Fish types, breeding grounds and migratory routes in Akwa Ibom State, Nigeria

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Abstract

Akwa Ibom State is one of the six maritime states in Nigeria and has a shoreline of approximately 129km. Three important rivers (Cross, Imo and Kwa Ibo) transiting through some Nigerian states, terminally pass through the state before discharging into the Atlantic Ocean. Despite the extensive drainage systems and huge fisheries potentials of the state, very little is known about her role in the sustainable productivity of major fish populations. This study was undertaken to bridge information gap on fish type, migratory path and breeding sites of some fish fauna in order to protect fish populations and diversity. The study revealed that Characidae, Cyprinidae, Cichlidae, Clariidae, Schilbeidae and Bagridae dominated the freshwater fauna, while Clupeidae, Carangidae and Ariidae dominated marine piscifauna. Mbo, Udung Uko, Oron Urbuan and Itu in the state serve as major migratory path for several diadromous fishes. The floodplains of the major rivers at Itu, Uruan, Okobo and Ibiono (Cross River), Oruk Anam, Ikot Abasi and Ukanafun (Imo River) and Eket, Onna Nsit Ubium and Etinan Local Government Areas (Kwa Ibo River) serve as major breeding sites. Consequently, the state hosts hundreds of fishermen that depend solely on fishing for their livelihood. However, fish diversity and productivity are threatened by pollution, unorthodox fishing techniques, over exploitation, deforestation and replacement of mangrove plants with exotic nypa palm. This study shows that Akwa Ibom State occupies a prime position in the sustainable fish productivity and biodiversity of the entire Niger Delta region and Nigeria. It is suggested that a well-coordinated strategy that should involve fishers, community leaders, researchers, non-governmental organizations (NGO) and governmental agencies be adopted to protect fish productivity and diversity of the major drainage systems that pass through the state.

Keywords: Conservation; biodiversity; sustainable fishery; fish migration path; breeding sites; Niger Delta.

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Introduction

Knowledge on the piscifaunal composition, major breeding sites and migratory paths of drainage systems within a region is essential for proper planning and sustainable management of aquatic resources. When lacking, fish populations could easily become endangered due to overfishing and habitat destruction, which could cause extirpation of ecological and commercially important species. However, this essential information is lacking for most Nigerian states. Therefore, this study was undertaken to provide some aspects of this important information for the drainage systems within Akwa Ibom State.

Akwa Ibom is a coastal state in the southern part of Nigeria, lying between latitudes 43˚2`N and 53˚3`N and longitudes 72˚5`E and 82˚5`E. The state shares the eastern, western and northern borders with Cross River, Rivers and Abia states, respectively. It is bordered on the south by the Atlantic Ocean. Akwa Ibom is one of the six maritime states in Nigeria with a coastline of approximately 129km and effective shelf area of 8,005km (Ekpo and Essien-Ibok 2013). The estuary covers a surface area of 121, 000ha (Ita 1993). The extensive coastline along with numerous rivers and estuaries make Akwa Ibom one of the major fishing destinations in Nigeria.

There are effectively eleven fishing Local Government Areas (LGA) in the state, which include Eket, Eastern Obolo, Esit Eket, Ibeno, Ikot Abasi, Itu, Mbo, Okobo, Oron, Udung Uko and Uruan. Together, these LGAs house more than two hundred fishing settlements (Ekpo and Essien-Ibok 2013). The major rivers in the state include Cross, Imo and Kwa Ibo. The rivers after an extensive sojourn through ecologically diverse areas, empty directly into the Atlantic Ocean. The fisheries potential of the state is enormous and sustains a thriving artisanal fisheries industry, which employs hundreds of fishers. The state provides several breeding habitats for different fish species and serves as path for migratory fishes to reach breeding and foraging sites further inland.

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Climate of Akwa Ibom State

The climate is tropical and there are distinct rainy and dry seasons. The temperature varies between 27.5°C and 33.0°C maximum; and 22.5°C and 24.0°C minimum. The dry season starts from November and lasts till the end of March or mid-April. The rainy season is between April and October (Mosses 1979; Ekpo 2013). Maximum precipitation (about 70% of the total) occurs between June and October although rainfall is all year. There is usually a short dry period referred to as August break that lasts between 10 and 21 days at any time in July/August. Consequent to this break, two rainfall peaks and water levels in the major rivers occur in June and September. The June peak is usually smaller than the September peak. At the onset of the rainy season, the water level of the major rivers starts to rise gradually from the dry season level. By the third week of June, the rise is rather sharp then drops slightly during August break.

Hydrology and drainages

There are three major rivers (Cross, Kwa Ibo and Imo) in Akwa Ibom State, with a total drainage basin of approximately 3,652 km^2, excluding the estuaries, within the state (Figure 1).

The Cross River

The Cross River system is formed by several tributaries arising from the western slopes of the Cameroon mountains. It flows first in an eastward direction, then turns southwards, and enters the Atlantic Ocean with limited delta formation (Moses 1979). The entire Cross River system lies approximately between longitude 3°30′E and 10°00′E and latitude 4°N and 8°N. Teugles *et al* (1992) and King (1996) reported a drainage basin of 70,000 km^2 with 50,000km^2 in Nigeria. The main Cross River channel covers a distance of 600km from source to mouth where it discharges into the Atlantic Ocean at the Bight of Bonny (King 1996). It has an estuarine of 95km^2, resulting in freshwater of 69,905km^2 (Ita 1993). Detailed information on the Cross River is available (Moses 1979; Teugels *et al* 1992; Akpan, 1999). The tributaries of the Cross within Akwa Ibom include Udom, Nung Oku, Esedeke, Iba Oku, Ikpa and Mbo rivers.

Kwa Ibo River Basin

River Kwa Ibo originates from Umuahia in Abia State (Moses *et al* 2015), travels through several forested areas and then empties into the Atlantic Ocean through the estuary at Ibeno LGA, Akwa Ibom State. The river is sometimes referred to as Qua Iboe, it covers a distance of between 150 and 180km. The surface area is approximately 500,200ha (Ita 1993).

Imo River Basin

The river is located on the western part of the state and flows directly into the Atlantic Ocean. It rises from the Okigwe uplands in Imo State and has a total drainage of 7,770km^2 (Amangabara 2015). The surface area of the main river is about 910,000ha. The river has an annual discharge of 4km^3 with a wetland of 26000ha. Its estuary is around 40km wide. The river and the estuary form an extensive brackish system that covers a surface area of 36,000ha (Ita 1993). Detailed hydrometeorological data is contained in ENPLAN (1974).

Fish types

The fish fauna of Akwa Ibom State comprises the freshwater fin and shellfish species from the Cross, Imo and Kwa Ibo river watersheds, and estuaries and marine species (Essien-Ibok and Isemin, 2020).

Freshwater Fish Species

The freshwater fish fauna of the state is quite diverse and include over 165 species (97 genera, 41, families, 15 orders) from the Cross River (King 1996; Okogwu 2008), River Kwa Ibo and River Imo (Ita 1993; Moses 1979, 1987; Ekpo 2013; Onuoha *et al* 2010; Essien-Ibok and Isemin 2020). The freshwater fish fauna is dominated mainly by Characidae, Cyprinidae, Cichlidae, Clariidae, Schilbeidae, Bagridae and some marine intrusive species (Table 1). The dominant fish species in the state include *Chrysichthys nigroditatus*, *Clarias gariepinus*, *Heterotis niloticus* and *Orechromis niloticus* (King 1996; *Onuoha et al* 2010; Ekpo and Essien-Ibok 2013). The marine intrusive species include *Liza falcipinnis*, *Eleotris daganensis*, *Trachinotus tersia*, *T. goreensis*, *Caranx hippos*, *Polynemus quadrifilis* and *Lutjanus endecacanthus*. The freshwater prawn *Macrobranchium vollenhovenii* is also common in Akwa Ibom aquatic freshwater ecosystem.

Estuarine water species

Estuary (brackish water) serves as transition zone between the freshwater and marine environment and the salt concentration is intermediary. The fish composition usually includes both freshwater and marine elements. Shellfishes such as *Penaeus notialis*, *Parapenaeus longirostris*, Oysters, mussels and periwinkles predominate this ecosystem (Table 2). They inhabit the creeks and mangrove swamps mostly. The marine and estuarine finfish species commonly found in the estuaries of Akwa Ibom are *Liza facipinnis*, *L. gradisquamis* (Mugilidae), *Tilapia guineensis*, *Sarotherodon galilaeus* (Cichlidae) *Chrysichthys nigrodigitatus* and *C. furcatus* (Bagridae) and *Pomotrygon* sp (Rajidae). Others include *Pseudotolithius elongatus*, Clupidae (*Ilisha africana*, *Ethmalosa fimbriata* and *Sardinella* spp).

Marine water fish species

The marine ichthyofauna include seasonal migrants to and fro the estuaries. The common marine species found in Akwa Ibom (Table 3) are *Ethmalosa fimbriata*, *Ilisha africana*, *Sadinella africana* (Clupeidae), *Caranx africanus*, *C. hippos* and *C. senegalius* (Carangidae), *Arius brachyconatus* (Ariidae), *Pentanemus* sp and *Polydactylus* spp (Polynemidae) and the shellfishes

Figure 1. Map of Akwa Ibom State showing the locations of different rivers and fish migratory paths

Penaeus notialis and *Parapenaeus longirostris* (King 1996; Ekpo and Essien-Ibok 2013). Studies have shown that some of the fish fauna in this region need protection because they are overfished, rare, monospecific and/or endemic. For instance, *Schilbe micropogon* is endemic to the Lower Cross (King 1996). Hepstidae, Notoruridae, Gymnarchidae and Eleotridae are some of the monospecific families in the region and thus require attention and proper management to avoid biodiversity decline (Okogwu 2008; Onuoha *et al* 2010). *Chrysichthys nigrodigitatus, Clarias gariepinus, Ethmalosa fimbriata* and *Macrobranchium vollenhovenii* are overfished and deserve proper and well-coordinated management (Okogwu 2008, 2011; Ama-Abasi *et al* 2004). *Malapterurus* sp, *Papyrocranus* sp, *Pelvicachromis guntheri* and *P. pulcher* persistently contribute few individuals to catch, annually and are considered rare (Okogwu and Ugwumba 2010; Onuoha *et al* 2010).

Breeding sites

The major breeding sites for marine fish species in Akwa Ibom State are the shallow creeks and estuaries of Rivers Imo, Kwa Ibo and Cross (Figure 2). There is anecdotal evidence of migrations of *Ethmalosa fimbriata, Sardinella* spp, *Pseudotolithus elongatus*, snappers, threadfins, pink shrimp and barracuda to the creeks to breed and forage (Ama-Abasi and Holzloehner 2002). The shallow nature of creek waters and high productivity due to fallen leaves from riparian vegetation make these creeks and estuaries fertile breeding grounds. The breeding sites on the Cross River estuary include creeks around Oron, Eastern Obolo, Ibeno, Mbo, Udung Uko and Ikot Abasi.

The freshwater fish species breed in temporary and permanent water bodies in the floodplains of the major rivers located at Oruk Anam, Ikot Abasi and Ukanafun (Imo river), Eket, Onna Nsit Ubium and Etinan (Kwa Ibo) and Itu, Uruan, Okobo, and Ibiono LGAs (Cross).

Migratory routes in Akwa Ibom State

Fish migration refers to movement between two or more habitats separated in time and space, which occur with regular periodicity and usually involves a large number of the fish population (Poulsen *et al* 2002, 2004). Migration, which is an essential part of fish life cycle occur because some fish species require different habitats to satisfy their needs. The process is often cued by seasonal changes in hydrology. Most freshwater, estuarine and marine fish species in rivers Cross, Imo and Kwa Ibo basins undertake seasonal migrations to reach breeding and foraging sites in the inland waters. The migrant fish populations target the floodplain lakes and ponds within the drainages of the rivers (Moses 1987; Okogwu 2011). The floodplain lakes

Table 1: Some Freshwater fin and shell fish species previously identified in Akwa Ibom State

S/N	FAMILY/SPECIES	NO OF SPECIES
1	**ANABANTIDAE**	2
	Ctenopoma kingsleyae	
	C. petherici	
2	**BAGRIDAE**	7
	Bagrus bayad	
	B. docmac	
	Chrysichthys auratus	
	C. nigrodigitatus	
	C. furcatus	
	Auchenoglanis biscutatus	
	A. occidentalis	
3	**CARANGIDAE**	
	Trachinotus goreensis	
	Trachinotus tersia	
4	**CHANNIDAE (OPHICEPHALIDAE)**	2
	Parachanna obscurua	
	P. africanus	
5	**CHARACIDAE**	8
	H. forskalii	
	Brycinus nurse	
	B. *leuciscus*	
	B. longipinnis	
	B. macrolepidous	
	Micralestes elongatus	
	M. humilis	
	M. occidentalis	
	Arnoldichthys spilopterus	
	Bryconaethiops quinquesquamae	
6	**CICHLIDAE**	16
	Hemichromis bimaculatus	
	H. fasciatus	
	H. niloticus	
	Chromidotilapia guntheri	
	Pelmatochromis guentheri	
	P. taeniatus	
	P. pulcher	
	Tilapia zillii	
	T. guineensis	
	T. dageti	
	Sarotherodon (T.) galilaeus	
	S. melanotheron	
	S. macrocephala	
	Oreochromis (T.) niloticus	
	T. mariae	
	T. melanopleura	
7	**CITHARINIDAE**	2
	Citharinus citharus	
	C. latus	
8	**CLARIIDAE**	5
	Clarias gariepinus	
	C. anguillaris	
	C. dumerilii	
	Heterobranchus bidorsalis	
	H. longifilis	
9	**CLUPEIDAE**	2
	Pellonula afzeliusi	
	Sierrathrissa leonensis	
10	**CYPRINIDAE**	4
	Labeo coubie	
	L. senegalensis	
	B. callipterus	
	B. aboinensis	
11	**DISTICHODONTIDAE**	3
	Distichodus rostratus	
	D. engycephalus	
	D. brevipinnis	
12	**ELEOTRIDAE (GOBIIDAE)**	1
	Eleotris daganesis	
13	**GYMNARCHIDAE**	1
	Gymnarchus niloticus	
14	**HEPSETIDAE**	1
	Hepsetus odoe	
15	**ICHTHYOBORIDAE**	2
	Ichthyoborus besse	
	Phago loricatus	
16	**LEPIDOSIRENIDAE**	1
	Protopterus annectens	
17	**SCHILBEIDAE**	8
	Parailia peliucida	
	Physalia pellucida	
	Schilbe brevianalis	
	S. micropogon	
	S. segegalensis	
	S. mystus	
	S. uranoscopus	
	Eutropius sp	
18	**MALAPTERINIDAE**	1
	Malapterurus electricus	
19	**Mockhokidae**	4
	Synodontis gobroni	
	S. courteti	
	S. eupterus	
	S. nigrita	
20	**MORMYRIDAE**	4
	Brienomyrus brachyistus	
	Mormyrus rume	
	Gnathonemus petersii	
21	*Marcusenius ihuysi*	
	POLYPTERIDAE	1
	Erpetoichthys calabaricus	
22	**PROTOPTERIDAE**	1
	Protopterus annectens	
23	**NOTOPTERIDAE**	2
	Papyrocranus afer	
	Xenomystus nigri	
24	**LUTJANIDAE**	1
	Lutjanus sp.	
	OSTEOGLOSSIDAE	1
	Heterotis niloticus	
	(b) Shellfish	
	Freshwater clam	
	Egeria radiate	
	Freshwater crayfish	
	Penaeus notialis	
	Fresh water Prawn	
	Macrobranchium vollenhovenii	

Sources: Ita (1993), King (1996), Ekpo and Essien-Ibok (2013), Okogwu (2008)

Table 2: Estuarine water fin and shell fish species in Akwa Ibom State, Nigeria

Estuary	Fish species
(a) Finfish	
	BAGRIDAE
	Chrysichthys nigrodigitatus
	C. furcatus
	MUGILIDAE
	Liza falcipinnis
	L. grandisquamis
	CICHLIDAE
	Tilapia guineensis
	Sarotherodon galilaeus
	RAJIDAE
	Pomatrygon sp
(b) Shellfish	
	Mussel
	Oysters
	Crabs
	Periwinkles

Sources: King 1996, Ekpo and Essien-Ibok (2013)

(which are inundated during the rainy season) and the tributaries to the rivers are the major foraging and breeding sites. Since Akwa Ibom State occupies the lower reaches of the rivers, it serves as a major route for several migratory fishes to reach the floodplains and second and third order tributaries within and beyond the state (Figure 3). In most of the basins, seasonal migrant fish populations sustain viable artisanal fisheries along the migration routes. Migrant fish species can be classified as follows:

1. Anadromous fishes: Fishes that spend the adult life in seas and migrate to freshwater to spawn. Anadromous migrant fishes in the Akwa Ibom aquatic systems are *Trachinotus tersia*, *T. goreensis*, *Caranx hippos*, *Polynemus quadrifilis*, *Lutjanus endecacanthus* and *Decapterus rhonchus* (Kings 1996). These fish species migrate from the lower reaches of the Cross, move through Mbo, Udung Uko, Oron Urbuan and Itu to reach breeding and foraging sites located more than 300km from the ocean (Kings 1996; Okogwu 2008).

2. Catadromous fishes: Fishes that spend the adult life in freshwater and breed in the sea.

3. Potamodromous fishes: These are fishes that spend their entire life in the river but undertake either lateral migrations to forage and spawn in floodplains or longitudinal migrations to reach more suitable sites upstream the river. These are the most common fishes in the Akwa Ibom drainage systems. Some species can undertake both longitudinal and latitudinal migrations.

Potamodromous fishes in the region include *C. gariepinus*, *Labeo* spp and *M. vollenhovenii.* Migration also includes movement from the floodplains by spawned juveniles during the onset of the dry season (when water level recedes) to the main river channels.

Table 3: Marine fin and shell fish species in fisheries in Akwa Ibom State

Marine	Fish species
	CLUPEIDAE
(a) Finfish	*Ethmalosa fimbriata*
	Ilisha africana
	Sardinella africana
	Pellonula leonensis
	SCOMBRIDAE
	Scomberomorus tritor
	S. maculate
	ELASMOBRANCHIDAE
	Scoliodon sp
	Carcharhinus sp
	Rhynchobatu sp
	Dasyatis sp
	Aerobatus sp
	CARANGIDAE
	Caranx africanus
	C. hippos
	C. senegalius
	Megalasois sp
	Chlorinemus sp
	Trachinotus tersia
	T. goreensis
	SCIAENIDAE
	Pseudotolithus elongatus
	P. typus
	P. senegalus
	LUTJANIDAE
	Upeneus prayens
	Lutjanus endecacanthus
	ARIIDAE
	Arius brachyconatus
	Tachysurus sp
	POLYNEMIDAE
	Pentanemus sp
	Galeoides decadactylus
	Polynemus sp
	Polydactylus quadrifilis
	SPHYRAENIDAE
	Sphyraena sp
	CYNOGLOSSIDAE
	Cynoglossus senegalensis
	C. monody
	C. canariensis
(b) Shellfish	PENAENIDAE
Shrimps	*Penaeus notialis*
	P. kerathurus
	Parapenaeus longirostris
	Parapenaeopsis atlantica

Sources: Ita (1993), Ekpo and Essien-Ibok (2013), Okogwu (2008)

Figure 2. Map of Akwa Ibom State showing some fish breeding sites in Cross River (a), River Kwa Ibo (b) and River Imo (c)-freshwater (green) and Estuary (d, maroon)

Figure 3. Map of Akwa Ibom showing the migratory path of fishes (arrows) in the different ecosystems

Available information shows that rise in water level trigger the migration of *C. gariepinus* (Moses 1987; Okogwu 2008) and *C. nigrodigitatus* (Ama-Abasi and Sambo 2014; Ama-Abasi *et al* 2019) from the Lower Cross to breeding sites in further inland waters. These migrants pass through several towns in Akwa Ibom and some do not reach their destinations as they are waylaid by fishers. Therefore, the state is key to the protection of migrant fish stock of the Cross, Imo and Kwa Ibo rivers, if the fisheries potential of these rivers must be sustained.

The cues that initiate fish migration are not well known but are linked to changes in hydrological conditions of the water such as drought and rise in water level (Moses 1987; King 1996; Poulsen *et al* 2002; Okogwu and Ugwumba 2010; Okogwu 2011). Inundations of the floodplains of major hydrological systems expand the foraging zones of the fish and thus provide habits conducive for spawning and growth of juvenile fish in food-rich but relatively predator-free shallow waters. There are reports that most of the fishes migrate to these floodplains during periods of high water level to feed and breed (Okogwu 2011). The shellfish, *M. vollenhovenii* has been reported to migrate inland as far as Asu River, more than 300km from the estuary (Okogwu *et al* 2010).

Anthropogenic impact on fish diversity

Overexploitation of some fisheries (Moses 1987; Ekpo and Essien-Ibok 2013), use of ichthyocides and explosives (Udolisa and Lebo 1986; King 1996), habitat destruction (Ekpo and Essien-Ibok 2013), introduction of exotic species and deforestation are anthropogenic activities that affect the fisheries of Akwa Ibom drainage systems. In some communities, plants' extracts from *Piptadeniastrum africanum, Acacia pennata, Trephosia vogelli and Randia* sp, and Gamalin 20 are used to kill fish. These poisons are generic killers and destroy adults, juveniles and eggs (King 1996). Continuous use of these poisons will imperil the fishes by gradually impairing the capacity of the major fishes of water bodies to recruit in subsequent years.

Pollution from the oil industry and domestic sources are common in Akwa Ibom (Moses *et al* 2015; Essien-Ibok and Isemin 2020), it is a major cause of habitat destruction and fish kill. Dredging and dam construction that alter and obstruct fishes' migratory paths are also serious anthropogenic activities that could have momentous adverse effects on biodiversity.

The gradual replacement of mangrove plants with nypa palm (*Nypa fruticans*) could indirectly reduce the habitat quality of breeding sites in the estuaries, floodplains and smaller rivers as the exotic *N. fruticans* do not have the same leave fall rate and root system as native mangrove species. These conditions could individually, additively or synergistically cause decline in food availability and habitat quality in the dwelling, forage and breeding sites. These will ultimately lead to decline in reproductive successes and the productivity of ecologically and commercially important fish species.

Conclusion

The drainage systems within Akwa Ibom State serve as spawning, foraging and migratory path to several ecologically and commercially important freshwater and marine fishes. This is the reason that the state hosts thousands of fishers that rely on fishing for their livelihood. Some of these fishers overexploit some fish species and fish occasionally by unorthodox fishing methods that are detrimental to sustainable fish productivity. Furthermore, pollution from industries and habitat alteration are major factors that also affect fish diversity. Thus, the state occupies prime position in any plan at sustainable management of the biodiversity and productivity of the fishes of the Cross, Imo and Kwa Ibo rivers as well as the estuarine and marine ecosystems. A well-coordinated and articulated management and conservation strategies to protect the fish stock is advocated. Such strategies, which must include the fishers, community leaders, government, NGO, policy makers and researchers are crucial for the sustainability of fish diversity and productivity in the entire Niger Delta region and Nigeria.

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