CHECKLIST OF THE AQUATIC MACROPHYTES OF JEBBA LAKE, NIGERIA

Adesina, G.O.[1*], **Akinyemiju, O.A.**[2] And **Muoghalu, J.I.**[3]

1. Department of Agronomy, Ladoke Akintola University, Ogbomoso,
2. Professor, Department of Plant Science, Obafemi Awolowo University, Ile Ife, Osun State.
3. Professor, Department of Botany, Obafemi Awolowo University, Ile Ife, Osun State.

(Received: October, 2010; Accepted: May, 2011)

ABSTRACT

The occurrence and diversity of aquatic macrophytes on Jebba Lake were documented during the rainy and dry seasons from 1999 to 2001. Analyses showed that the species diversity increased by 20, from 26 in 1988 to 46 in 2001. The number of species encountered during the dry and wet seasons during the period of sampling between 1999 and 2001 differed only marginally. The emergent macrophytes formed 93.3% of the total macrophyte population with the dominant species irrespective of season being *Vossia cuspidata* Griff., *Eichhornia crassipes* (Mart.) Solms, *Mimosa pigra* Linn, *Vetiveira nigritana* (Benth.) Stapf, and *Mariscus longibracteatus* Cherm., *Sesbania dalzielii*. E. Philip & Hutch. which is an annual, was found to be dominant only during the rainy period.

Key words: Aquatic Macrophytes, Diversity, Abundance, *Vossia cuspidata, Eichhornia crassipes, Sesbania dalzielii.*

INTRODUCTION

Aquatic plant infestation of water bodies is a worldwide problem. Many aquatic plants grow as weeds in paddy crops, drainage systems and waterways (Akobundu, 1987). Weeds of paddy crops (Akobundu, 1987) and aquatic macrophytes occurring in Lake Kainji, Nigeria (Obot and Ayeni 1987) have been reported. Massive occurrence of water hyacinth on Lake Kainji (Akinyemiju, 1995), Itoikin irrigation channel, Lagos state (Akinyemiju, 1989) and Kofawei creek, Ondo State (Akinyemiju and Imevbore, 1990) have also been reported. Jebba Lake, impounded in 1983 for hydroelectric power generation and flood control in Nigeria (Anonymous, 1983) is currently threatened by aquatic macrophytic infestation.

Water hyacinth invasion of water body is a biological stressor which endanger other aquatic flora and fauna (Akinyemiju, 1987; Olaleye and Akinyemiju, 1999) and impair physico-chemical quality of water bodies (Olaleye, 2002). A market survey around fishing communities in Nigeria revealed a sharp decline in the tonnage of fishes of economic importance in aquatic vegetation infested areas (Alimi and Akinyemiju, 1991). This study was carried out to document the changes in the aquatic macrophytic composition of Jebba Lake which is one of the biggest artificial lakes in Nigeria.

MATERIALS AND METHODS

Study Area.

The study was carried out on Jebba Lake, which lies between 9° 10' and 9 ° 55'N and 4 ° 30' and 4 ° 50'E. The Lake, which was impounded in 1983, has a drainage basin extending 100 km from Fakun, immediately below Kainji Reservoir, to the Jebba dam site. The hydrological pattern of Jebba Lake, which is closely linked with that of the Kainji Lake, experiences two annual floods. Between June and July at the onset of the annual rainy season, water drawn from rivers and streams within the catchment area is discharged into the Lake (Obot and Mbagwu, 1988). The second flood originates from areas around the source of River Niger in Guinea, comes in as black flood into Kainji Lake and subsequently enters Jebba lake as excess discharges from the lake (Obot, 1984). The black flood which reaches Kainji Lake in early November finds its way into the Jebba Lake by the end of November or early December. Six major tributaries which empty into Jebba Lake: the Oli, Wuruma, Moshi and Awuru Rivers on the western side and the Kontangora and Eku Rivers on the Eastern side (Figure 1).

Methods

An initial field reconnaissance survey was carried out along both banks of Jebba Lake between June and July 1999. Sampling was done at approximately 3 km interval such that 68

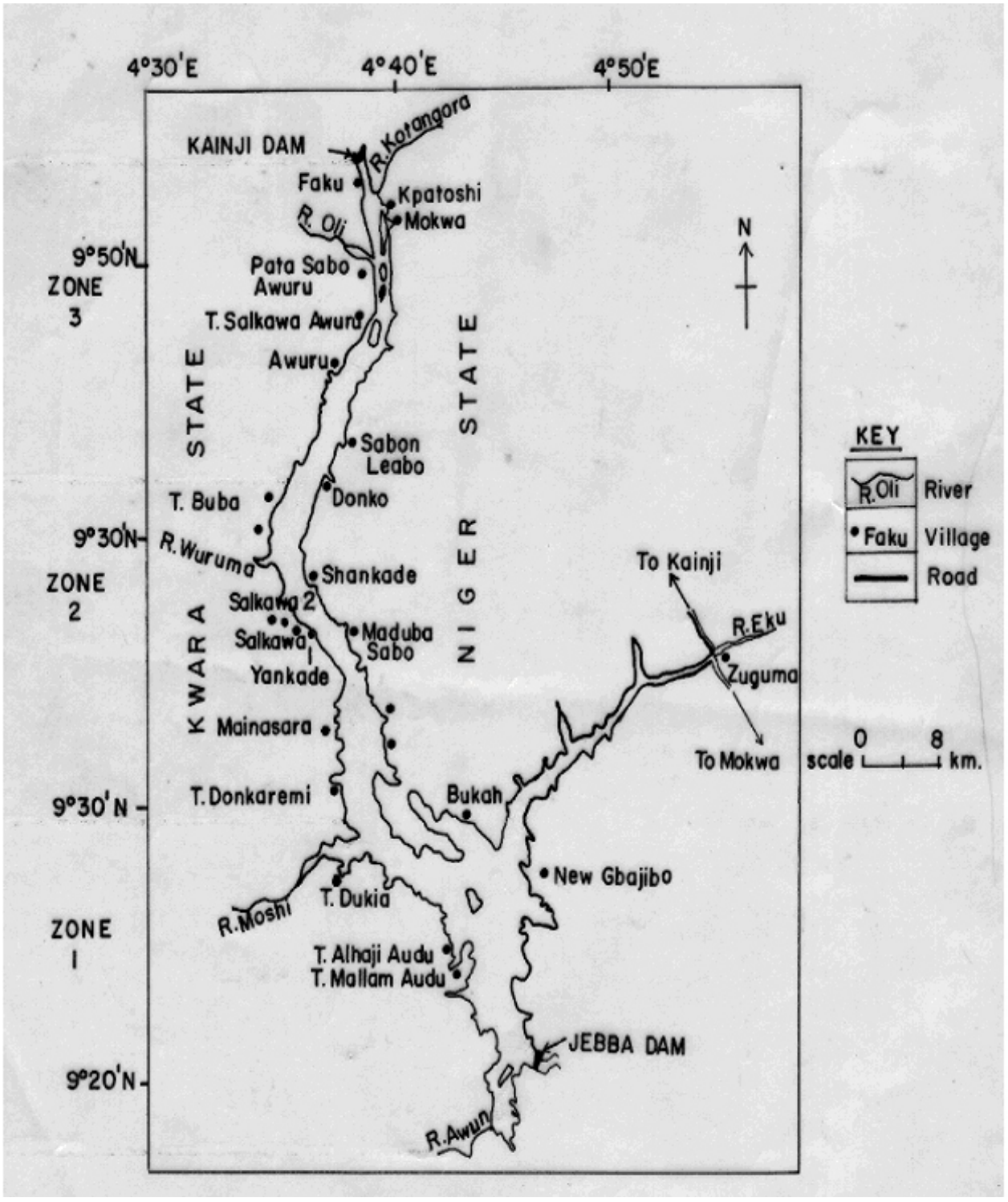

Figure 1: Map of Jebba, Lake Nigeria

(Source: Natioanl Institute for Freshwater Fisheries Research, New Bussa, Niger State, Nigeria)

designated stations were sampled along the shoreline and the open water. Based on the preliminary results, a systematic-sampling technique was then adopted to map out sampling points on the lake during the field survey between August 1999 and August 2001. With the aid of line transects, 20 sampling points were then established at 10 km intervals with the aid of a GPS**,** on the eastern and western sides of the lake (Figure 1). Sampling was carried out over two years (1999-2001) during the rainy season, which corresponds to the period of drawdown or lower water regime over the lake, and during the dry season, which corresponded to the high water regime (when the lake holds the highest volume of water).

A 5 x 5 m sampling plot which was established at each location, extends from the open water (with a depth of 5-10 m) up to the shoreline. Across each sampling plot, a perpendicular line transect was laid. A 1 m^2 quadrat was then laid at 1 m interval to facilitate a complete littoral and open water plant species data collection. Herbaceous and woody species within each transect were also identified to species level according to Hutchinson and Dalziel (1954-1972). The encountered plant species composition was then compared with earlier documented aquatic plant species composition on the Jebba Lake (Obot and Mbagwu, 1986; 1988).

RESULTS

A total of 46 plant species belonging to 22 families were recorded (Table 1) during the period of study. The floristic composition consist of 21 perennial plants species, 18 annual species while only three species were either annual or perennial, depending on the prevailing environmental conditions. A total of 45 aquatic species were observed during the rainy season, while 47 species were observed during the dry period (Table 1). On the basis of life forms, macrophytic species accounted for about 4.4% of the total species composition, submerged aquatic species accounted for 2.2% while emergent species with 93.30% of the total number of species encountered across the seasons. *Ludwigia hyssopifolia* was encountered only during the dry season.

Comparison of the aquatic macrophytic species found on the Jebba Lake during the 1986, 1988 and 2001 samplings is shown in Table 2. The occurrence of the macrophytic species during the rainy season is shown in Figure 2. The result showed that the dominant species during the rainy season include *Vossia cuspidata, Sesbania dalzielii, Eichhornia crassipes* and *Mimosa pigra* with 10.7%, 10.3%, 8.7%, and 8.2% occurrence respectively. Other less prominent species arranged in the descending order of occurrence were *Mariscus longbracteatus, Ipomoea aquatica, Vetiveria nigritana and Polygonum lanigerium.* Comparatively, the following were prominent species during the dry period: *Vossia cuspidata, Eichhornia crassipes, Echinochloa* spp. and *Mimosa pigra* with 10.3%, 10.3%, 9.1% and 8.3% occurrence respectively. Analysis further showed that irrespective of the season of sampling, the dominant aquatic macrophytic species were *Vossia cuspidata, Eichhornia crassipes, Sesbania dalzielii, Mariscus longibracteatus, Echinochloa* spp.*, Mimosa pigra, Polygonum lanigerium, Ipomoea* spp. and *Vetiveria nigritana.* Comparative analysis also showed that the low number of macrophytes species on the Jebba Lake between 1986 and 1988 has increased from 18 species (in 1986) to 30 species (in 1988) and to 46 species between 1999 and 2001. Analysis also showed that twenty new species have established in the lake while sixteen species were no longer present in the lake 13 years after (Table 2).

DISCUSSION

Comparative studies showed that the macrophytic species composition of the Jebba Lake was similar to those of plants encountered on the Kainji Lake. This was probably because Kainji Lake supplies a lot of plant propagules to Jebba Lake (Obot and Mbagwu, 1988). However, factors responsible for the development of many of new species encountered on the Jebba Lake was probably reduction in the hydraulic water turnover in Jebba Lake which allows for extended water retention period, consequently allowing for new plant development.

The effect of human impacts in terms of non-fishing activities like crop farming and animal husbandry in the riparian communities indirectly enrich the lake through application of inorganic and organic fertilizers. Both Jebba and Kainji Lake catchment basins service several thousand livestock especially cattle, sheep and goats as grazing and water holes (Adesina *et al.*, 2004). These animals through grazing of diverse vegetation deposit viable seeds in addition which end up in the nearest riparian waterbody and later germinate thereby adding to the species diversity

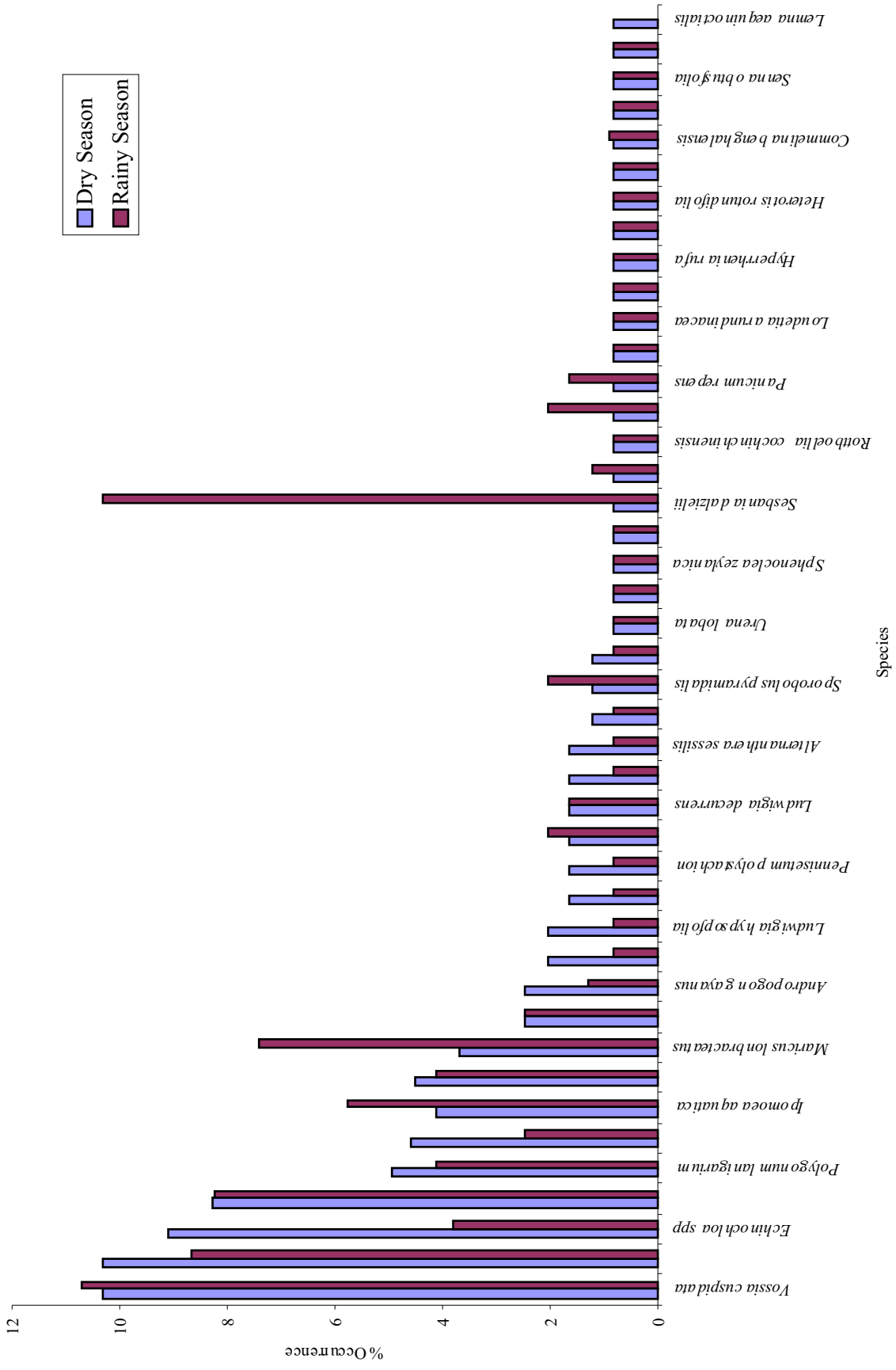

Figure 2: Percentage Occurrence of Aquatic Macrophyte Species on Jebba Lake During the Dry and Rainy Seasons between 1999 - 2001.

of vegetation within the lake catchment. Also, the two lakes (Kainji and Jebba) share some basic hydrological characteristics, which encourages the proliferation of floating aquatic macrophytes like water hyacinth. Such floating macrophytes arrive annually with floodwater from neighbouring countries and from different tributaries on Kainji Lake and are subsequently washed downstream into Jebba Lake during the annual flooding (Akinyemiju, 1995; Daddy *et al.,* 1999).

The increased diversity of identified aquatic macrophyte species on the lake which was season-dependent and with the highest diversity index of 3.8 during the dry period (Adesina *et al.,* 2007) was probably due to the flooding of the shoreline areas during the dry period leading to the increase in biodiversity. The Lake has its highest volume of water during the dry season when water from all its tributaries reaches the lake (Adesina *et al*., 2007). This hydraulic phenomenon on Jebba Lake therefore probably created a conducive environment for emergent macrophytes on the littoral zone of the lake to thrive. During the rainy season, the dominant annual *Sesbania dalzielii* emerged during the period of the study. Other aquatic macrophytes that had their growth apparatus such as rhizomes buried in the soil or seeds dropped on soil surface probably emerged due to the favourable soil condition (Obot, 1984). The occurrence of the shrubs, *Mimosa pigra* irrespective of season of sampling on the bank/littoral area of the lake was probably because the seedlings developed throughout the year. Some upland plants species like *Andropogon gayanus* and *Sporobulus pyramidalis* were found growing on the littoral zones of the lake probably because majority of the annual macrophytic species identified were emergent (Adesina *et al.,* 2007), only dominant during the rainy season but as dry season approaches, it produces seed for regeneration into another season and withers off.

Eichhornia crassipes, which is listed in 1995 as one of the invasive, problematic aquatic plants (Cronk and Fuller, 1995) was found as one of the dominant macrophytes on the Lake, although it was not a prominent aquatic plant in 1988 (Obot and Mbagwu, 1988). Other prominent macrophytes recorded during the current study which were absent in the earlier reports were *V. nigritana, S. dalzielii* and *T. australis*. *Sesbania dalzielii,* which the riparian communities livestock farmers depend on as a forage plant (Obot, 1984; Adesina *et al*., 2007) and whose growth is naturally tied to rainy seasons, does not pose threat to the lake. However, the other newly recorded macrophytic species pose major threat to the lake existence. Adequate control or management techniques must therefore be put in place (Anonymous, 2001) to prevent their uncontrolled proliferation.

CONCLUSION

The result of this study indicated a dangerous trend in the rate at which invasive aquatic plants colonize the fresh water bodies in Nigeria with Jebba Lake as a case study. Nigerian water bodies are of high economic importance to the riparian populace and other stakeholders that depend on such water bodies for their economic activities. It is therefore essential to monitor and manage the influx of these exotic aquatic plants in the country. Most countries around the world that had Water Hyacinth (*Eichhornia crassipes*) and other aquatic plants bore heavy financial losses hence the need to stem such tide of aquatic weed infestation in Jebba Lake.

ACKNOWLEDGEMENTS

The senior author is grateful for the support of the management of the National Institute for Freshwater Fisheries Research, who funded this work, and also the technical staff of the Aquatic Vegetation Programme of the Institute for all their effort in the field to see the work to a successful completion.

REFERENCES

Adesina G. O., Akinyemiju, O. A. and Daddy, F. 2004. Influence of aquatic weeds infestation on the riparian communities around Jebba Lake. Nigerian Journal of Weed Science 17: 59-65.

Adesina G. O., Akinyemiju, O. A. and Olaleye, V. F. 2007**.** Assessment of aquatic vegetation of Jebba Lake, Nigeria. *African Journal of Ecology* 45:365-373.

Akinyemiju O.A. 1987. Invasion of Nigeria waters by water hyacinth. *Journal of Aquatic Plant Management* 25: 24-26.

Akinyemiju O.A. (Ed) 1989. Herbicidal control of water hyacinth of Itoikin near Lagos. *Final report submitted to Ogun-Oshun River Basin Development Authority, Abeokuta, Nigeria, 67p.*

Akinyemiju O.A. 1995. An inventorial tour on Lake Kainji. *Unpublished report to National Institute for Freshwater Fisheries Research, New Bussa. 30pp.*

Akinyemiju O.A. and Imevbore A.M.A. (Eds) 1990. Herbicidal control of water hyacinth. A pilot demonstration at Kofawei Creek, Igbokoda, Ondo State. Final Report to the Presidency, special services, Tafawa Balewa Square, Lagos 18pp.

Akobundu I.O. 1987. Weed Science in the Tropics: Principles and practices. John Wiley and Sons, NY, 522pp.

Alimi T and Akinyemiju O.A. 1991. Effect of water hyacinth on water transportation in Nigeria. *Journal of Aquatic Plant Management* ***28****: 109 -112.*

Anonymous 1983. Report on the pre-impoundment studies of Jebba Lake. Kainji Lake Research Institute, New Bussa, 86pp.

Anonymous 2001. National surveys of infestation of water hyacinth, Typha grass and other noxious weeds in water bodies of Nigeria. Unpublished reports by National Institute for Freshwater Fisheries Research and Federal Ministry of Agriculture and Rural Development, New Bussa, Nigeria. 52pp.

Cronk Q.C.B. and Fuller J.L. 1995. *Plant invaders: the threat to natural ecosystems.* Chapman and Hall, London. 241pp

Daddy F, Ladu B.M.B., Okaeme A.N. and Adesina G.O. 1999. An integrated approach for the control of water hyacinth in Lake Kainji basin: a model for Niger Delta wetland(s). *International Journal of Environmental Research* ***1****: 11-16.*

Hutchinson, J. and Dalziel, J. M. 1954-1972. Flora of West Tropical Africa, 2nd Ed. (Revised by R.W.J. Keay & F.M Hepper) Crown Agent, London

Obot E.A. and Ayeni J.S.O. 1987. The biology of Burugu (*Echinochloa stagnina* Beauv.) in Lake Kainji: a case study. In: Olatunde AA and Ayeni JSO (eds) *Proceedings of the annual conference and general meeting of the Ecological Society of Nigeria, National Institute for Freshwater Fisheries Research, New Bussa* 17- 20 June 1987.

Obot E.A. 1984. Studies on the productivity of *Echinochloa stagnina*(Retz) P. Beaur in the Kainji Lake Basin of Northern Nigeria *Ph.D. Thesis, University of Ife, Nigeria***.**

Obot E.A. and Mbagwu I.G. 1986. Macrophyte flora of the newly impounded Jebba Lake Nigeria. *African Journal of Ecology* 24:195-198.

Obot E.A. and Mbagwu I.G. 1988. Successional pattern of aquatic macrophytes in Jebba Lake. *African. Journal of Ecology* **26**: 295-300.

Olaleye V.F. and Akinyemiju O.A. 1999. Flora and fauna of Abiala creek, Niger Delta. *Nigerian Journal of Aquatic Sciences* **14**: 61-65

Olaleye V. F. 2002. Water quality changes in a post-herbicide trated water hyacinth (***Eichhornia*** *crassipes* (Mart.) Solm-Laub.) infested aquatic environment. *Journal of Aquatic Sciences* 17(2):140-144

Table 1 : Aquatic Macrophyte Species Recorded on Jebba Lake from 1999 to 2001

Species	A/P[1]	Wet Season[2]	Dry Season[3]
Amaranthacea			
Alternanthera sessilis **(L.) R. Br. ex DC.**	**A**	+	+
Asteraceae			
Tridax procumbent **L.**	**A**	+	+
Azollaceae			
Azolla pinnata **subsp. africana (Desv.)**		+	+
Caesalpinioideae			
Chamaecrista mimosoides **(L.)Greene**	**A/P**	+	+
Senna obtusfolia **(L.) Irwin & Barneby**	**A/P**	+	+
Ceratophyllaceae			+
Ceratophyllum demersum **L.**	**P**	+	+
Cochlospermaceae			
Cochlospermum planchonii **Hook. f.**	**P**	+	+
Commelinaceae			+
Commelina benghalensis **L.**	**A/P**	+	+
Convolvulaceae			
Ipomoea asarifolia **(Desr.) Roem. & Schult**	**P**	+	+
Ipomoea aquatica **Forsk.**	**P**	+	+
Ipomoea eriocarpa **R. Br.**	**A**	+	+
Cyperaceae			
Mariscus longbracteatus **Cherm.**		+	+
Fabaceae			
Indigofera hirsuta **L.**	**A**	+	+
Mimosa pigra **L.**	**P**	+	+
Mucuna spp	**A**	+	+
Lemnaceae			
Lemna aequinoctialis **Welwitsch**		-	+
Malvaceae			
Urena lobata **L.**	**P**	+	+
Melastomataceae			
Heterotis rotundifolia **(Sm.) Jacq-Fel**	**P**	+	+
Nymphaeaceae			
Nymphaea lotus **L.**	**P**	+	+
Onagraceae		+	+
Ludwigia decurrens **Walt. Syn.**	**A**	+	+
Ludwigia hyssopifolia **(G.Don) Excell**		-	+
Papilionoideae			+
Tephrosia bracteolata **Guill. & Perr.**	**A**	+	+
Sesbania *dalzielii.* **E.Philip & Hutch**	**A**	+	+

Poaceae			
***Andropogon gayanus* Kunth.**	**P**	+	+
***Digitaria longiflora* (Retz.) Pers.**	**A**	+	+
***Echinochloa obtusflora* Stapf**	**P**	+	+
***Echinochloa pyramidalis* (L.) Hitchc. & Chase**	**P**	+	+
***Echinochloa colona* (L.) Link.**	**P**	+	+
***Echinochloa stagnina* Retz. P. Beauv.**	**P**	+	+
***Hyperrhenia rufa* (Nees.) Stapf.**	**A**	+	+
***Leersia hexandra* Swartz**	**P**	+	+
***Loudetia arundinacea* (A. Rich.) Steud.**	**P**	+	+
***Panicum repens* L.**	**P**	+	+
***Paspalum scrobiculatum* L.**	**P**	+	+
***Pennisetum polystachion* (L.) Schult.**	**A**	+	+
***Phyragmite karka* (Retz.) Steud.**	**P**	+	+
***Rottboellia cochinchinensis* (Lour.) W.D. Clayton.**	**A**	+	+
***Schizachyrium sanguineum* (Retz.) Alston**	**P**	+	+
***Setaria pumila* (Poir) Roem & Schult**	**A**	+	+
***Sporobolus pyramidalis* P. Beauv.**	**P**	+	+
***Vossia cuspidate* Griff.**	**P**	+	+
***Vetiveria nigritana* (Benth.) Stapf**	**P**	+	+
Polygonaceae			
***Polygonum lanigerum* R.Br.**	**P**	+	+
Pontederiaceae			
***Eichhornia crassipes* (Mart.) Solms**	**P**	+	+
Rubiaceae			
***Borreria octodon* Hepper**	**A**	+	+
Sphenocleaceae			
***Sphenoclea zeylanica* Gaertn.**	**A**	+	+
Typhaceae			
***Typha australis* Schum & Thorn**	**P**	+	+

1=A Annual; P - Perennial;

2 = Wet season is between May and September

3 = Dry season is between October and April

Plus(+) =Present and Minus(-) = Absent

Table 2: Comparison of Macrophyte Species Composition in Jebba Lake in 1986, 1988 and 1999-2001

Species	Obot and Mbagwu 1986	Obot and Mbagwu 1988	Current Study 1999 2001
Adiantaceae			
Ceratopteris cornuta (Beauv.) Le Prieur	X	X	-
Amaranthaceae			
Alternanthera nodiflora (L.) R. Br.	-	X	-
Alternanthera sessilis (L.) R. Br. ex DC.	-	X	X
Araceae			
Pistia stratiotes L.	X	X	-
Asteraceae			
Tridax procumbens L.	-	-	X
Eclipta prostrata L.	-	X	-
Azollaceae			
Azolla pinnata subsp. africana (Desv.)	-	X	X
Boraginaceae			
Heliotropium indicum L.	-	X	-
Caesalpinioideae			
Chamaecrista mimosoides (L.)Greene	-	-	X
Senna obtusfolia (L.) Irwin & Barneby	-	-	X
Ceratophyllaceae			
Ceratophyllum demersum L..)	X	X	X
Cochlospermaceae			
Cochlospermum planchonii Hook. f.	-	-	X
Commelinaceae			
Commelina benghalensis L.	-	-	X
Convolvulaceae			
Ipomoea asarifolia (Desr.) Roem. & Schult	-	X	X
Ipomoea aquatica Forsk.	X	X	X
Ipomoea eriocarpa R. Br.	-	-	X
Cyperaceae			
Cyperus dilatatus Schumach & Thonn.	-	X	-
Mariscus longbracteatus Cherm.	-	-	X
Scirpus cubensis Poepping and Kunth	X	X	-
Fabaceae			
Indigofera hirsuta Linn.	-	-	X
Mimosa pigra Linn.	-	X	X
Mucuna spp	-	-	X
Lemnaceae			
Lemna aequinoctialis Welwitsch	X	X	X
Malvaceae			
Urena lobata L.	-	-	X
Melastomataceae			
Heterotis rotundifolia (Sm.) Jacq.-Fel	-	-	X
Nymphaeaceae			
Nymphaea lotus L.	X	X	X
Onagraceae			

Ludwigia decurrens Walt.	X	X	X
Ludwigia erecta (L.) H. Hara	X	-	-
Ludwigia hyssopifolia (G. Don) Excell	X	X	-
Ludwigia leptocarpa (Nutt.) H. Hara	X	X	-
*Ludwigia stolonifera (*Guil and Per.) Raven	X	X	-
Ludwigia suffruticosa Walter	-	-	X
Papilionoideae			
Indigofera hirsuta Linn.	-	-	X
Tephrosia bracteolata Guill. & Perr.	-	-	X
Sesbania dalzielii E.Philip & Hutch	-	-	X
Poaceae			
Andropogon gayanus Kunth.	-	-	X
Digitaria longiflora (Retz.) Pers.	-	-	X
Echinochloa obtusflora Stapf	-	-	X
Echinochloa pyramidalis (L.) Hitchc.& Chase	-	X	X
Echinochloa colona (L.) Link.	-	X	X
Echinochloa stagnina Retz. P. Beauv.	X	-	X
Hyperrhenia rufa (Nees) Stapf.	-	-	X
Leersia hexandra Swartz	X	X	X
Leptochloa caerulescens Steud.	-	X	-
Loudetia arundinacea A. Rich.) Steud.	-	-	X
Panicum repens L.	-	-	X
Paspalum scrobiculatum L.	-	-	X
Pennisetum polystachion (L.) Schult.	-	-	X
Phyragmite karka (Retz.) Steud.	-	-	X
Rhytachene magastachachya Stapf.	-	X	-
Rottboellia cochinchinensis (Lour.) W.D. Clayton.	-	-	X
Sacciolepis africana Hubbard and Snowden	X	X	-
Schizachyrium sanguineum (Retz.) Alston	-	-	X
Setaria pumila (Poir) Roem & Schult	-	-	X
Sporobolus pyramidalis P. Beauv.	-	-	X
Vossia cuspidata Griff.	X	X	X
Vetiveria nigritana (Benth.) Stapf	-	-	X
Polygonaceae			
Polygonum lanigerum R.Br.	-	X	X
Polygonium senegalensis Meisn.	X	X	-
Pontederiaceae			
Eichhornia crassipes (Mart.) Solms	-	-	X
Salvinaceae			
Salivina nymphelulla Desv.	X	X	-
Rubiaceae			
Borreria octodon Hepper	-	-	X
Sphenocleaceae			
Sphenoclea zeylanica Gaertn.	-	X	X
Typhaceae			
Typha australis Schum & Thorn	-	-	X

NB:(X) = Presence and (-) = Absence.

Ife Journal of Science

Table of Contents: June Edition 2011; Vol. 13, No. 1

Omotoye Olorode, Sekinat O. Hassan, Olajumoke A. Olabinjo and Idris O. Raimi	Tithonia (Asteraceae) in Nigeria	1
Obuotor E.; Adewumi A. A. and Olaleye V. F.	The Effect of Copper on Some Laboratory Indices of Clarias Gariepinus (Burchell 1822).	11
Salami, B. M. Conte, R. A. and Falebita, D. E.	Geoelectric Evalution of the Groundwater Potential of Parts of Osogbo, Southwestern, Nigeria	17
Ogunfowokan A.O., Akanni M.S., Ajibola R.O and Ayinde F.O.	Trophic Status and Physico-Chemical Parameters of Three Reservoirs in Osun State Nigeria	27
Oláyíwolá M.A[1] and Odébòdé M.O.	Foraminiferal Distribution of Southwestern Nigeria's Offshore Littoral Sediments: Benthic Faunal Diversity Indices and Patterns	45
Chinedu S.N., Okochi V. I. and Omidiji O.	Cellulase Production by Wild Strains of *Aspergillus Niger, Penicillium Chrysogenum* and *Trichoderma Harzianum* Grown on Waste Cellulosic Materials.	57
Bayode S. and Akpoarebe O.	An Integrated Geophysical Investigation of a Spring in Ibuji, Igbara-Oke, Southwestern Nigeria.	63
M. O. Adepoju and J. A. Adekoya	Reconnaissance Geochemical Study of a Part of Igarra Schist Belt, Southwestern Nigeria	75
Adesina, G.O., Akinyemiju, O.A. and Muoghalu, J.I.	Checklist of the Aquatic Macrophytes of Jebba Lake, Nigeria	93
Fasasi, K. A., Malaka, S. L. O. and Amund, O. O.	Studies on the Life Cycle and Morphometrics of Honeybees, *Apis Mellifera Adansonii* (Hymenoptera: Apidae) In A Mangrove Area of Lagos, Nigeria.	103
A.O. Olorunfemi, K.S. Salahudeen and T.A. Adesiyan	Ground Water Quality in Ejigbo Town and Environs, Southwestern Nigeria	111
Govardhan Singh, R.S; Ogunsina, B.S. and Radha, C.	Protein Extractability from Defatted *Moringa Oleifera* Lam. Seeds Flour	121
A. M. A. Sakpere	Identification of ISSR Primers for Genetic Analysis of *Telfairia Occidentalis* Hook F.	129
O. K. Owoade, F. S. Olise, H. B. Olaniyi, I. B. Obioh and E. Bolzacchini	Mass and Energy Audit in a Nigerian Iron and Steel Smelting Factory: An Operational and Efficiency Study.	133
F. A. Oloyede, B. Aponjolosun & A. A. Ogunwole	Reproductive Potentials of a Tropical Fern *Cyclosorus Afer* (Christ.) Ching (Thelypteridaceae: Pteridopyhte) at Obafemi Awolowo University, Ile Ife, Nigeria	143
M.O.Olawole, L. Msimanga, S.A.Adegboyega & F.A. Adesina	Monitoring and Assessing Urban Encroachment into Agricultural Land - A Remote Sensing and GIS Based Study of Harare, Zimbabwe	149
Benjamin, U.K and Nwachukwu, J.I	Model Compaction Equation for Hydrostatic Sandstones of the Niger Delta. 161	
J.O. Ojo and C.E. Adeeyinwo	Dependence of Vanadium Recovery on Oxidation State in its Solvent Extraction from Hydrochloric Acid Solutions With TRI N Butyl Phosphate	175
Akintorinwa, O. J., Ojo J. S. and Olorunfemi M. O.	Appraisal of the Causes of Pavement Failure along the Ilesa - Akure Highway, Southwestern Nigeria Using Remotely Sensed and Geotechnical Data	185
O. J. Matthew and O. O. Jegede	Modelling Soil Surface Temperature and Heat Flux Using Force-Restore Method at an Agricultural Site in Ile-Ife, Nigeria.	199
Ojo J.F.	On the Theory of One Dimensional Integrated Autoregressive Bilinear Time Series Modelling	209