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Ecological Studies of the Ossiomo River with Reference to the Macrophytic Vegetation

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Abstract: In the present study, the composition, distribution, cover, biomass and phenology of aquatic plants in the Ossiomo river were investigated. The dominant aquatic macrophytes are the emergent forms. Some free floating species like *Eichhornia crassipes*, *Pistia stratiotes*, *Lemna* sp. and *Azolla africana*, were more abundant in the downstream sampling stations. *Eichhornia crassipes*, which is an exotic invasive species that has recently entered Nigerian waters, was recorded in the river. There is need to curtail its spread as it is a very difficult weed to control.

Key words: Aquatic, macrophyte, river, Ossiomo, tropical, Nigeria, cover, ecology

INTRODUCTION

Aquatic macrophytes are a key component to aquatic ecosystems and the services they provide. They stabilize sediments and shorelines, reduce turbidity, provide habitat for aquatic organisms and food for waterfowl (Wantzen and Junk, 2000; Bamidele and Agbogidi, 2002). Aquatic macrophytes also constitute a problem when they extensively cover water bodies (Pimentel *et al*., 2000). In most instances, extensive nuisance growths of aquatic macrophytes are not caused by cultural eutrophication, but by the introduction of invasive plants species. Invasive species are typically introduced from other continents through horticultural or aquaria trade, but have become a widespread problem worldwide (Huber *et al*., 2002; Mullin *et al*., 2000). Invasive species impact both human uses and ecological attributes of water resources. Invasive species directly impact human uses of water resources through obstructing commercial and recreational boat traffic, clogging hydropower generation turbines and increasing flood risk (Madsen and Smith, 1999). Invasive plants have also impacted societal values of water resources indirectly through increasing the spread of insect-borne disease and decreasing property values (Madsen and Smith, 1999). *Salvinia molesta*, a perennial floating fern from South America, has become a severe nuisance in tropical regions of Africa, Australia and some portions of the United States (Nelson *et al*., 2001). *Eichhornia crassipes*, a native of Central and South America, remains the most common nuisance aquatic macrophyte in tropical regions. Invasive Aquatic weeds have become a nuisance in West African water bodies. The often-multifunctional use of canals, rivers, lakes and lagoons becomes seriously hampered, which strongly affects daily life of the local population. In affected areas, rural households loose time and efforts to keep up their daily activities. Rural communities face problems in keeping water open for local transport. There are also increased health problems. Fishermen and particularly women fish traders have experienced significant reduction in their income. There is thus a need to be proactive by regularly carrying out surveys of water bodies for possible outbreak of invasive aquatic weeds.

Systematic study of aquatic macrophytes in Nigerian rivers is scarce. The Southern States in Nigeria are increasingly been impacted by the activities of industries. These include petroleum oil, plywood and oil palm industries. There is a need to provide baseline information on the flora against which potential impacts of industrial activities can be measured. The purpose of this investigation is to provide baseline information on the macrophyte plants along the Ossiomo River.

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MATERIALS AND METHODS

A survey of the macrophytic vegetation along the River was carried out to determine the plant species composition, distribution, cover, biomass and phenology. The selected sites are indicated in Fig. 1. All plant species present along the established transects at each site was recorded. Those species that could not be identified on the field were collected, pressed and taken to the University where they were correctly identified. For the estimation of plant species cover, the Braun-Blanquet scale of abundance rating was employed. The scale is as indicated below (Causto, 1988).

Braun Blanquet Cover Scale

Rating	Description
+	Sparsely or very sparsely present cover very small.
1	Plentiful but of small cover value
2	Very numerous or cover 5-20%
3	Any number of individuals, cover 25-50%
4	Any number of individuals, 50-75%
5	Cover greater than 75%

For the determination of species biomass, the quadrat method described by Philips (1959) was employed. One meter square quadrats were laid out at random at the chosen site. At least 20 quadrats were employed per site. All the shoot of each species in the quadrat was harvested by cutting at soil level excluding all the plants not within the quadrat. The harvested shoots were then loosely stacked in newspapers and labeled. The samples were dried at 75°C to constant weight. The dried plant samples were subsequently weighed on a balance.

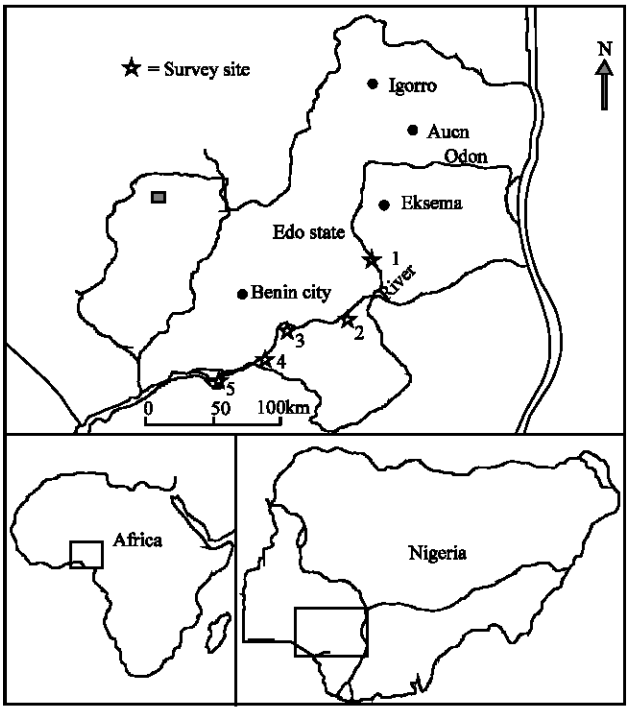

Fig. 1: Map showing the Ossiomo River and the study sites asterisk(*)

The vegetative and reproductive phases of development for different plant species were studied by regular observation of the plants over a period of six months (May-October). The sites were visited monthly for proper monitoring of their flowering periods.

RESULTS AND DISCUSSION

The results of the floristic survey showed that all the aquatic macrophytes along the River were herbaceous and mostly angiosperms with few ferns. Table 1 and 2 show the plant species composition and distribution. About 80% of these plants were restricted to the banks of the River, 4% were emergent species 10% of the species occurred both on the banks and over the water surface. About 15% were also found on the water surface either floating freely or rooted with floating leaves.

The data for the cover estimate is presented in Table 1. Some species have high coverage in all the sites. These include *Rhynchospora corymbosa*, *Eichhornia natans*, *Commelina* sp., *Nymphaea lotus* and *Eleocharis* sp (Table 1). *Cyrtosperma senegalense* has the highest value of 788.6 g m^{-2} while *Azolla africana* has the lowest value of 9.04 g m^{-2}. Other species have intermediate values (Table 2).

About 25% of the plant species showed only vegetative growth throughout the period of study. Examples include *Sacciolepis africana*, *Asystasia gagentica* and *Azolla africana*. On the other hand, some species exhibit both vegetative and reproductive growth. These include *Ipomoea aquatica* and *Nymphaea lotus*, *Ludwigia decurrens* and *Eichhornea crassipes* (Table 3).

The data indicated that there was a large variation in the composition and distribution of macrophytes along the river. Some of the recorded species are widely distributed throughout the world and therefore well known in Botanical literature. These include *Pistia stratiotes*, *Nymphaea lotus*, *Polygonum* sp., *Utricularia* sp. and *Eleocharis* sp. Most of them have acquired global distribution with the help of man and animals who have acted as agents of dispersal over centuries, either intentionally or inadvertently. One of the species *Eichhornia crassipes*, is an invasive plant which has become a menace in the tropics (Nelson *et al*., 2001; Huber *et al*., 2002). It is present in the lower reaches of the Ossiomo River up to Ologbo. It is apparently being transported along with the raft of timbers being towed on the river by plywood merchants. Invasive species are typically introduced across continents through horticultural or aquaria trade and have become a widespread problem worldwide (Huber *et al*., 2002; Mullin *et al*., 2000). Invasive plants can impact societal values of water resources indirectly through increasing the spread of insect-borne disease and decreasing property values. An effective management of invasive aquatic weed requires an integrated approach through the use of a combination of proven biological control by means of the insect along with physical control by mechanical harvesting and/or hand tools approaches. A sustainable integrated approach for the control of water hyacinth thus requires active participation of the local communities, riparian population and agricultural research and extension work. More importantly, public awareness activities and utilization of the harvested weeds should also be included in the integrated control programs, for sustainable results.

A large proportion of the recorded macroscopic species are emergent forms (Table 1). These are mostly confined to the bank of the river. The emergent macrophytes perform several functions. They help in consolidating the banks of the river, thus preventing erosion. They also serve as refuge and spawning ground for many fishes (Bamidele and Agbogidi, 2002). These plants are also potential sources of food for fishes (Petr, 1990, 1993; Gopal, 1990). Some of the floating plants also perform useful functions. Herbivorous fish such as *Tilapia zilli* fishes feed on some species of aquatic macrophytes which grow at the bank. Examples include *Azolla africana* and *Lemna pausicoustata*.

It has been reported that floating leaves of aquatic macrophytes such as that of *Nymphaea lotus* and roots of floating aquatic macrophytes provide shelter and serve as substrate for the deposition of fish eggs (Petr, 1993; Lewis, 1995). Macrophytes also produce organic matter which is used as

Table 1: Cover estimates for macrophytic vegetation in Ossiomo River

Scientific name	Cover estimate site				
Emergent species	1*	2	3	4	5
Amphiblemma mildbraedi	2	-	+	1	-
Saccolepis africana Hubb and Snowden	2	-	1	2	-
Vossia cuspidata Griff.	3	2	2	3	2
Cyrtosperma senegalense	2	3	-	1	-
Pycreus lanceolatus (Poir.) C.B.Cl.	2	-	-	-	-
Sacciolepis africana Hubb. and Snowden	2	+	+	1	-
Sphenoclea zeylanica Gaertn.	-	-	+	-	-
Fimbristylis ferruginea (L.) Vahl.	1	1	-	1	-
Fuirena umbellata Rottb.	1	-	-	-	-
Asystasia gagentica (Linn.) T. Anders	2	-	-	-	-
Polygonum africanum Meisn.	+	-	-	+	-
Rhynchospora corymbosa (Linn.) Britt.	-	2	3	4	4
Dryopteris filixmas	-	-	-	-	2
Leersia hexandra Sw.	-	-	-	-	+
Kylingia erecta (Schumach) Mattf and Kuk	-	2	+	-	-
Paspalum orbiculare Forst.	+	+	+	-	-
At the bank but spreading over water					
Ludwigia decurrens Walt.	3	1	+	2	-
Ipomoea aquatica Forst.	1	+	3	1	-
Ludwigia adscendens L.	-	-	2	+	-
Hydrolea glabra Schum and Thonn	2	1	+	+	4
Commelina nudiflora L.	5	4	1	3	2
Free floating					
Lemna paucicostata Heglm.	+	-	2	3	4
Azolla Africana Desv.	+	-	2	2	3
Eichhornia crassipes (Mart.) Solms.	-	-	-	3	4
Pistia stratiotes L.	1	3	1	4	4
Utricularia foliosa L.	2	4	1	2	1
Rooted, with floating leaves					
Nymphaea lotus L.	1	3	2	2	3
Submerged species					
Eleocharis dulcis (Burm.f.) Hensch.	-	2	2	1	3
Eleocharis naumaniana	2	3	1	3	3
Crinum natans Baker	1	2	3	1	2
Eichhornea natans(P.Beauv.) Solms-Laub	3	1	2	1	1
Bacopa monieri Pennel.	2	1	-	1	1

*: See Fig. 1 for the sites

detritus. Ita (1993), noted that detritus serves as a source of food for benthos, zooplankton and also adds nutrients to the pond giving rise to the production of more food for the fishes. Masser and Anderson (1989) pointed out that floating aquatic plants provide shade thereby reducing the stress caused by high temperature. These plants thus provide a cool place for fishes to retreat to during hot weather.

Although, aquatic macrophytes have some positives impacts on the fishes in the river, the existence of some invasive types could be regarded as nuisance. The water surface at some sites along the Ossiomo River was almost covered by the floating leaves of *Nymphaea lotus*. Hepher and Pruginin (1985), noted that such phenomenon can lead to a reduction in the amount of light reaching the bottom of the river. Excessive growth of some aquatic species such as *Ipomaea aquatica*, *Cyperus haspan* and *Pistia stratiotes* was observed at sites 2 and 3. It is well known that in water bodies where the growth of aquatic macrophytes are excessive, large amounts of soluble nutrients are absorbed, thereby reducing the production of planktons and other food organisms on which the fishes feed (Pokorny *et al*., 1990).

The phenological data show that many of the species were in vegetative and reproductive phases, while a few species showed only vegetative growth. Information on phenology is critical in terms of proper method of control of weedy growth of macrophytes. Some aquatic weeds are best managed in

Table 2: Biomass of the dominant macrophytes in the Ossiomo River

Scientific name	Biomass (g m^{-2})
Paspalum orbiculare	81.40
Ipomoea aquatica	212.60
Crytosperma senegalense	788.60
Ludwigia decurrens	112.60
Saccolepis africana	165.76
Commelina sp.	112.79
Vossia cuspidata	608.32
Polygonum sp.	32.48
Rhynchospora corymbosa	130.90
Azolla africana	9.04
Nymphaea lotus	125.60
Asystasia gagentica	64.65
Eleocharis dulcis	207.75
Fimbristylis ferruginea	206.18
Eichhornea natans	124.01
Eichhornea crassipes	245.00
Crinum natans	127.60
Pycreus lanceolatus	79.00
Echinochloa stagnina	69.50
Jussiaea repens	56.70
Sphenoclea zeylanica	28.50
Fuirena umbellata	97.80

Table 3: Vegetative and flowering phenology of the macrophytic vegetation in the Ossiomo River (May-October)

Plant species	May	June	July	August	September	October
Azolla africana	-	-	-	-	-	-
Nymphaea lotus	+-	+-	+-	+-	+	+
Ipomoea aquatica	+-	+-	+-	+-	-+	-+
Eleocharis maumaniana	-	-	-	-	-	-
Asystasia gagentica	-	-	-	-		
Ludwigia decurrens	+-	+-	+-	+-		
Eichhornia crassipes	-	-+	-+	-+	-+	-+
Brachiaria deflexa	-	-	-	-		
Crinum natans	-	-	-	-	-+	-+
Thalia geniculata	-	-	-	-	-	-+
Utricularia foliosa	-	-	-	-	-	-
Vossia cuspidata	+-	+-	+-	+-		
Paspalum orbiculare	-	-	-	-	-+	-+
Sacciolepis africana	-	-	-	-	-	-
Dissotis erecta	+-	+-	+-	+-	-+	-+
Dryopteris filixmas	+-	+-	+-	+-	-+	-+
Jussiaea repens	-	-	-	-+	-+	-+
Amphiblemma mildbraedi	-+	-+	-+	-+	-+	-+
Cyrtosperma senegalense	-	-	-	-	-	-+
Eichhornia natans	-	-	-	-	-	-
Leersia hexandra	-	-	-	-	-	-+
Sphenoclea zeylanica	-	-	-	-	-	-
Commelina sp.	-+	-+	-+	-+	-+	-+
Rhynchospora corymbosa	-+	-+	-+	-+	-+	-+
Bacopa aquatica	-	-	-	-	-	-
Fuirena umbellata	-	-	-	-	-	-
Fimbristylis ferruginea	-	-	-	-	-+	-+
Polygonum sp.						

- : Vegetative phase, + : Reproductive phase, -+ : Vegetative and reproducing, +- : Reoroducing and vegetative

their vegetative phase while others can only be totally controlled when both the vegetative and reproductive organs are totally destroyed. The control of any excessive aquatic macrophytes population is paramount to ensure the healthy development and maximum production.

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