Aquatic Macrophyte Composition in Lake Alau, Arid Zone of Nigeria in West Africa.

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Abstract: Six field survey were conducted to evaluate the aquatic macrophyte vegetation in Lake Alau, Maiduguri Borno- State during the Harmattan period between (October - December 2005), dry hot period (March – April 2006), and wet raining period (July – August 2006) seasons. Four categories of the aquatic macrophytes were identified into free floating, submerged, fringe, and emergent vegetations. A total of 48 species were recorded. The species with the highest occurrence was *Pistia stratioles, Lemna paucicostata.* The raining season was significantly different in terms of species composition and taxa richness. The percentage composition of each category of the aquatic macrophytes varied with seasons. The Shannon weaver index calculated for the seasonal taxa compositions showed that the raining season had 1.16, followed by 0.77 in the harmattan and the least value of 0.42 was recorded in the dry season months. The species index was also higher in the rainy season, compared with other seasons. The abundance of the four categories of the aquatic macrophyte composition in the three seasons was not uniformly distributed in all seasons.
[Idowu Racheal Toyosi, Gadzama Usman Ngamarju. Aquatic Macrophyte Composition in Lake Alau, Borno State, Arid Zone of Nigeria. Nature and Science 2011;9(9):14-18]. (ISSN: 1545-0740). http://www.sciencepub.net.

Key words: Aquatic Macrophyte, Floating, Submerged, *Lemna paucicostata*,

1. Introduction

Aquatic macrophytes are large macroscopic plants that occur in lakes, streams, and wetlands. A number of workers have studied macrophytes communities in order to understand their functions in such communities. Gopal and Kulshreshthe (1980) described aquatic macrophytes as reservoirs of nutrients. They accumulate high concentration of sodium, chlorine, magnesium, nitrogen, and phosphorus and their litter release these nutrients back in to the aquatic habitats. Edward et. al., (1987) observed that many floating macrophytes are forage for a large number of aquatic animals and a hiding place for juvenile fish. The development of aquatic macrophytes communities in non man- made lakes has been of considerable interest in Africa. Obot (1985) observed that efforts are often directed towards the elimination of obnoxious macrophytes from the lake after impoundment. Allanson and Carmouze (1992) noted that knowledge of the dynamics of macrophyte communities is imperative for the management of shallow waters. Such knowledge according to them is clearly important in situations where the vegetation is likely to change rapidly or dramatically such as in irrigation channels, impoundments and waters that drain from catchments with excessive agricultural, industrial or urban areas.

Thompson and Gaudet (1980) observed that accurate descriptions and detailed floristic compositions of macrophytes vegetation in as many regions of Africa as possible are highly desirable. The significant of aquatic macrophytes cannot be overemphasized, since they produce complicated micro-environments in a given water column. Careful monitoring of changes in the plant activities such as growth rates, can serve as an early warning signs of change in environmental conditions.

To date, there has not been any known publication or research of the aquatic composition in of Lake Alau in Maiduguri, Borno State. Studies carried out on this lake have often concentrated on fishing gear survey (Bankole et. al., 1994), Zooplankton composition and abundance (Fasesan, 2000), Physical –chemical studies (Idowu, 2004 A), Macro invertebrate studies (Idowu et .al, 2004 B), Dipterans community in the littoral zone (Idowu et. al.2004 C).

The aims and objectives of this study therefore, are to examine the various types of aquatic macrophytes and their seasonal abundance. The results will provide an early warning of developing problems and guide appropriate policy decisions to minimize impending deleterious effects on water quality and aquatic resources.

2. Materials and methods.

2.1 The Study Area.

Lake Alau is located in a tropical region and is characterized by non- vigorous mixing. It is situated some 19 km along Maiduguri Bama road, at an elevation of about 120 m above the sea level. It lies between latitude 12˚N and 13˚N and longitude 11˚E and 13˚E. The climate is Sahelian with 3 distinct seasons. A raining seasons starts from June to September. The harmattan season precede dry season from October to February. This is a period of very

low temperature and cold dry harmattan wind. The dry hot season starts from March to May marking the driest period with intense heat (CBDA, 1986; Bankole et .al., 1994).

2.2 Methodology.

Six field surveys were conducted to collect aquatic macrophyte between October- December 2005, March- April 2006, and July- August 2006; These coincide with the three distinct seasons (Harmattan, dry hot and wet seasons conditions) respectively. The modified method of mycrophyte collection by Wood (1975) was used. The method involved collection of plant species with their flowers, seeds and roots by using hand and rake in and around the lakes. After collection, the plants were kept in polyethene bags and were carried to the laboratory, where they were identified to species level using keys in Hutchinson and Dalziel (1952-1973), Lowe and Standfield (1974), Fitter and Manuel (1986). Aquatic vegetation analysis was confined to the assessment of species abundance. In determining the Diversity Index and Evenness. Shannon Weaver diversity, and Sorensen's similarity indices were used, (Greig-Smith, 1983),

DI = H Plog Pi

Where P is the proportion of the Item in the sample.

DI = H = Diversity Index.

One-way analysis of variance (ANOVA) as indicated by Wood (1975) was used to test for significant differences in species diversity and similarity between the seasons.

3. Results.

The results of aquatic macrophyte taxa and their distributions in relation to seasons are presented in Table 1. Four major categories were identified as free floating vegetation, submerged, fringe and emergent vegetations. A total of 38 species were recorded to be present in Lake Alau of which all the species were found to be present during rainy season. Table 1 gives the check list of Mycrophyte speciesof Lake Alau. Categorization of the mycrophyte species revealed that the free floating and submerged were represented by 11 species each while emergent and and fringe were represented by 10 and 6 species respectively. Species abundance were found to be significantly different ($P < 0.05$) between seasons. Higher species diversity was observed during the rainy season with all the species represented, followed by harmattan period while the list number of species richness were recorded during the dry hot season (Table 2).

Similarly, the percentage composition of each category of the aquatic macrophytes varied with seasons, Free floating vegetation was highest (34.6 %), in the harmattan season, but lowest percentage composition was recorded in the dry season (25.2 %). The Submerged vegetation was highest in the rainy season with 26.5%, but lowest percentage composition was observed in the harmattan season with 22.6%. The emergent vegetation had the highest composition of 26.5% in the rainy season, while the lowest value of 15.7 % was recorded in the hot season. The fringe vegetation was highest in the dry hot season with 35 % (Table 2). There were significant differences ($P < 0.05$) between the species occurrence in various seasons. The Shannon weaver index calculated for the seasonal compositions showed that the raining season had 1.16, followed by 0.77 in the harmattan season. The least value of 0.42 was recorded in the dry season months. The species richness index was also higher in the rainy season, compared with other seasons. There were significant differences ($P < 0.05$) in the species diversity among the seasons. Based on Sorenson's similarity coefficient, the three seasons were significantly different ($P < 0.05$). The abundance of the four categories of the aquatic macrophyte in the three seasons was not uniformly distributed in all seasons. Floating and submerged macrophytes had coefficient of variation of 67.86 and 44.67, while fringe and emergent macrophytes had 34.45 and 56.86 respectively. The rainy season had the highest abundance of the four categories of the macrophytes observed, with floating vegetation being the most abundant. The species frequencies show *that Lemna paucicostata* and *Pistia stratiotes* were more frequent in all the seasons studied. The differences in species frequencies were significant ($P<0.05$).

4. DISCUSSIONS

The aquatic species of macrophytes that occur in Lake Alau are few. The species abundance and occurrence results confirmed that the three seasons (Harmattan, dry hot and the raining seasons) influenced the composition of the aquatic macrophytes in the Lake. The distribution of species (38 species) recorded in the Lake in all the seasons were very low in comparison with those in similar environments. Elemi (1990) recorded 278 species in Ibadan, Mwalyosi (1992) recorded 215 species, in Northern Tanzania, Atama observed 135 species in Enugu.

Table 1. Check list of Mycrophyte taxa found in Lake Alau by species and their occurrence by seasonal change.

	Harmattan (Oct-Feb)	Dry Season (March-May)	Wet Season (June-Sept)
Free floating			
Pistia stratioles	+	+	+
Woffiella hyaline	+	+	+
Spirodella polyrrhiza	+	-	+
Lemna minor	-	-	+
Salvinia natans	-	-	+
Lemna perpusilia	+	-	+
Lemna tricusuica	+	-	+
Azolla Africana	+	-	+
Azolla filiculoides	-	-	+
Nymphea lotus	+	+	+
Wolffia arrhiza	-	-	+
Submerged			
Ceratophlum sp	+	-	+
Ceratophyllum dermasum	+	-	+
Potamogeton pectinatus	-	-	+
Vallisneria spiralis	-	-	+
Equisetum fluviatile	-	+	+
Hippuris vulgaris	-	-	+
Ranucutish a*deracius*	+	-	+
Carex acuta	+	+	+
Najas manna	-	-	+
Rupia spiralis	-	-	+
Ulticularia sp			
Emergent			
Polygonium senegalense	+	-	+
Polygonium amphibum	+	+	+
Polygonium hydropiper	+	+	+
Vossia cuspidatua	-	-	+
Rumex hydropaphathum	-	-	+
Lythrum salicaria	-	-	+
Chara globularis	-	-	+
Cladium mariscus	-	-	+
Eleacharis palustris	-	-	+
Scirpus maritumus	-	-	+
Fringe vegetation			
Acacia ap	+	+	+
Combretum ap	+	+	+
Tarminalia catappa	+	+	+
Termarindus indica	+	+	+
Andropogon gayanus	+	+	+
Khaya senegalensis	+	+	+
Frequency of species occurrence by season	21	13	38

Key: + = Present - = Absent

Table 2. Percentage composition of species category richness and diversity index of aquatic macrophyte groups in relation to seasons in Lake Alau, Maiduguri.

	Harmattan Season (Oct-Feb)	Dry hot season (March-May)	Rainy season (July-Sept)
Species category			
Free Floating	34.6	25.2	29.0
Submerged	22.6	23.2	26.5
Emergent	21.0	15.7	26.5
Fringe	21.8	35.0	18.0

The incidence of few species of aquatic macrophytes in Lake Alau during the dry hot season may be due to the climatic regime of the arid environment which may impose extreme heat due to high temperature on the macrophyte community. This agreed with the findings of Obot (1985) who observed that the climatic regime changes aquatic macrophyte vegetation as well as soil stability in the arid region. Other reasons may be due to the effect of livestock grazing on the littoral region and the loss of plants in major areas around this period of the annual drawdown. Many aquatic macrophytes are forage for a large number of animals. The local community depends on some of the aquatic macrophytes directly as food in the dry hot seasons. Edward et. al. (1987) observed that plant species like *Lemna paucicostata, , Lemna perpusilia, Nymphea lotus* are eaten raw by Borno indigenes. Another reason may be due to the exposure of the littoral region to high temperature which also affected the water level. Most of the banks were dried and majority of them could not survive the drought.

The littoral zone of Lake Alau is a highly complex areas that support abundance and varied species of submerged macrophyte communities. Talbot and Ward (1987) and Hanson et al. (1989) described that the littoral zone of many lakes and ponds in Alberta supported weed beds, and aquatic macrophytes composition and abundance. The high species composition recorded in the rainy season was as a result of increase in water level and flooding regime which could have favored the increase in aquatic vegetation and other biological communities. Ita (1994) reported that rainfall has direct influence on the distribution and abundance of aquatic vegetation. The few species observed in the harmattan compared with the rainy season may be attributed to drop in humidity which caused dryness and total loss of some vegetation. The abundance of *Pistia stratiotes, Lemna paucicostata, Lemnat ricusulea, and Azolla filiculoides* was due to their location as free floating plants, as well as their dispersal processes as the people throw them back into the water after consumption by the local communities . This gives them the advantage of survival over other species. Both the similarity indices and species abundance results confirmed that the three seasons were different in composition and abundance of macrophytic species. Species diversity in all the seasons was very low compared with similar other environments (Ita, 1994). The differences in land use may likely contribute to this variation.

The fringe vegetations were fully represented throughout the three seasons. This is because they were planted for afforestation several years ago and they have been fully grown to trees.

5. Conclusion

This study have shown that aquatic macrophyte species composition of lake Alau to be low compared to some other water bodies where similar study have been carried out. Effort must be directed to the conservation of these floras for sustainability. Knowledge of the dynamics of macrophyte communities is imperative for the management of shallow water bodies like Lake Alau.

REFRENCES

[1]. Allanson BR, Convenor TP, CarmouzeJP. The physico-chemical limnology of Lake Sibaya. Monographic biological 1992;42-74.

[2.]. Bankole NO, Sule OD, Okwundu EC, Amadi M. Preliminary investigation on the frame and catch assessment survey of Alau Lake. Annual Report of NFFRI 1994; 28.

[3]. CBDA. A resettlement plan for the Lake Alau Dam and Jere Bowl scheme .Report submitted to Chad Basin Development Authority by Askoning. Nig. Ltd. 1986;59.
[4]. Edward AW, Mbamarrah LV, Akinsoji A. Annual populations inhabiting the roots of *Pistia stratioles*. Paper presented at the conference of the ecological Society of Nigeria .New Bussa. June 1987;17-21.
[5]. Elemi BE. A limnological assessment of Ona River, Ibadan. Nigeria. M.Sc .Thesis University of Ibadan. Nigeria. 1990; 87.
[6]. Fasesan R.T. Zooplankton composition and abundance in Lake Alau, North Eastern Nigeria. Nigeria. Journal of Experimental and Applied Biology. 2000;1(2):111-116
[7]. Fitter, R and Manuel R. Freshwater life. Collins and Sons. Glasgow 1986;382
Gopal B, Kulshreshthe M. Role of aquatic macrophytes as reservoir of nutrients and in their cycling. International Journal Ecology and Environmental Science. 1980;16 (15):145- 152.
[8]. Greig-smith P. Quantitative plant ecology. Blackwell Scientific Publication Oxford. 1983; 260.
[9]. Hanson JM, Prepas.EE, Mackey WC. Size distribution of the macroinvertebrate community in a freshwater Lake. Canadian Journal of fisheries and aquatic Sciences 1989;46:1510-1519.
[10]. Hutchinson J. Datziel MB. . The flora of West TropicalAfrica. Crown Agent for the Colonies. London. 1972;1-3.
[11]. Idowu RT. Limnological Studies of Lake Alau Maiduguri, Borno-State.Nigeria. Ph.D Dissertation, University of Nigeria, Nssuka. 2004 A ;148.
[12]. Idowu RT, Inyang NM, Mgbenka BO. Macroinvertebrate studies of the littoral region in an Arid Zone Lake Alau, Maiduguri, and Borno State. Pecop Resources Nigeria Ltd. 2004B;1(1):1-7.
[13]. Idowu RT, Inyang nNM, Eyo J. The physicochemical parameters of an African Arid Zone man made Lake.(Lake Lau). Maiduguri, Borno State, Nigeria, Biop-Research 2004C;2(1):67-74.
[14]. Ita EO. Aquatic plants and wetland wildlife resources of Nigeria. CIFA Occasional paper 21 FAO Rome 1994;38.
[15]. Lowe J, Stanfield DP. The flora of Nigerian sedges. Ibadan University Press. Ibadan. 1974; 144.
[16]. Mwalyosi RBB. Influence of Livestock grazing on range condition in South-West, Maisailand, and Northern Tanzania. Journal of Applied Ecology. 1992;29:581-589.
[17]. Obot EA. Studies in the productivity of *Echinochloa stagnina*(Retz) in the Kainji Lake basin of Northern Nigeria. Ph.D. Thesis. University of Ife. 1985.
[18]. Talbot JM, Ward JC. Macroinvertebrate associated with aquatic macrophytes in Lake Alexandrina New Zealand .Journal of marine and fresh water research**.** 1987;25(*4*):75-80.
[19]. Thompson K, Gaudet .JT. Species association and zonation in papyrus swamps in Africa.. Aquatic Botany. 1980;2 (2):23-30
[20]. Wood DR. *Hydrobotanical methods*. Maryland University Park Press. Baltimore, USA. 1975; 173.

7/17/2011