse of soils and loss of topsoil due to the rain;

- Decline in biodiversity due to human action: Although neither systematised nor updated quantitative and qualitative data are available in relation to wildlife, the eastern coastal zone of Lake Niassa seems to be experiencing a decrease in biodiversity, as a consequence of human action (presence and hunting).

Note: No information exists on invasive species and aliens

b) in the surrounding area:

The impact of burning on nutrient influx into the lake: Although it is difficult to confirm the main source of this phosphorous, it seems that it is from combustion of vegetal biomass around the lake. Global analysis of biomass burnt indicates that East-Central Africa experiences the highest frequency of combustion of vegetal biomass on earth. The survey showed that during biomass burning more than 96% of nitrogen from the surface and 56% of phosphorous are lost from the soil. Therefore these fires have not only impact on the lake, but result also in the loss of soil fertility.

There are not enough historical data to confirm whether the influx of nutrients has increased, but analysis of sediments suggests that the influx of nutrients increased in the last 40 years. However, so far there are no signs of eutrofication in Lake Niassa, which in other lakes, like Victoria, are one of the main threats for maintenance of diversity of fish communities. Offshore waters are clear during the major part of the year

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27. Conservation measures taken:

a) List national and/or international category and legal status of protected areas, including boundary relationships with the Ramsar site:
In particular, if the site is partly or wholly a World Heritage Site and/or a UNESCO Biosphere Reserve, please give the names of the site under these designations.

No protected area of any kind exist in the area

b) If appropriate, list the IUCN (1994) protected areas category/ies which apply to the site (tick the box or boxes as appropriate):
Not applicable.

Ia ❑;Ib ❑; II ❑; III ❑; IV ❑; V ❑; VI ❑

c) Does an officially approved management plan exist; and is it being implemented?:

No management plan of any kind exists in the area.

d) Describe any other current management practices:

Local enforcement is done by the Maritime Authority and the Ministry of Fisheries specially regarding the movement of fishermen from other countries.

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28. Conservation measures proposed but not yet implemented:
e.g. management plan in preparation; official proposal as a legally protected area, etc.

The MICOA (Ministério para a Coordenação da Acção Ambiental) initiated a process for the establishment of an Integrated Management program aimed at the conservation of biological

diversity and sustainable use of the natural resources. In its Integrated Management of Lake Niassa Coastal Zone Project (Lakeshore Districts of Lichinga and Lago), MICOA has started the process of a Strategic Environmental Assessment (SEA), where one of the expected results is the elaboration of the management plan of the area. The Provincial Directorate of Mineral Resources and Energy is planning the preparation of Master Plan of the area. The Government of Niassa Province, with the support from USAID and WWF also initiated, in 2004, the discussion of a Reserve in the shores of the Lake, exclusively in the Lago District. This process is somehow well advanced and, after local consultations, a draft management plan is being prepared. The area proposed, however, is much smaller than the current proposed Ramsar site.

No drafts or other documents are currently available.

29. Current scientific research and facilities:
e.g., details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

In the context of the WWF proposed wider "Ecoregion of Lake Malawi/Niassa/Nyasa, a great deal of information was generated and compiled (Chafota, 2000, Ribbink, 2001). Most of the information, however, is from Malawi. In the Mozambican side of the lake, little scientific information regarding fisheries exists, and covers only the fishing activities (fishing centres, fishing methods and catches) and socio-economic aspects. Information concerning taxonomy, limnology, evolution, ecology, biology of fisheries resources and legal and institutional aspects does not exist. In terms of geographical distribution of scientific knowledge, studies are concentrated in Metangula. The Institute of Fisheries Research (IIP) maintains a research station in Metangula and supports the sampling and monitoring of fish landings together with staff from the Institute for Small Scale Fisheries (IDPPE). Studies are also under way on the possibility of aquaculture in the Lake and the impact of aquarium fish industry in the Cichlids (Halafo, 2008).

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:
e.g. visitors' centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

Not much in terms of education and awareness on the benefits of the Lake is taking place. In the light of some of the initiatives mentioned on chapter 27 above, several workshops in the proposed Ramsar site were organised in 2003-2004. The workshops aimed to highlight the importance and role Lago Niassa Coastal Zone for Mozambique, regionally and internationally. The meetings also discussed the socio-economic and ecological impacts of developments along the area. Currently, the Ministry of Fisheries is facilitating the establishment of co-management of fisheries with fishermen and local authorities through a process of awareness related to the need to manage the fisheries resources in a better way.

31. Current recreation and tourism:
State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Although tourism still at embryo stage there are few activities going on. Metangula Municipality has some small tourism enterprises. Every year, the area receives hundreds of overseas tourists interested to enjoy the beautiful beaches, producing incomes for Mozambique government and partially for the local communities.

32. Jurisdiction:
Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept of Agriculture/Dept. of Environment, etc.

Territorially, the area is in the jurisdiction area of two districts of Niassa province, namely the districts of Lichinga (Posto Administrativo of Meponda) and Lago (Posto Administrativo of Lunho and Cobue) and the municipality of Metangula.

Administração do Distrito de Lichinga; Posto administrativo de Meponda.

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

- At National Level: Mr. Rogèrio Wamusse, National Director for Environmental management, Ministry for the coordination of Environmental Affairs, mobile:
- Focal Point for the Ramsar Convention: Ms Sidónia Muhorro
- At Provincial level: Mr. Bernardino Victor, cell +258 82 4099320, Provincial Director for the Coordination of Environmental Affairs (MICOA)
- At Provincial level: Mr. João Juvêncio, cell 82 4840950, Provincial Director of Tourism

Site managers:

Districts usually receive their correspondence through their head offices; we suggest sending correspondence to the administrator of Lichinga in Lichinga town. He will then distribute to the administrative posts.

- At local level: Mr.Carlos Abudo Momade , Administrator of Lago District, Administration of Lago District
- Administrator of Lichinga District: Mr. Juma Taratibo, Adminitration of Lichinga District, Lingaga Town
- Major of Metangula Municipality, Mr. Assimo Anasse, Conselho Municipal de Metangula
- Head of Administrative Post Meponda, Mrs. Laura Cristovão, Meponda
- Head of Administrative Post Lunho, Mr. Jaime Catungue, Lunho
- Head of Administrative Post Cobue, Mr. Xavier Adamo, Cobue

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see 15 above), list full reference citation for the scheme.

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