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Assessment of Aqua-fauna diversity and abundance for tourism potentials in Osse/Ovia River, Okomu park Nigeria

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Abstract
Understanding the potential of fishery resources of Osse/Ovia River, of Okomu National Park Edo state, Nigeria is crucial in achieving a sustainable exploitation through tourism/sport fishing activities to ensure economic growth and conservation. This study was conducted to assess the aquatic-fauna biodiversity (aquatic ecology) of the park. This was achieved by enumerating and identifying species distribution, composition, richness, evenness and abundance of fish species from January 2013 to March 2013. A total of twenty one (21) species belonging to twelve (12) families where obtained from this study. Identification was made based on their morphometric and meristic features. The families identified included Schilbeidae, Mormyridae, Cichlidae, Pantodontidae, Channidae Anabantidae, Bagridae, Gymnarchidae, Hepsetidae, Distichodontidae, Mochokidae, Palaemonidae. The family Mormyridae had the most abundant species with six (6) members represented while Hepsetidae was least, having a single member. *Macrobrachium macrobrachion* recorded the highest number of invertebrate individuals with 2487 enumerated and *Hepsetus odoe* accounted for only 12 individuals. It is concluded that the Osse / Ovia river is highly productive and in excellent condition capable of maintaining, managing and conserving a perfectly balanced aquatic ecosystem resources for tourism purposes.

Keywords: Fish, aquatic ecology & tourism, aqua-fauna biodiversity abundance, specie richness, specie evenness & diversity

Introduction
Aquatic tourism is a subset of ecological tourism which is regarded as a sustainable tourism that constitutes mainly of renewable resources such as flora, fauna, watersheds, soil, rivers, creeks etc. in which Communities of organism that are dependent on each other and on their environment live in aquatic ecosystems. The Okomu National park offers fresh water activities as it is characterized as a water dam destination.

Generally, ecological tourism focuses on socially responsible travel, personal growth, and environmental sustainability [1]. Ecotourism typically involves travel to destinations where flora, fauna, rivers, waterfalls plus cultural heritage are the primary attractions with the intention of offering the tourists an insight into the human impact on the environment, and to foster a greater appreciation of our natural habitats [2].

Globally, aquatic tourism has been identified as significant contributors towards national economies [3]. However, most of the research within this frame of reference has taken place within the developed world, where there is high level of (private, government & individual) participation with low reliance on fish stocks for food [4]. Recreational fisheries in the developing countries are, on average, less well developed and therefore receive less scientific attention. Little to nothing is none with regards to compositions of species and / or organisms, relative abundance, ecological evenness / richness and seasonality of existing organisms. Here, fisheries research has traditionally focused on small-scale artisanal fisher folks [4, 5] due to its potential for poverty alleviation.

However, in the continuum of tourism activities that stretch from conventional tourism to ecotourism proper, there has been a lot of contention to the limit at which biodiversity preservation, local social-economic benefits, and environmental impact can be considered as ecotourism. For this reason, environmentalists, special interest groups, and governments have defined ecotourism differently. Environmental organizations have generally insisted that

ecotourism is nature-based, sustainably managed, conservation supporting, and environmentally educating [6].

The Osse / Ovia river of the Babiu range Nikorogha forms one of the major rivers the Okomu park drains into which in-spite of all its natural endowments, the park is currently being threatened with large-scale illegal logging, expansion of rubber and oil-palm plantations nearby, and incursions by a growing human population involved in farming and hunting [7]. Sources said that the protected area of the Okomu National Forest is too small and too vulnerable and without further efforts to improve protection, it is unlikely that the forest will remain viable long into the future causing a major threat to the water shed system apparently reducing the strength of rivers the park drains into [7]. Indications are that despite appeals to the State government, little has been done to prevent further illegal encroachment and destructive logging activities in the park, which both threaten the rare species and will cut short the long-term revenue to be earned from eco-tourism. At the moment, not much as being done to improve or maximize the water bodies within the park to attract tourists to it through creative sporting activities such as boat cruises, sport fishing, nature observation, photography, picnicking, educational study. Tourists tend to congregate in areas of high interest to have fun and probably mingle with locals which makes catchment areas like this a potential revenue generator. But with the uncensored level of illegal activities taken place in the park, the result often is a complete hemorrhaging of cash from the park [7].

The purpose of this study is to access the diversity and abundance of the aquatic fauna resources in Osse/Ovia River towards tourism potential development of Okomu National park. The results obtained will contribute to existing knowledge on the state of the aquatic resources of the park.

Materials and Methods

Study Area

Nikorogha community located within the Okomu National Park, formerly the Okomu Wildlife Sanctuary, is a forest block within the 1,082 km² of Okomu Forest Reserve in the Ovia South-West Local Government Area of Edo State in Nigeria and lies between north latitudes 6^0.14'55.21"N and longitude $5^0$16'01.31" E at an elevation of 110ft. It reportedly covers a land mass area of approximately 19,712 hectares [8]. The park holds a small fragment of the rich forest that once covered the region, and is the last habitat for many endangered species. It continues to shrink as villages encroach on it, and is now less than one third of its original size [1]. The study site Ovia River, is located inside Nikorogha a community in Babiu range sector of the Okomu National park which drains into it forming the major source of its water.

Methods of Data collection

Artisanal fisher folks around the river deployed surface gillnet, cast nets and plank canoes for their catches. The fish sampling was carried out during fisher folks landing at the fishing terminals of the sampling stations by monitoring and recording. The number of individuals for each species was counted and recorded. Landings of fisher folks were sorted out [9]. Identification of species was made with the aid of relevant texts based on their morphometric and meristic features [10, 11]. Also, interview and structured questionnaires were used to obtain information from local fisher folks, indigenous dwellers within the study area about their capture methods (active or passive), gears used and the species of aquatic fauna frequently captured or encountered, the mesh size of net used, period of fishing and the seasonality of different species discovered. All of which are factors that control the maximum sustainable yield of the water body.

Species richness, relative abundance and community evenness was determined using the Mangalef's index & Shanon-Wienner species diversity index and also, on sight analysis or examination was carried out as well.

Fish Abundance and species richness indices

Species richness S is the simplest measure of biodiversity and is simply a count of the number of different species in a given area. This measure is strongly dependent on sampling size and effort. Two species richness indices try to account for this problem: Mangalef's index;

$$Dm_g = \frac{(S-1)}{\ln N}$$

Species diversity

Species diversity is an appearance of community structure, a characteristic unique to the community level of organization. A community shows a high diversity if many or nearly equally abundant species are present but if composed of a few species /or if only a few species are abundant, then species diversity is low. The theory takes into account three different ecological phenomena (i.e., species richness, relative abundance and community evenness) [11].

Species Richness

The total number of species present in a community. However, it does not take into account the numbers of individuals per species or the evenness of the individuals within each species [11].

High species diversity indicates a complex community in which a high degree of species interactions is possible. These communities typically has a higher level of energy transfer (food webs), predation, competition and niche availability, than other similar communities that exhibit low species richness. Table 1 shows the total species (species richness) identified within the sample unit signaling the fact that this ecological community (Ovia River) represents such with high species diversity.

Relative Abundance

This revealed the number of individuals within each species, or the relative abundance of individuals within a given community. Apparently if the theory that state that at high species richness a higher energy transfer is possible then higher levels of energy transfer within the community should be higher still [12].

Relative abundance calculations show the percentage of individuals within each species present in a community and how that specie relate numerically to the abundance of any other species present in that community [12]. Calculations of this type are valuable to ecologists because they reveal ecological patterns that indicate which species is dominant or least dominant, or if there is an even distribution of individuals within the community as shown in fig 1.

Community Evenness

The third parameter contained within the theory of species diversity relates to the evenness of the numbers of individuals within each species or its community evenness. Communities that exhibit more even numbers of individuals within the total number of species present are thought to be closer to a state of equilibrium than those in which the numbers of individuals is less even, because the energy flow within ecological systems is constantly changing. Consistent patterns of evenness within a given community can be equated with community stability [13]. Nearly all diversity and evenness indices are based on the relative abundance of species, thus on estimates of pi in which

$$Pi = \frac{Ni}{N}$$

With Ni = the abundance of the i=th species in the sample
S = the total number of species in the sample

$$Ni = \sum_{I=1}^{S} Ni$$

Result and Discussion

Compositions and identification of Ovia potential aquatic vertebrates: The aquatic ecological evaluation was done in the Ovia River Nikorogha, an enclave to the Babiu range of the park (supporting community). The data was taken eight different times within a three months period from active fisher-folks in the community and a total of nineteen wildlife species of fish distributed within eleven different families and two prawn species were collected and identified. The total of 9657 organisms was collected out of which 6983 are fishes and 2674 were prawns. The composition and identification of the sampled vertebrates of Ovia River are given in the table below.

The study was carried out from January to March which represents the low catch season in the area (late December – march) as shown in table2, species with highest numerical percentage abundance was *Macrobrachium macrobrachion* at 25.75% followed by *Schilbe intermedius*, *Mormyrus tapirus*, *Hyperopisus bebe*, *Gnathonemus abadii*, *Gnathonemus tamanda*, *Ctenopoma kingsleyae* and *Synodontis occellifer*, having 8.6,7.8,7.3,7.2, 6.8, 6.3 and 6.1% respectively while *Hepsetus odoe* and *Ichthyborus monodi* represent organisms with the lowest percentage having 0.12 and 0.2% respectively all represented in table 1

Table 1: List of fish identified by families, genera and species in Osse/Ovia River and their relative abundance

Family	Genus	Species	Common names	Local ijaw names	Nos sampled per families	Nos of individual species	Relative Abundance %
Anabantidae	Ctenopoma	*Ctenopoma kingsleyae*	Butterfish	Ayin		608	
Claroteidae	Clarotes	*Clarotis laticeps*	Rayed finned fish	Ikele		151	
Channidae	Channa	*Parachanna obscura*	African snakehead fish	Ewii		91	
Cichlidae	Hemichromis	*Hemischromis fasciatus*	Banded jewelfish	Tomii	2	302	3.1
	Oreochromis	*Oreochromis aureus*	Tilapia	Tomii		301	3.1
Distichodontidae	Ichthyborus	*Ichthyborus monody*			1	15	0.2
Gymnarchidae	Gymnarchus	*Gymnarchus niloticus*	Trunkfish	Eba	1	31	0.32
Hepsetidae	Hepsetus	*Hepsetus odoe*	African pike	Usaku	1	12	0.12
Mochokidae	Synodontis	*Synodontis occellifer*	Target squeaker catfish	Osika	2	586	6.1
		Synodontis vermiculatus	Squeaker catfish	Ikpoki		223	2.3
Mormyridae	Hyperopisus Gnathonemus Mormyrus Mormyrops Marcusenius	*Hyperopisus bebe*	Elephant fish	Agbala	6	702	7.3
		Gnathonemus tamandu a	Trunkfish	Izimu		601	6.8
		Gnathonemus abadii	Mormyrids/trunkfish	Abadii / Afinfin		695	7.2
		Mormyrus tapirus	Elephant fishes	Ugbala		758	7.8
		Mormyrops deliciosus	African carp	Boya		119	1.2
		Marcusenius psittacus	Mable catfish			430	4.5
Palaemonidae		*Macrobrachium vollenhoven*	Prawn / crayfish (decapoda)	Osu	2	187	1.9
		Macrobrachium macrobrachion	Prawn / crayfish (decapoda)	Osu		2487	25
Pantodontidae	Papyrocranus	*Papyrocranus afer*	Featherback reticulate knifefish	Ipelepele	2	365	3.8
	Xenomystus	*Xenomystus nigri*	African knifefish, false featherback			101	1
Schilbeidae	Schilbe	*Schilbe intermedius*	Butterfish	Ayin	1	832	8.6
							100%

***Source*:** Field work (2013).

Table 2: Seasonality of aqua-fauna diversities

		Frequency	Percent
Period with highest catch	October-Early December	14	70.0
	May – July	6	30.0
	Total	20	100.0
Period of lowest catch	January-March	19	95.0

	December – January	1	5.0
	Total	20	100.0

***Source*:** Field work (2013).

The Shannon- Wienner Species diversity index

The Shannon Wienner species diversity index, when properly manipulated will always result in a diversity value (H') ranging between 0 (indicating low community complexity) and 4 (indicating high community complexity) [14]. As observed in fig 3, the values are between the ranges of 3.58 to 3.75 consequently having the lowest and highest level of evenness at 1.08 to 1.13 respectively showing a strong and high community complexity thereby corroborating the work of [15] on measuring biological diversity.

$$H = 3.322 \left[\log N - \frac{\sum Ni (\log Ni)}{N} \right]$$

The value of evenness across the river in the eight sample reading (fig 2) are closely related. Three of which are a paired value and the other two shows a difference of 0.03 proving them to be in a state of equilibrium.

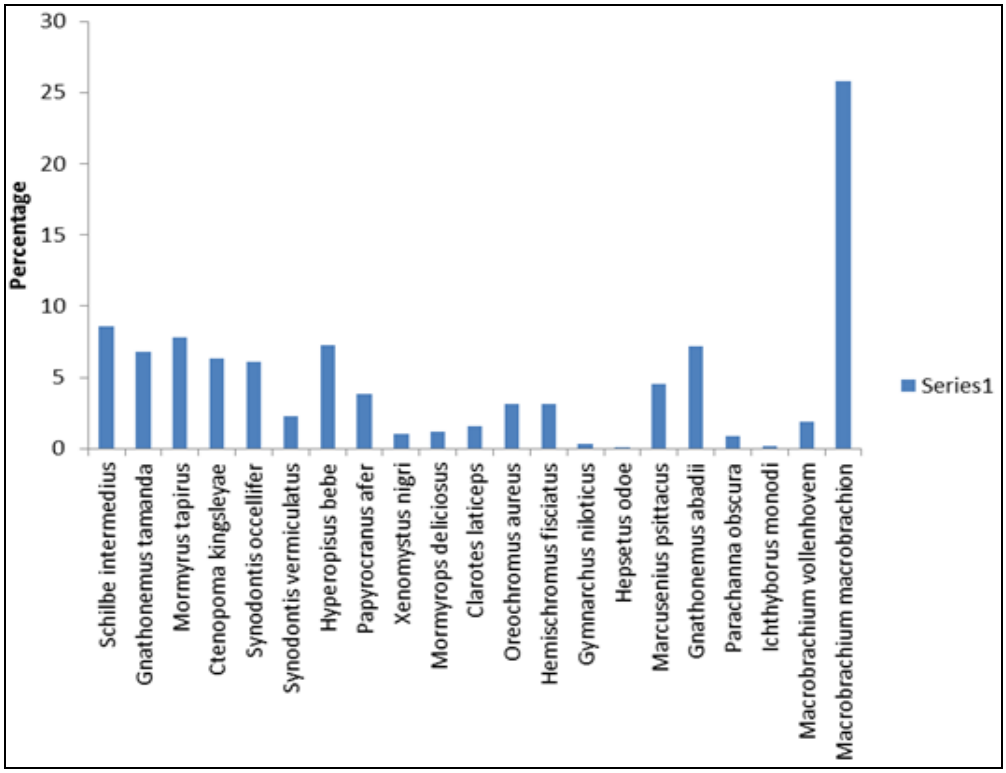

Fig 1: Relative abundance of organisms within the river course

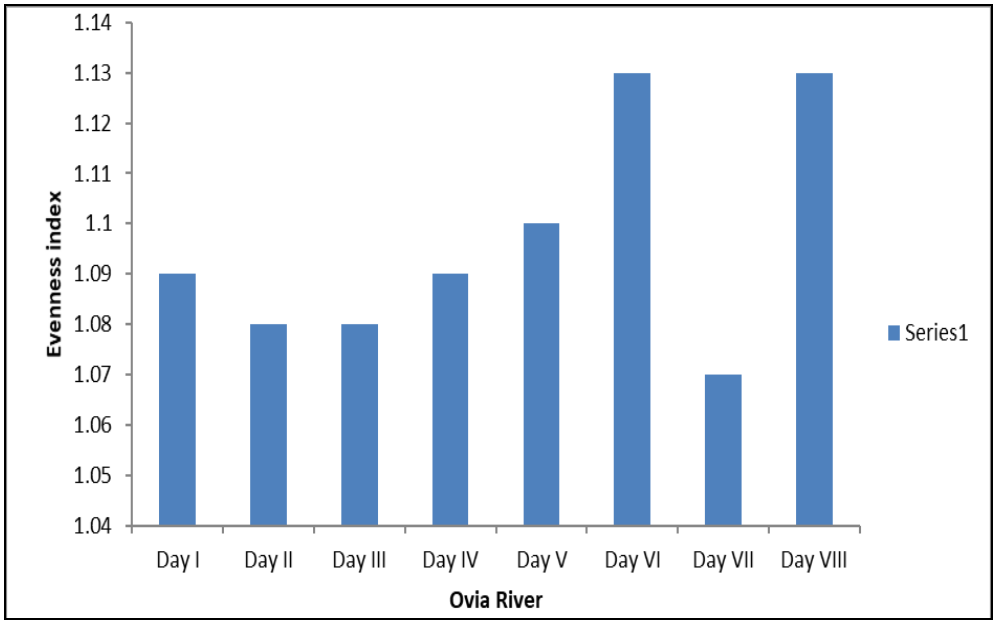

Fig 2: Species richness across Ovia / Osse River

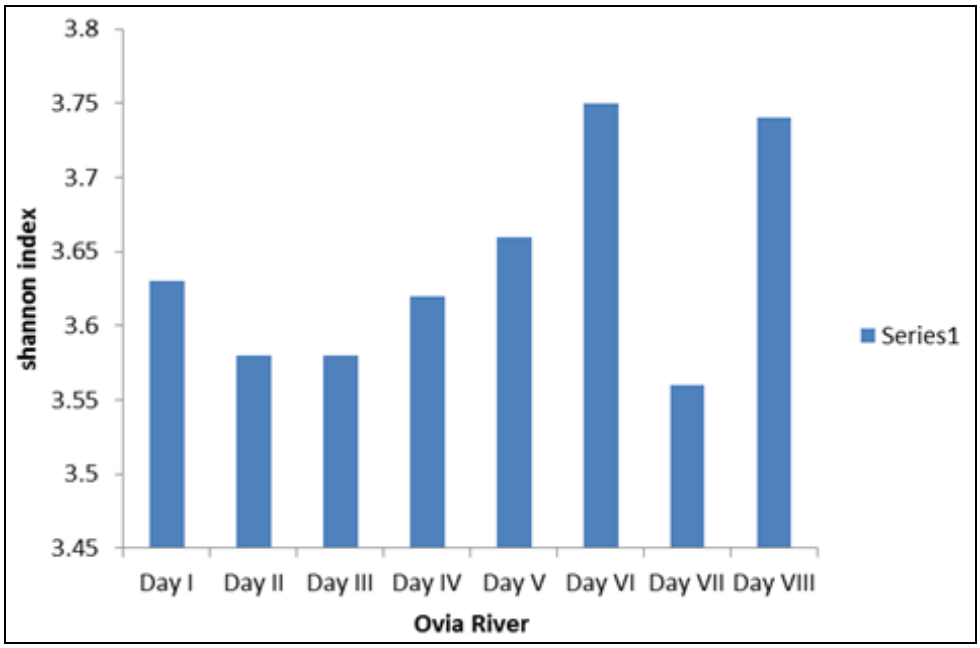

Fig 3: Shannon – Wienner species diversity indices across the river course

Discussion

This study was carried out from January 2012 to March 2013 which represents the low catch season in the area (late December – march) due to the dry season so apparently not all species could be recorded. Although, those available at this period some of them are available all-round the year while others arrive in the wet season. A total of 12 families, 21 species were identified throughout the study which shares a close similarity with the result obtained by Okomoda *et al*., [15]; with a record of 13 families, 28 species. The number of catches in this study also exceeds the records of Okomoda *et al*., [15]. This perhaps indicated that the fishes are faring well plus the river is a good breeding and nursery ground for various fish species. Another reason for the increase in this study compared to others might be due to loss of habitats in other communities along the Niger river as a result of urbanization, farming activities and flooding peculiar to these regions where as, Osse / Ovia River forms the major body of water in Okomu National park having a much relatively insignificant level of disturbance. Abiodun and Odunze [16] observed that 51 species belong to 12 families. These fluctuations in the number of families and number of species within the same river and from one to another could be attributed to seasonal and environmental changes, anthropogenic factors such as damming of the Niger River giving rise to migration or possible obstruction of movement of fish species from one location to another.

This study reveals that *Schilbe intermedius* of the family *Schilbeidae* was the most abundant of the fish species with 8.6% than *Mormyrus tapirus* of the family *Mormyridae with 7.8%* followed closely by *Hyperopisus bebe*, *Gnathonemus abadii*, *Gnathonemus tamandua* all belonging to the same family having 7.3%, 7.2% & 6.8% value of abundance respectively (table 1). Both families were confirmed by the fisherfolks to be available all year round and could be attributed to their high fecundity and proliferation rate.

In this study two species belonging to families *Hepsetidae* and *Distichodontidae* were found to be the least abundant having 0.12 & 0.2 respectively, each being represented by a single specie namely *Hepsetus odoe* and *Ichthyborus Monody*. The reason for this might be due to the spawning period of *Hepsetus odoe* which usually begins in August and last till January though in some locations there are extended spawning season which last until May [17] while this study lasted only till March. *Hepsetus Odoe*, though endemic to west and central African waters, are piscivorous in nature, diurnal ambush predators whose diet consists primarily of Cichlids and Mormyrids [17] both of which are abundant within the study area. The Mormyrids family was represented by six different species in this research, though almost the same were obtained by Okomoda *et al*. [15] but the species differed. Through the fish biodiversity result obtained from this study along this river, it is apparent that the river is productive and that the fish obtained are in excellent condition according to factors from the result presented in table 3

Table 3: Biodiversity parameters for fish fauna in Osse / Ovia River Okomu Park

Diversity index	Day I	Day II	Day III	Day IV	Day V	Day VI	Day VII	Day VIII
Shannon index (H)	3.63	3.58	3.58	3.62	3.66	3.75	3.56	3.74
Evenness	1.09	1.08	1.08	1.09	1.1	1.13	1.07	1.13

As observed in table 3, the biodiversity parameters revealed a close similarity in values of abundance, spread and evenness of species across the eight different readings in all the sampling plots. The Shannon index ranges between 3.58 to 3.75 consequently having the lowest and highest level of evenness at 1.08 to 1.13 respectively showing a strong and highly competitive level of community complexity thereby corroborating the work of Magurran [18] on measuring biological diversity usually with diversity value (H') ranging between 0 (indicating low community complexity) and 4 (indicating high community complexity).

Personal contact with indigenous fisher-folks through physical observation, communication and questionnaires administration reveals that fish like *Gymnarchus niloticus*,

clarotis laticeps, Parachanna obscura Mormyrops deliciosus & Papyrocranus afer has the most economic values. These fishes have a highly desirable flavor to humans, a high local market demand with commercial value and often used for marital engagements Nugroho *et al*., [19].

Aside assessing aqua-fauna diversity data and evaluating fish species with incisive potentials for tourism tenacities, biodiversity studies such as this could be used as rudimentary statistics for fish conservation within the park. Although, anthropogenic factors like illegal logging, farming, excessive fishing especially with unsanctioned mesh sizes might cause harm to aquatic diversity and in turn the entire ecosystem, which could effectively results in loss of essential tree canopies, loss of water shed system through exposure of the forest floors with inevitable reduction in the strength of rivers the park drains into, loss of nursing or breeding grounds for both indigenous and migratory fish, eutrophication, increased turbidity of the water and so on thus necessitating a continual need for more frequent and elaborate biodiversity studies with conservation exercises if we are to ensure a sustainably managed, tourism viable, economically profiting and educationally informative park operational system.

Conclusion

From this study we can conclude that Ovia River has a high diversity and abundance of both macro vertebrate and invertebrates, which shows that it has relatively good water quality. The park though small in size compared to other established ones with its strength majorly in trail and game viewing but with this study, we can adequately accommodate other aspect with equally ecological importance to the already existing management itinerary.

Recommendation

Conservation managers must recognize the need to adopt an inclusive approach which takes into account interests of stakeholders (individuals, group or community living within and around the park or likely to be affected by a management decision or action,) and, as far as possible, encourage their involvement in all aspects of management and planning otherwise there will always be intruders.

Incursions into the parks territorial perimeters both by poacher and powerful cooperation like the Michelin rubber plantation bringing vices as logging and poaching should be strongly checkmated especially as climate change is upon us.

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