AQUATIC HABITATS IN AFRICA

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LIMNOLOGY OF RIVERS AND LAKES - Aquatic Habitats in Africa – Gamal M EL Shabrawy

Summary

Although, Africa has abundant freshwater resources, 14 countries are subject to water stress (1700 m³ or less per person per year) or water scarcity (1000 m³ or less per person per year), and another 11 countries are expected to join this list in the 2025. This chapter highlights the major aquatic habitats in Africa, including the main rivers, lakes, lagoons and wetlands. The economic importance and human interaction with the water of these aquatic habitats are discussed. A combination of climatic changes, human population growth, unsustainable resource use, and desertification is threatening the African ecosystems and ability to supply crucially needed natural resources to the people of Africa. Unfortunately, the human pressure on African aquatic ecosystems is expected to increase as populations grow, unless strategic action plans are put in place for their conservation. National and international efforts are required to manage these habitats.

1. Introduction

Although the presences of large rivers and lakes such as the Congo, the Nile, the Zambezi, the Niger, Lake Victoria (the world’s second largest), Lake Chad, Lake Tanganyika, etc., Africa is the second driest continent in the world, after Australia, and millions of Africans still suffer from water shortages throughout the year. Shortages are often due to problems of uneven distribution (sometimes there is much water where there are fewer people) and also to management of existing supplies that could be improved (WWF, 2002).

Aquatic habitats are defined as water bodies supporting aquatic life. They include: rivers, streams, lakes, ponds, cave water, springs, floodplains, and wetlands (bogs, marshes, and swamps) that provide water for drinking, sanitation, agriculture, transport, electricity generation and recreation (CBD 2005). They provide valuable but often unaccounted for, regulation of floods, drought, nutrient and sediment deposition. They are also habitats for diverse faunas and floras which constitute a vital and important source of food and fiber that sustains incomes and livelihoods, particularly for rural communities in all developing countries (CBD, 2005).

Africa is the second-largest continent after Asia and is currently considered among the most strategic regions in terms of global development opportunities. The vast landscape of Africa contains a host of natural wonders and rich resources. Its grasslands, wetlands, mountains, deserts, rainforests and marine areas are home to thousands of species of plants and animals. Africa is rich in freshwater systems comprising natural lakes, man-made lakes or reservoirs and rivers.

The major lakes (Fig. 1) include in alphabetical order Albert, Bangwuelu, Chad, Chilwa, Edward, George, Kivu, Kyoga, Malawi (Nyasa), Mweru, Nasser-Nubia, Tanganyika, Turkana, and Victoria. The major man-made lakes include: Cahora Bassa (Also spelt Cabora Bassa.), Kariba, Kainji, Nasser-Nubia and Volta. The larger natural lakes of the rift valley include Albert, Edward, George, Kivu, Tanganyika and Turkana. In addition, the rift valley has a number of smaller lakes including Baringo, Bagotia, Nakuru, Naivasha, Magadi, Natron, and Manyara (Ogutu-Ohwayo and Balirwa 2006). The African Great Lakes include Victoria which is the second largest lake in the world,
Lake Tanganyika which is the second deepest lake in the world. Other smaller lakes such George, Nakuru, Naivasha have been useful in understanding the production processes in African lakes. The African lakes such as those of the Rift valley are amongst the oldest on earth (e.g. Lake Tanganyika: 2-20 million years BP) and are sensitive to climatic and physico-chemical changes. Lake Victoria is reported to have dried up about 12,500 years ago (Johnson et al, 1996) while 6000 years ago Lake Chad was 20 times larger and its maximum depth was 154 m compared with about 4 m today (ILEC, 2003). As recent as the 1960s, the environments (particularly water level) of Lakes Victoria, Kyoga, Tanganyika and Malawi have changed in response to variable rains. The African lakes contribute significantly to poverty reduction and food security. They are a source of dietary proteins and water, they provide revenue through fish harvest, export and tourism, and are used as avenues for transport of people and goods. The lakes also provide water for irrigation, agriculture and hydropower projects. Lakes Malawi, Tanganyika and Victoria harbour diverse endemic fish faunas of ecological and scientific importance.

During this century, African lakes have experienced declines in fish catches, reduction in fish species diversity and deterioration in water quality. Much effort has already been put in mitigating these threats but there is still need to strengthen these efforts.

![Figure 1. The main rivers and lakes in Africa](Modified from Ogutu-Ohwayo& Balirwa, 2006)
Lakes: 1 - Bardawil lagoon; 3 - Nasser-Nubia; 4- Tana; 5 - Turkana; 6 - Kioga; 7 - Albert; 8 - Edward; 9 -Victoria; 10 - Tanganyika; 11 - Malawi; 12 - Chilwa; 13 - Kariba; 14 - Bangwelu; 15 - Mweru; 16 - Chad; 17 - Volta
Rivers: 2 - Nile; 18 - Juba-Schebele; 19 - Tana; 20 - Athi; 21 - Ruaha; 22 - Ruvuma; 23 - Zambezi; 24 - Save (Sabi-Lundi); 25 - Limpopo; 26 - Orange; 27 - Kunene; 28 - Zaire; 29 - Niger; 30 - Volta; 31 - Senegal.

2. African Aquatic Habitats

Aquatic ecosystems consist of living organisms together with their nonliving habitat. Although the ecosystem concept is a useful one, the exact definition is somewhat arbitrary. For example, an ecosystem can range in size from a small water droplet to the vast oceanic ecosystem, and the upper, lower, and horizontal boundaries are often not well established. Similarly, the temporal aspects of ecosystems are often fuzzy. For example, a vernal (spring) pond is a temporary wetland filled with rainwater, and is transformed from an aquatic ecosystem into a terrestrial one when it dries up during the summer. An intermittent stream is one that sometimes is full of water and at other times dry. Ecosystems are not always self-sustaining. For example, fish and other aquatic animals in streams depend on leaves and insects falling from terrestrial (land) ecosystems as energy sources. Just as no single life form (species) is sufficient unto itself, neither is any one ecosystem. Ecosystems and their plant and animal life are not independent from one another in time, space, or energy. The four basic parts of any ecosystem, whether aquatic or terrestrial, are: • abiotic (nonliving) substances (mainly inorganic and organic compounds), producers (largely green plants), • consumers (animals), and decomposers (bacteria and fungi). Plants, animals, decomposers, and organics are interdependent with one another.

Any large geographic region characterized by a certain type of ecosystem is known as a Biome. Aquatic biomes may be freshwater (lakes, ponds, rivers and streams), Freshwater/brackish (estuaries and wetlands) and marine (inter-tidal regions, coral reefs, oceanic pelagic zones and abyssal zones). An ecosystem is generally defined as a community of organisms living in a particular environment and the physical elements in that environment with which they interact. Within each ecosystem, there are habitats which may also vary in size. A habitat is the place where a population lives. A population is a group of living organisms of the same kind living in the same place at the same time. All of the populations interact and form a community. The community of living things interacts with the non-living world around it (soil, water, air and energy), to form the ecosystem. The habitat must supply the needs of organisms, such as food, water, temperature, oxygen, and minerals. If the population's needs are not met, it will either die off or move to a better habitat. The processes of competition, predation, parasitism, cooperation, and symbiosis occur and characterize habitats.

Inland aquatic habitats, such as rivers, lakes, ponds and wetlands, provide a range of important ecosystem services and benefits to society. However, the unsustainable use of aquatic habitats, including by the urban water management sector itself, tends to alter and reduce their biodiversity and thus their ability to provide services, including clean water, protection of human health from waterborne diseases and pollutants, protection of urban areas from flooding, and the maintenance of aesthetic and recreational...
ecosystem services. Spurred by increasing urbanization, population increases and climate change, this is a global issue that is likely to grow more and more serious over the coming years, in particular in the South. If it is not addressed, there is the threat that several of the Millennium Development Goals will not be reachable (Wagner et al, 2007).

<table>
<thead>
<tr>
<th>Country</th>
<th>No. of lakes</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uganda</td>
<td>69</td>
<td>10.0</td>
</tr>
<tr>
<td>Kenya</td>
<td>64</td>
<td>9.5</td>
</tr>
<tr>
<td>Cameroon</td>
<td>59</td>
<td>8.7</td>
</tr>
<tr>
<td>Tanzania</td>
<td>49</td>
<td>7.2</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>46</td>
<td>6.8</td>
</tr>
<tr>
<td>South Africa</td>
<td>37</td>
<td>5.5</td>
</tr>
<tr>
<td>Rwanda</td>
<td>29</td>
<td>4.3</td>
</tr>
<tr>
<td>Ghana</td>
<td>29</td>
<td>4.3</td>
</tr>
<tr>
<td>Morocco</td>
<td>26</td>
<td>3.8</td>
</tr>
<tr>
<td>Madagascar</td>
<td>25</td>
<td>3.7</td>
</tr>
<tr>
<td>Egypt</td>
<td>16</td>
<td>2.4</td>
</tr>
<tr>
<td>Nigeria</td>
<td>16</td>
<td>2.4</td>
</tr>
<tr>
<td>Mali</td>
<td>15</td>
<td>2.2</td>
</tr>
<tr>
<td>Tunisia</td>
<td>15</td>
<td>2.2</td>
</tr>
<tr>
<td>Zaire</td>
<td>15</td>
<td>2.2</td>
</tr>
<tr>
<td>Malawi</td>
<td>13</td>
<td>1.9</td>
</tr>
<tr>
<td>Botswana</td>
<td>12</td>
<td>1.8</td>
</tr>
<tr>
<td>Gabon</td>
<td>8</td>
<td>1.2</td>
</tr>
<tr>
<td>Others</td>
<td>134</td>
<td>20.0</td>
</tr>
<tr>
<td>Total</td>
<td>677</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 1. Principal lakes in Africa

2.1. Lakes

Lakes are usually formed when natural depressions or basins in the land surface become filled with water over time. They can range from small ponds to water-bodies stretching hundreds of kilometers and containing vast quantities of water. In contrast to flowing streams and rivers, lakes provide a means for pooling or storing water for varying periods of time. They provide water for consumption, fishing, irrigation, power generation, transportation, recreation, and a variety of other domestic, agricultural and industrial uses (Zinabu 1998).

Africa, particularly East Africa, has numerous lakes that support important fisheries which provide livelihoods for millions of people and contribute significantly to the food supply (UNEP 2006). According to the world lake database, there are 677 lakes in Africa, with 88 of them listed as principal lakes (Table 1). Although lakes are a source of livelihoods in most African societies, they are also a major source of natural disasters, tropical diseases and pandemics. It is important to note that Africa’s lakes are also undergoing significant changes due to a combination of human activities and
climate change, with potentially serious implications for people’s livelihoods and aquatic biodiversity. The major characteristics of main rivers of Africa are shown in Table (2).

<table>
<thead>
<tr>
<th>Country</th>
<th>Volume (km³)</th>
<th>Surface Area (km²)</th>
<th>Shoreline Length (km)</th>
<th>Mean Depth (m)</th>
<th>Max Depth (m)</th>
<th>Residence Time (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burundi, Congo, Tanzania, Zambia</td>
<td>18900</td>
<td>32900</td>
<td>1900</td>
<td>750</td>
<td>1435</td>
<td>440</td>
</tr>
<tr>
<td>Malawi, Mozambique, Tanzania</td>
<td>8400</td>
<td>30900</td>
<td>245</td>
<td>290</td>
<td>706</td>
<td>114</td>
</tr>
<tr>
<td>Kenya, Tanzania, Uganda</td>
<td>2750</td>
<td>69000</td>
<td>3440</td>
<td>40</td>
<td>92</td>
<td>21</td>
</tr>
<tr>
<td>Congo, Rwanda</td>
<td>569</td>
<td>2370</td>
<td>-</td>
<td>240</td>
<td>496</td>
<td>114</td>
</tr>
<tr>
<td>Congo, Uganda</td>
<td>280</td>
<td>5300</td>
<td>-</td>
<td>3</td>
<td>58</td>
<td>-</td>
</tr>
<tr>
<td>Congo, Uganda</td>
<td>78.2</td>
<td>2325</td>
<td>-</td>
<td>17</td>
<td>112</td>
<td>-</td>
</tr>
<tr>
<td>Cameroon, Chad, Niger, Nigeria</td>
<td>72</td>
<td>1600</td>
<td>650</td>
<td>4</td>
<td>8</td>
<td>-</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>28</td>
<td>3150</td>
<td>385</td>
<td>9</td>
<td>14</td>
<td>1.5</td>
</tr>
<tr>
<td>Ghana</td>
<td>148</td>
<td>8500</td>
<td>4800</td>
<td>19</td>
<td>75</td>
<td>4.3</td>
</tr>
<tr>
<td>Zambia, Zimbabwe</td>
<td>185</td>
<td>5580</td>
<td>2164</td>
<td>30</td>
<td>97</td>
<td>3</td>
</tr>
<tr>
<td>Malawi, Mozambique</td>
<td>1.8</td>
<td>1750</td>
<td>200</td>
<td>1</td>
<td>2.7</td>
<td>-</td>
</tr>
<tr>
<td>Egypt, Sudan</td>
<td>162</td>
<td>6000</td>
<td>7844</td>
<td>26</td>
<td>120</td>
<td>-</td>
</tr>
<tr>
<td>Kenya</td>
<td>204</td>
<td>6750</td>
<td>-</td>
<td>30</td>
<td>109</td>
<td>12.6</td>
</tr>
</tbody>
</table>

Table 2. Major characteristics of main lakes of Africa

2.1.1. Lake Tanganyika

Lake Tanganyika (03° 30’ and 08° 50’ S and 29° 05’ and 31° 15’ E) is an ancient lake with a history of geographical isolation of some 20 million years. It occupies a deep and narrow trough of the western branch of the Rift Valley of East Africa (Coulter, 1994). Lake Tanganyika is the largest and oldest of the Rift Valley lakes and the second largest and deepest freshwater body in the world after Lake Baikal (Horne and Goldman, 1994). The lake is ca. 650 km long and 50 km in average width with an approximate surface area of 32,600 km² and volume of 18,880 km³. Lake Tanganyika is shared by four nations, viz., Burundi, Tanzania, Democratic Republic of Congo and Zambia. Flora and fauna therefore have unique characteristics not found elsewhere (Coulter, 1991). There are three distinct basins: the Kigoma basin in the north (max depth: 1310 m), the Kungwe basin in the centre (max depth: 885 m) and the Kipili basin in the south (max depth: 1410 m). Lake Tanganyika is meromictic with anoxic monimolimnion. It has the second largest volume of anoxic water in the world after the Black Sea. While the large volume of Lake Tanganyika provides a temporary buffer against a deterioration in the water quality (Spigel and Coulter, 1996), the long residence time creates conditions in
which human generated pollutants can accumulate, leading to negative effects on the lake’s water quality, fish stocks and biodiversity (Verschuren, 2003).

Figure 2. Lake Tanganyika basin After Allison et al., (2010)

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symposium at the 1998 American Association for the Advancement of Science (AAAS), Annual Meeting, Philadelphia.

Biographical Sketches

Gamal M. El-Shabrawy, was born on 24 February 1964. He obtained his PhD degree from the Faculty of Science, Mansoura University, Egypt in 1996. Working as research assistant, researcher and team leader in many research projects that have been carried out in the Egyptian lakes, wetland ecosystems since 1993 up till now. Contributed in producing 4 and 2 chapters in 2 international reference books published by Springers and Nova Publication and one chapter in local reference book for the National Biodiversity Unit of EEAA, Lake Bardawil (2005). Teaching post graduate lectures on aquatic ecology, limnology and lake management. Collaborating and consultant in the EIA studies of many tourist Village and Petroleum Company. Attending many training courses and scholarships in Egypt, Jordan and Belgium as well as several national and international symposia, conferences and congresses in Egypt and abroad. Supervisors of 14 M.Sc.’s and Ph.D.’s in the fields of population and community of zooplankton and Macrobenthos. Member of many national and international councils, committees and societies in the field of limnology and Aquatic Environmental Sciences. Consultant of many international and local journals. Forty two publications, in national and international specialized journals.

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