

Species Composition and Diversity of the Coastal Waters of Ondo State, Nigeria

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ABSTRACT

A study of the species composition, distribution and diversity of the coastal waters of Ondo State, Nigeria conducted for 18 months (June 2011-December, 2012) in Ilaje Local Government Area of Ondo State using three randomly selected fishing villages of Mahin, Ode-Ugbo and Ugbo-Nla and monthly sampling of catches revealed the presence of 67 finfish species (belonging to 36 families out of which 25 were mono-specific) with the clariids and cichlids dominating the stock accounting for 42% and 16% respectively. Other six predominant families were 'Claroitedae' with 9.2% contribution, 'Channidae' (8.7%), Arapaimidae/ Osteoglossidae (*Heterotisniloticus*) with 7.1%, Gymnarchidae (4.5%), Mugilidae e.g *Mugilcephalus* (3.85%) and Clupeidae (3.8%). Species count of 65 was recorded for Mahin while that of Ode-Ugbo and Ugbo-Nla were 58 and 57 respectively showing Mahin to be the most species-rich fishing site. Lausanne Index of Abundance was 89.7% while Margalef's index (a measure of species richness) was 5.18. A high level of heterogeneity of stock was observed as revealed by Simpson Index and Shannon-Weiner Index of General Diversity (H_i) which were 0.13 and 0.35 respectively. A lot of similarity in species composition existed among the sampling coastal villages as revealed by Evenness Index (E) of 0.20 and Berger-Perker Index of 0.88. There was comparatively higher catches of fish in the dry season than the wet season probably due to reduced water volume which concentrated the fishes for easier catchability. The researcher recommended the need to avoid loss of aquatic biodiversity and protect the existing stock especially the mono-specific families like the Arapaimidae/ Osteoglossidae, Hepsetidae and Gymnarchidae through regular monitoring of the water quality of the coastal waters in view of the on-going industrialization, oil-exploration, high anthropogenic activities and perennial occurrence of water hyacinth.

Keywords: Predominant, diversity, heterogeneity, species, ichthy of auna, abundance

INTRODUCTION

Fish constitutes the major source of animal protein in Africa. It has the most balanced amino acid profile and its consumption cuts across all religious and cultural barriers, hence the high demand for it (Fasakin, 2008; Adewunmi and Fagbenro, 2009). Twenty-one percent of global fish output is consumed by Africans despite the fact that its contribution to global output is the lowest (Bolarinwa, 1995; FAO, 2007).

Nigeria has a rich and varied ichthyofauna resources which over the years could not be translated to increased domestic fish output due to disregard to maritime law of the Sea security issues, environmental pollution and erratic policy changes of the government (FAO, 2008; Bolarinwa, 2014). The total land area of Nigeria is 923,728 sq km out of which 910,768 sq km is land and 13,000sq km is water (Obasohan and Oronsaye, 2005). Nigeria as a coastal state has a coastal line of 900km bordering the Gulf of Guinea and a continental shelf area of 7,934sq km. In 1978, Nigeria declared a 200 nautical miles Exclusive Economic zone (EEZ) which gave an area of 210,900km² over which she has propertial rights for the purpose of exploiting, conserving and managing her fisheries resources. The large shortfall of about 1,800,000 metric tonnes was partially met by importation of 700,000-900,000 metric tonnes (Amire, 2008; Areola, 2009).

These coastal ecosystems which were once rich in biodiversity and biological productivity (due to estuarine influence) are considered mismanaged and underutilized. There is gradual reduction in quantity and diversity of fisheries resources, thus leading to reducing catches (a threat to livelihood in

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the coastal areas). This is partially due to the fact that these coastal wetlands are the centre of oil production in the Delta basin where fossil oil is exploited as a non-renewable resource to the detriment of the environment. The advent of oil exploration has so far been ecologically disastrous to aquatic life in the coastal wetlands (Olawusi-Peters and Ayo-Olalusi, 2009).

Adeyemo (2004) reported that fish and coastal resources face the threat of total collapse or extinction due to overfishing, destruction of aquatic life by pollution, unregulated and excessive use of pesticides, dumping of toxic waste into our water bodies. Fishes like the mudskippers (*Periophthalmusspp*) and the cripedes (*Balanustintinabulus*) which were very common in the '60s were observed to be depleting in stock in Nigerian coastal waters. Depletion of mangrove-dwelling molluscs such as *Littorinacingulifera*, *Littorinapunctata*, annelids (*Mercierallaenigmatica*) as a result of land reclamation have also been reported (Adeosun, 2007; Bello-Olusojiet.al, 2010).

In order to get the best out of our diverse coastal resources, there is a need to study the biology of the fauna of the neglected and mismanaged coastal wetlands zone. Obasohan and Oronsanye (2005) reviewed the fish diversity in Nigerian freshwater bodies and identified the endemic fish species as well as those which are considered potentially endangered. The problems facing fish resource conservation include; the negative effects of frequent policy changes, auditing and sampling, analysis and taxonomy, pollution, management, land reclamation and drought were discussed.

Despite the importance of freshwater / Inland fisheries as a contributor of about 40 % of the total domestic fish supply in Nigeria, the Nigerian natural lakes and wetland resources have received little attention (FDF, 2013). There are only few documented records of fish species despite the fact that they constitute the bulk of animal protein source. Only 108 species so far have been recorded within the natural lakes and wetlands of Nigeria. Only a small fraction of inland aquatic ecosystems have been scientifically investigated (Ita, 1993). There is poor knowledge of Nigerian aquatic ecosystem, hence the need for this present study of fish diversity, finfish species composition and distribution of the coastal wetlands of Ondo State.

Benedictaet.al (2008) stressed the need for identification of the diverse fauna in Nigerian territorial waters. 46 species belonging to 28 genera and 16 families were identified in the flood plain of Cross River, Nigeria with members of the bagridae family forming the most abundant followed by the cichlids and clariidae. *Chrysichthysnigrodigitatus* was the most dominant fish constituting 40% of the catches. The importance of good management of fish stock was emphasized.

Odulete (2010) also identified 69 fish species (59 fin fishes species and 10 shellfish species) from 42 families in his study of diversity and growth parameters of fish population in the marine front (Ode-Omi) of Ogun waterside local government area of Ogun State with the clupeids constituting the most dominant family by weight and abundance. A high fish species diversity and good water quality that need to be conserved for sustainable management were observed despite the on-going oil exploration taking place in the study areas.

Odikoet.al (2009) identified the existence of 81 species of fish belonging to 42 genera and 27 families in Ovie River, Edo State. The most abundant in terms of frequency of occurrence were the mormyrids, mochokids and the cichlids. In terms of number, the clariids (especially *Clariasagboviensis*) and mochokids (especially *Synodontisnigrita*) were predominant. Odiko (2012) reported fish species diversity indices to be relatively high (1.46) in River Ovie in comparison with that of other Nigerian freshwater bodies. Degree of similarity between stations assessed using the Sorenson's Index of Similarity (S) revealed a marked ichthyofauna similarity in all the sampling stations along River Ovie in Edo State of Nigeria (Idodo-Umeh, 2003). Wet season catches were significantly higher than that of the dry season.

Oginni (2004) reported the existence of 10 species of fish belonging to 7 families in Iwo reservoir. The most important of these species was *Sarotherodongalilaeus* and the least was *Gnathonemuscyprinoides*. A low species diversity of 0.17 was observed in the reservoir reflecting high heterogeneity of species in the reservoir. Olawusi-Peters (2008) investigated the fish species abundance, frequency of occurrence, number of occurrence of fishes in Agboyi creek in Lagos State and observed the occurrence of 25 species belonging to 17 families. *Tilapia zilli* constituted 81.52% of the catch followed by *Oreochromis aureus*, *Oreochromis niloticus* and *Hemichromis fasciatus*. Low diversity index status of the creek was revealed by Shannon Index of Diversity (H) and Species richness (D) which were found to be 1.1932 and 2.8285 respectively

MATERIALS AND METHODS

Study Area

The study area is bounded in the east by Benin River in Edo State, in the West by Ogun State coastline and in the North by the land mass of Okitipupa and Irele local government areas in Ondo State. The study area is parallel to Nigeria South West coastline which is characterized by extensive lagoons and river delta systems. It ranges from 4 ° to 6 ° latitude and it is part of the approximately 670 kilometres coastline of Nigeria. The area represents a reflection of what occurs physically, morphologically and environmentally in the adjoining areas. There is a large concentration of mangrove and fresh water swamps. The area is subject to tidal fluctuations with salt water incursion, two to ten months of the year. There are three subzones viz freshwater, brackish water and saltwater bordering the coastal swamps and creeks (See Fig 1).

The study area is separated from the open sea by a strip of sandy land which varies in width from about 2-16 kilometres. Being a low lying land mass, the entire area is subject to flooding as a result of poor drainage. There are two hydrological cycles in the study area i.e the wet and dry seasons. The wet season starts from May to October while the dry season spans November to April. The area is highly susceptible to climate, probably a result of climate change. The rivers and creeks overflow their banks during the rainy season, thus isolating most farming villages and settlements. Falaye (2013) reported over flooding of about 76 fishing communities in Ilaje-EseOdo local government area.

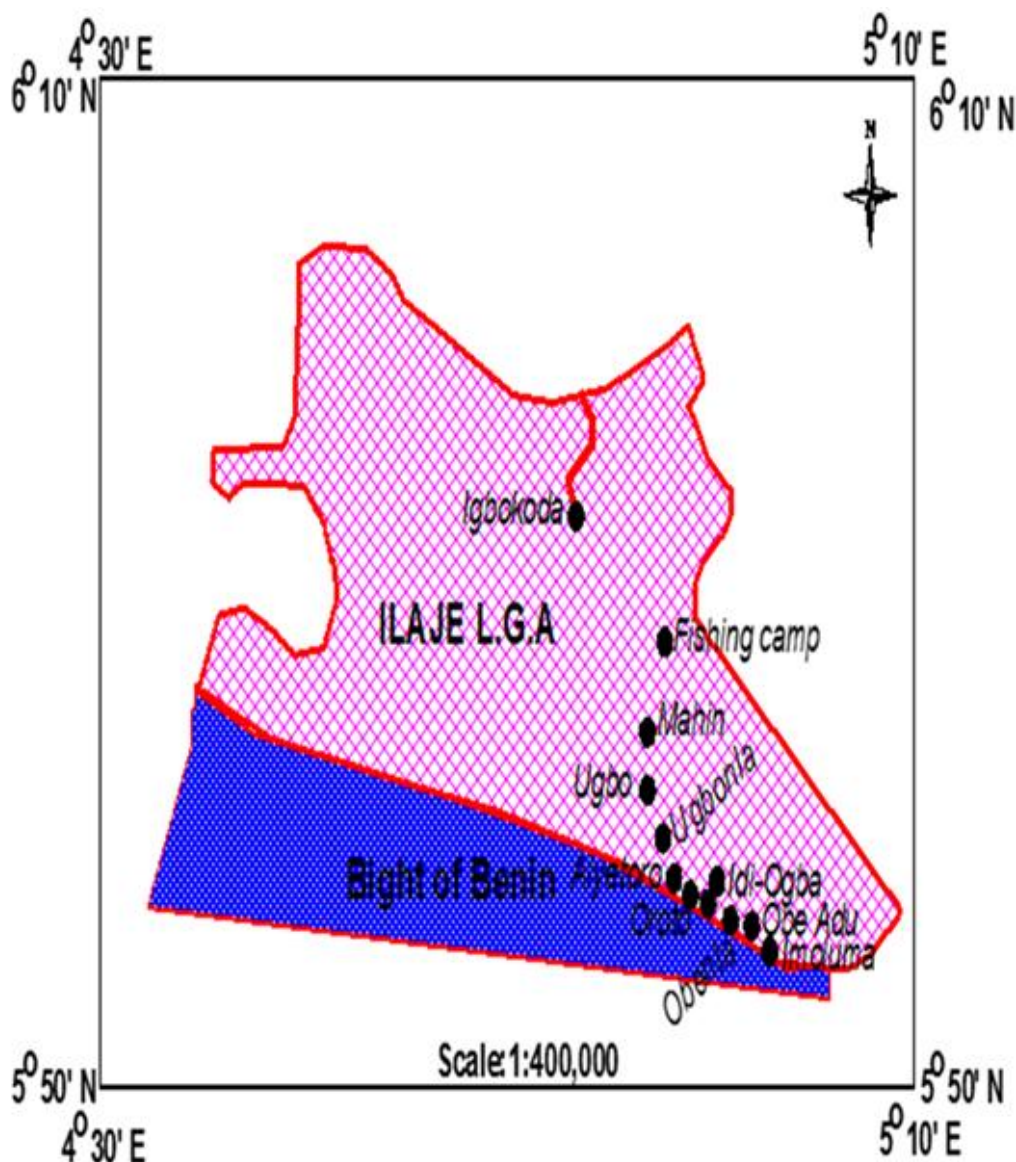


Fig1. Map of the surveyed coastal fishing villages in Ilaje Local Government Area of Ondo State, Nigeria.

Research Methodology

The study involved collection of fin fishes from randomly selected fish landings sites of Mahin, Ode-Ugbo and Ugbo-Nla out of the fishing communities in a purposively selected Ilaje Local Government Area. The criteria for choosing Ilaje LGA was based on the high intensity of fishing activities and prominence as an administrative group.

Fresh fish catches from four (4) boats were sampled on a monthly basis in each fish landing site for 18 months (June 2011-December, 2012). Diverse fishing gears used (depending on targeted species and size) were mainly monofilamentous gill nets (25.4mm-50.8mm) to catch migratory species and cast nets(13mm-50.8mm) for mainly the tilapias. Others like traps (80-90cm mouth diameter) were used to catch the catfishes and crabs while hooks & lines were used to catch *Hepsetus odoe*, cichlids and *Chrysichthys* spp. Spears were mainly used by the Ilaje fisher folks to catch *Gymnarchus niloticus*. The catches were sorted into taxonomic groups (species and families) using standard fish identification keys provided by Adesulu and Sydenham (2007); Boulenger (1916), Fish Base web site and Olaosebikan and Raji(2013). Personal communications with experience fisher folks were also done. Personal communications with experience fisher folks on the local names of the fishes were also solicited. The fishes were subsequently counted and weighed.

Species abundance and composition at each sampling site were calculated using Species count, Lausanne Index of Abundance while the Species Diversity was calculated using Margalef's Index(d) of taxa richness, Simpson's Index of Heterogeneity (D), Reciprocal of Simpson, Index(*Dr), Shannon-Weiner index of General Diversity(H_1). The level of similarity of species composition of the sampling sites of the coastal waters was calculated using Jaccard's Index, Sorensen Index, Berger and Perker Index and Evenness Index.

RESULTS

Table 1 show that Mahin has the greatest number of finfishes by weight and number. Out of the 67 species from 36 families, Mahin had 65 species while Ode-Ugbo and Ugbo-Nla had 58 and 57 species respectively. The most predominant fish family in terms of number and weight is the family 'Clarinda', followed by families Cichlidae, Claroteidae, Channidae, Osteoglossidae, Mugilidae and Clupeidae respectively. The nine major fishes commonly found in the coastal waters of Ondo State of Nigeria were *Clarias gariepinus*, *Heterobranchus bidorsalis*, *Oreochromis niloticus*, *Chrysichthys nigrodigitatus*, *Parachanna africana*, *Heterotis niloticus*, *Gymnarchus niloticus*, *Mugil cephalus* and *Ethmalosa fimbriata*. Mahin waters were richer in species diversity than Ode-Ugbo and Ugbo-Nla.

There was a seasonal variation in fish output with November and December being the peak production months. Generally, there was comparatively higher fish catches in the drier season (November- April) than in the wet season (May-October) though marginal and not significantly different at 5% level of significance. A higher fish catch of 18.5 tons in the dry season i.e 53.5% of the total catch while 16.05 tons were recorded for the wet season.

Species Diversity

Table 1 also reveals the various diversity indices of the three sampling sites. A total number of 67 species belonging to 36 families were observed in the coastal waters of Ondo State. Species count of 65 was recorded for Mahin while that of Ode-Ugbo and Ugbo-Nla were 58 and 57 respectively showing Mahin to be the most species-rich fish landing site. Fish abundance by number was 45,100 for Mahin, 26,193 for Ode-Ugbo while Ugbo-Nla recorded 20,139 individuals. Fish Output by weight recorded for a period of 18 months was highest in Mahin at 17.458 tons followed by Ode-Ugbo and Ugbo-Nla. The Index of Abundance according to Lausanne (1983) was highest in Mahin as well (98%), followed by Ode-Ugbo (87%) and lastly Ugbo-Nla with 85%.

The mean value of Simpson's Index recorded in the coastal waters was 0.128 showing a high degree of heterogeneity of species composition. Margalef Indices for Taxa Richness 'd' was highest at 5.69 for Mahin. It decreased from 5.69 in Mahin to 4.86 in Ugbo-Nla, the most polluted fishing site by virtue of the oil leakages of the boat transporters.

The values of Diversity indices like Jaccard's coefficient, Berger and Perker(1970) Index, Sorensen's Index(SI), Shannon-Weiner Index(H) and Evenness Index calculated showed there was a lot of similarities in species composition between Ode-Ugbo and Ugbo-Nla.

Jaccard's coefficient was 0.81 between Mahin and Ugbo-NIa while the value calculated for Ode Ugbo and Ugbo-NIa was 0.95. The higher value got for Ode-Ugbo and Ugbo-NIa showed similarity of the two sampling sites in terms of species composition. This corresponds with the values of Sorensen Index 'S I' (a measure of similarities of species composition between two communities). Evenness Index (E) was 0.19 showing all the species were not equally abundant. This trend cuts across all the sampling sites. The maximum value of 1 show all species were equally abundant

Table1. Diversity Indices of the Three Sampling Sites in the Coastal Waters of Ondo State, Nigeria

DIVERSITY INDICES	MAHIN	ODE-UGBO	UGBO-NLA	POOLED
Species Count	65	58	57	67
Fish Abundance by No	45,100	26,193	20,137	91430
Index of Abundance	97%	87%	85%	
Simpson,s Index(D).	0.137	0.125	0.121	0.127
* Dr 7.29	8.00	7.78	7.69	
Margalef Index	5.69	4.99	4.86	5.18
Jaccard Index (Mahin&Ode-Ugbo)	0.86	0.86	-	
Jaccard Index (Mahin&Ugbo-NIa)	0.81	0.81	-	
Jaccard Index (Ode-Ugbo&Ugbo-NIa)	-	0.95	0.95	
Berger&Parker Index	0.86	0.88	0.89	
Evenness Index(E)	0.198	0.20	0.21	0.20
Sorensen,s Index (Mahin&Ode-Ugbo)	86%	86%	-	
Sorensen,s Index (Mahin&Ugbo-NIa).	81%	-	81%	
Sorensen,s Index (Ode-Ugbo&Ugbo-NIa)	97%	97%	-	
Shannon-Weiner Index of General Diversity(H ₁)	0.35	0.36	0.34	0.35

DISCUSSION

Species Composition, Distribution and Abundance

Table 1 shows that generally, Mahin waters was richer in species than Ode-Ugbo and Ugbo-NIa probably due to the fact that there are more creeks where the hardy and predominant catfishes like the clariids and the snakeheads (*Parachanna obscura* and *Parachanna africana*) hide in Mahin than in Ode-Ugbo and Ugbo-NIa. These mud-loving catfishes were difficult to catch during the dry season because they do hibernate in holes made in muddy bottom in the creeks. Once it rains, they troop out of the vegetated areas into the open waters for oxygen where they are caught with fishing traps, set nets, hooks and lines and spears (by the more dexterious Mahin fisher folks). Another possible reason for the higher occurrence of the fishes in Mahin might not be unconnected with the relatively fresher waters of Mahin (2.46ppt). By virtue of the nearness of Ode-Ugbo (4.64ppt) and Ugbo-NIa (4.80ppt) to the Atlantic ocean, they have more salty waters than Mahin (Akegbejo-Samsons, 1995, Pers.comm.). Some of the fishes run away from the salty waters of Ode-Ugbo and Ugbo-NIa to the fresher water of Mahin lagoon. However, the more salt-tolerant fishes like *Tilapia guineensis*, *Sarotherodon melanotheron*, mullets and the bonga which respond with salinity occurred more during the higher salinity of the dry season from January-April (Bolarinwa, 1984; Agboola and Anetekhai, 2008). The onset of rainy season in May brings in young *Heterotis niloticus* called 'Pete' and the clariids.

There is also the problem of oil pollution which is more in Ugbo and Ugbo-NIa (which are oil prospecting area) coupled with more anthropogenic and industrial activities. The on-going canalization for the Natural liquefied Gas Project and Olokola Free Trade Zone might have led to destruction of breeding sites, loss of aquatic flora and fauna (Akegbejo-Samsons, 1995; Odulate, 2010). The second most predominant family found in the coastal waters of Ondo State after the clariids are the cichlids especially *Oreochromis niloticus* and *Tilapia zilli* otherwise known as 'Red-belly tilapia'. Mahin waters is richer in all the freshwater species like *Heterotis niloticus*, *Gymnarchus niloticus*, *Chrysichthys nigrodigitatus* (except *T. guineensis* and *S. melanotheron*) apart from the clariids and the channids. Ornamental fishes like *Gnathonemus* spp, Red tilapia, *Psettussebae*, *Malapteruruselectricus*, *Phagomaculatus* are more tolerant of the less saline waters of Mahin. Extraneous fishes like the *Ethmalos* spp (bonga), *Elops lacerta* (ten-pounder) and *Megalops atlanticus* (tarpon) stray from the salty waters of Aiyetoro and Orioke-Iwamimo into Mahin for breeding purposes especially in June. There is higher occurrence of gravid females of *Chrysichthys nigrodigitatus*, *Heterotis niloticus* and *Hepsetus odoe* during the rainy months of July-

October coinciding with high water volume, hence the high incidence of the young juveniles at that period. Various workers have recorded the clariids and cichlids as most dominant families in different coastal waters and reservoirs (Olopade *et al.*, 2006; Adeosun, 2007; Imaobong, 2012, Oboh, 2013)

There is seasonal variation in fish output with November and December being the peak production months. Generally, there is comparatively higher fish catches in the drier months than in the wet months probably due to lower volume of water coupled with higher concentration of food and easier catchability and accessibility. Previous studies, Araoye (2005) and Akegbejo-Samsons (1995) reported higher catches during the dry seasons in Asa Dam, Ilorin, Nigeria and Ondo State coastal waters respectively probably due to more intense fishing activities in the dry season. Olawusi-Peters (2008) also observed higher catches in Agboyi Creek, Lagos State during the dry season. However, workers like Odulate (2010) recorded higher catches in the rainy month of July in Ode-Omi coastal marine waters of Ogun State, Nigeria. Oginni (2004) in Iwo reservoir and Bello-Olusoji (1998) in Asejire Dam, Nigeria observed higher fish catches during the wet season attributing it to the draw-down effect of water volume in Lakes and reservoirs to be responsible for the higher catches. The dry season is a period of high volume draw-down in reservoirs and lakes.

Species Diversity

A total number of 67 species belonging to 36 families were identified in the coastal waters. Out of the 36 families, 25 were represented by just one species. The high number of species recorded in the present study did not correspond with the findings of Akegbejo-Samsons (1995) who recorded 32 species from the coastal waters of Ondo State. Previous workers also reported lower number of fish species attributing it to extinction, pollution and overfishing. Ogaga (2012) observed 34 species as against 91 recorded previously in Warri River, Nigeria. The sharp drop in species diversity was attributed to extinction. Yemet *et al.* (2009) reported extinction of threatened fishes and succession in Kainji Dam as a result of impoundment. The reason for the higher abundance observed in the present study might not be unconnected with speciation due to physical, ecological and climatological barriers. A lot of earth movement and canalization for industrial projects like Olokola Free Trade Zone have been on-going over the past two years. This was confirmed by the higher value of Fish abundance by number and by weight recorded for Mahin. The highest fish abundance observed in Mahin might be due to the low salinity of Mahin which waters are not as saline as that of Ode-Ugbo and Ugbo-Nla (which are closer to the salt-laden Atlantic Ocean). Their nearness to salty waters of Orioke, Iwamino, Aiyetoro and other sea fishing villages might be responsible. There was a possibility of fish migration from the more saline waters of Ugbo and Ugbo-Nla to the cooler, more or less fresh waters of Mahin, hence the higher abundance of fish in Mahin.

The value of Simpson's Index recorded for the coastal waters was low showing a high degree of heterogeneity of species composition. Margalef Indices (a measure of species Richness or Taxa Richness 'd') was also high. It decreased from 5.69 in Mahin to 4.86 in Ugbo-Nla, the most polluted fishing site by virtue of the oil leakages of the boat transporters at the jetty.

Diversity indices like Jaccard Coefficients, Berger and Perker (1970) Index, Sorensen's Index (SI), Shannon-Weiner Index (H) and Evenness Index calculated showed there was a lot of similarities in species composition between Ode-Ugbo and Ugbo-Nla. Jaccard's coefficient was 0.81 between Mahin and Ugbo-Nla while the value calculated for Ode Ugbo and Ugbo-Nla was 0.95, The higher value got for Ode-Ugbo and Ugbo-Nla showed similarity of the two sampling sites in terms of species composition. This corresponds with the values of Sorensen Index 'SI' This might not be unconnected with the similar value of salinity and other physicochemical parameters, the two fishing villages being near the Atlantic ocean.

Value obtained for Evenness Index (E) showed all the species are not equally abundant. This trend cuts across all the sampling sites. The maximum value of 1 show all species are equally abundant.

CONCLUSION AND RECOMMENDATIONS

By and large, 67 finfish species (belonging to 36 families out of which 25 were mono-specific) were identified in the coastal waters of Ondo State of Nigeria with the clariids and cichlids dominating the stock accounting for 42% and 16% respectively. Other six predominant families were Clariidae, Channidae, Arapaimidae/ Osteoglossidae, Gymnarchidae, Mugilidae and Clupeidae. Mahin was more species-rich as revealed by species count, Lauzanne Index and Margalef's index. Though a high level

of heterogeneity of stock was observed in Ondo State coastal waters as revealed by Simpson Index and Shannon-Weiner Index of General Diversity (Hi).there is a need to prevent further loss of biodiversity.

A lot of similarity in species composition existed among the sampling coastal villages as revealed by Evenness Index (E) and Berger-Perker Index. There was comparatively higher catches of fish in the dry season than the wet season probably due to reduced water volume which concentrated the fishes for easier catchability. The researcher recommended the need to avoid loss of aquatic biodiversity and protect the existing stock especially the mono-specific families like the Arapaimidae/Osteoglossidae, Hepsetidae and Gymnarchidae through regular monitoring of the water quality of the coastal waters in view of the on-going industrialization, oil-exploration, high anthropogenic activities and perennial occurrence of water hyacinth.

There is a need to diversify into culture fisheries to augment the threatened mono-specific families like Gymnarchidae, Hepsetidae, Osteoglossidae and Elopidae. A more conducive enabling environment should be provided for the artisanal fisherfolks especially in the area of microcredit, and supply of fishing inputs. More funds should be committed to researches on resource survey, mariculture, sensitization and training of artisanal fisherfolks in the coastal communities of Ondo State.

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