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The Climate Change Challenge and the Ornamental Fish Stocks of the Upper New Calabar River, Niger Delta Area of Nigeria

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Abstract
As the world braces up for the continuous threats of Climate change related floods, a review of the possible influence of the global challenges of Climate change related floods on the composition, diversity and abundance of Ornamental fish fauna of the Upper New Calabar River , a tributary of the Niger Delta Basin (Ibim and Gogo, 2013) was undertaken. This work was aimed at creating urgent awareness towards the status of the Ornamental fish stocks of the New Calabar River, the possible effect of floods on these fishes, and the need to protect and conserve them. A review of a fifteen –week study on the composition, diversity and abundance of Ornamental fish fauna of the Upper New Calabar River (Ibim and Gogo, 2013), revealed a total catch of 30,055 fishes, having a composition of forty one (41) ornamental fish species belonging to thirty five (35) genera and twenty five (25) families. However, species abundance/score varied amongst the families with a few species high (*Hemichromis fasciatus* – 20.16%- dominant), but most being very low (*Gnathonemus petersii* (2.82% and *Aethiomastacembelus nigromarginatus* (0.07%) rare). Also, the species diversity was low among all the families except the Cichlids that had nine species. Also, a review on the effect of global Climate change related floods on fish populations, revealed a variety of threat situations including, habitat salinity and ionic content distortion, habitat destruction, introduction of new species, migration of endemic species, fish seed loss, death and even extinction .From this it could be inferred that any such natural disaster in the Upper New Calabar River will have terrible consequences. A review of recommendations were made to stakeholders on how best to mitigate/adapt to the threats of Climate change related floods, to reduce the possible deleterious effects of the impending floods on the already declining ornamental fish stocks of the Upper New Calabar River of the Niger Delta Area of Nigeria.
Keywords: Climate change related floods, Upper New Calabar River, Niger Delta Area, Nigeria, Ornamental fish Stock.

1.0 Introduction

Climate change has been defined differently from place to place, by varying institutions in different ways. However, it can simply be referred to as change in Climatic conditions over time. It is known to have major impacts on biodiversity (Blommestein *et al*, 1996). Global warming (temperature elevation) and rise in sea level (increased rainfall plus polar ice melting) are among the two major features of climate change affecting fisheries. Climate change impact on Nigerian rivers, have been devastating in recent years, as a result of severe flooding in many parts of the country. The most recent was the huge floods of the Ogun River, the floods in the North East, middle belt to the Niger delta area, South of Nigeria, in 2012.

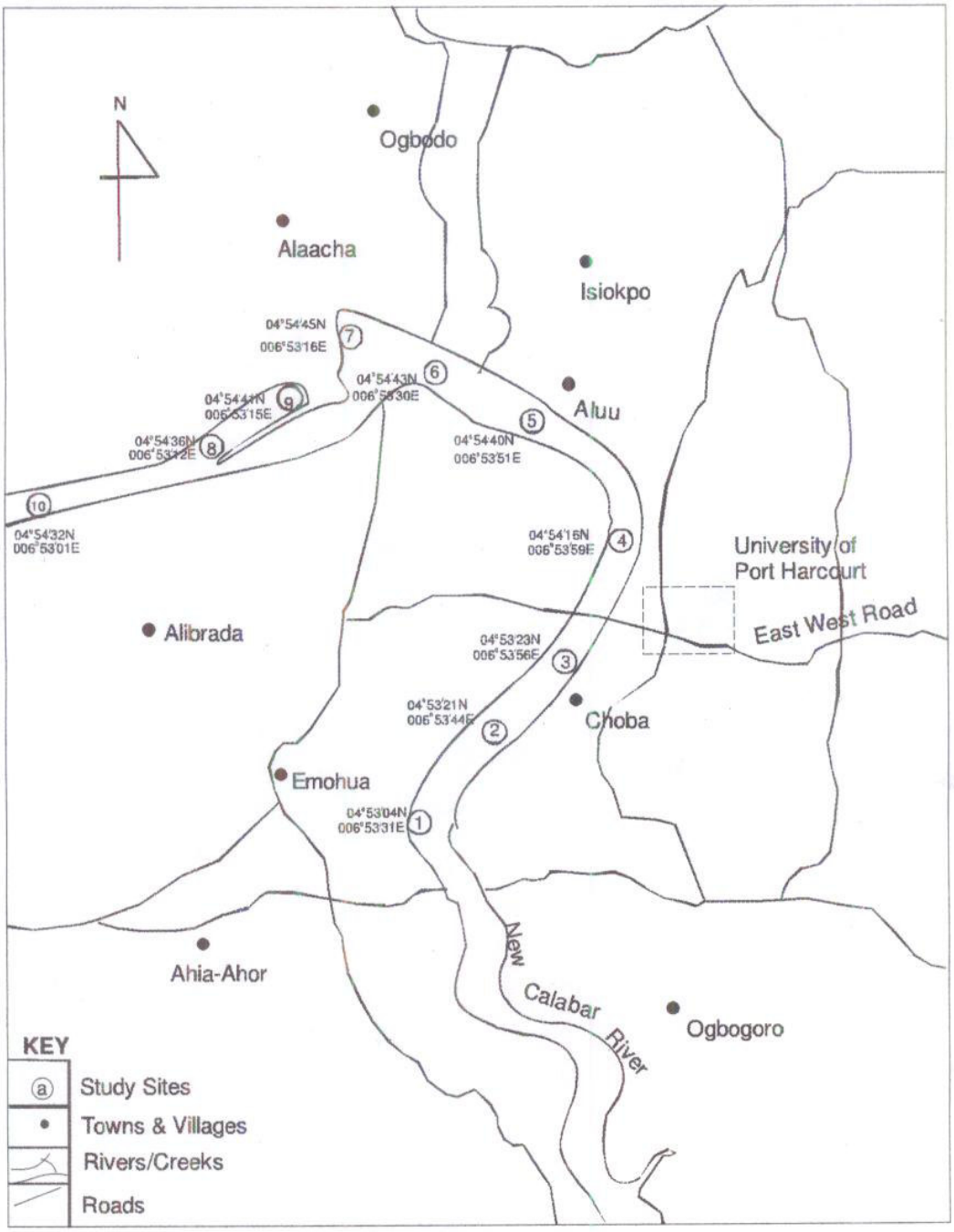

Figure 1. Map showing the Upper and Lower Reaches of the New Calabar River, Niger Delta
Figure 1; Map of the New Calabar River, showing the Upper and Lower New Reaches.

The New Calabar River,(fig. 1), an economically important waterway located in Rivers State, Niger Delta Area, Nigeria, is a tidal river, that is unic as its lower part is brackish and the upper part fresh(Erondu and Chinda, 1991;Nwadiaro and Ayodele, 1992). The upper fresh water regime spans from the Aluu to Isiokpo, and the lower from Aluu towards Ogbogoro, all communities in Rivers state. Several researchers have reported many species of fishes belonging to several families at various sections of this River(Nwadiaro and Ayodele ,1992; Olori, 1995 and Dickson *et al.*,1999), of which some are of ornamental value. Ibim and Gogo (2013) reported twenty(25) families of fishes of Ornamental value in the Upper, fresh water section of the river. However, the species diversity was noted to be low for almost half of the families reported.

There is a rapid increase in the need for fish for aesthetic purposes and recreation. Also, the economic value of fish as ornamentals is increasingly higher than food fish in many developed countries, and some African countries. The growing interest in aquarium fishes and their economic potentials has resulted in steady increase in aquarium fish trade globally. Around 2000 species and millions of specimens are traded annually in the

ornamental fish trade (Livengood and Chapman, 2009). Many species currently sold are fresh water species. In Nigeria, an estimated value of exports in the ornamental fishery sub-sector stood at approximately U.S. $500.090 for ornamental live fishes; also, there is a general appreciation of the ornamental fish species from Nigeria (Areola, 2003 and Areola, 2004). However, Ornamental fishery in Nigeria, is in its infancy stage and so depends on wild collection of indigenous fish species. In the Upper New Calabar river, besides the natural low diversity noted, many of these fishes are declining in abundance as a result of overfishing, oil pollution, loss of catchment, habitat destruction.

Currently, Climate change related floods have also come in to be a major threat to these fish species.

The impact of these climate change related floods is a great challenge to the Ornamental fish population in the Upper New Calabar River which will subsequently threaten the development of Ornamental fish trade in the River state, and Nigeria at large.

Thus, it is pertinent to take a close look at the existing Ornamental fish families/species, likely effects of the Climate change challenge, and highlight recommended measures for the mitigation/adaptation to this challenge, to prevent possible extinction of the already low fish assemblage observed in this river.

1.1 The Status of Ornamental Fish Species and the Upper New Calabar River

1.1.1The Upper New Calabar River, Rivers State

The study was carried out at the Upper reaches of the New Calabar River(Figure 1). The New Calabar river is located in the coastal area of Niger Delta, between Latitude: 4°25¹ ON; Longitude: 7°16¹ OE in the Niger Delta, central part of Southern Nigeria (NDES, 2003), and it empties into the Atlantic Ocean.

Nwadiaro and Ayodele (1992) described the river as being black in colour and tidal. Wright (1986 and 2000), reported that, the New Calabar River appears very turbid when viewed from above, the colour is dark and light penetration may be low, the bottom sediment at the bank where activities are high is fine sand. The bottom sediment at the middle is silky mud. The river contains fresh water at its upper and middle reaches but brackish towards the mouth. Several ecological studies on this river reveal that it is a fresh water system at some points but euryhaline (brackish water) at the Choba axis where University of Port Harcourt is situated (Gideon and Chidiebere, 2008).

The seasons predominant are, a wet season , between March and November (Abowei, 2000) and a dry season, from November to February, with occasional rainfall (Iwena, 2000).

The vegetation of this area is made up of the red and white mangrove (*Rhizophora mangle* and *Avicenia spp*., respectively), Nypa palm (*Nypa fruticans*), *Ipomoea aquatica*, *Nymphea lotus*, *Mimosapigra*, *Eichhornianatans* etc., with mangrove swamps, and flood plains bordering the river and its numerous creeks (Abowei and Davies, 2009).

The New Calabar River is one of the economically important water resources in the Niger Delta region of Southern Nigeria. It is in the vicinity of the rapidly expanding oil city of Port Harcourt in Rivers State, Nigeria, and a number of human and economic activities are taking place along it; for instance, construction of a major bridge at the Choba axis connecting the East-West Highway, Oil companies/Off-shore rigs, abattoirs located at (Aluu, and Choba respectively), dredging activities, which will likely affect the biological diversity of this aquatic ecosystem.

1.1.2. Composition Diversity and Abundance of Ornamental Fish Species.

The species composition as shown in Table 1, revealed a total of thirty thousand and fifty five (30,055) fishes consisting of forty one (41) ornamental species belonging to thirty five (35) genera, twenty five (25) families and eleven (11) orders were caught and recorded from the Upper reaches of the New Calabar River, during a thirteen week survey, in 2013. This indicated the presence of a good number of ornamental species/ families in the river system. However, among the twenty five ornamental fish families, the family Malapteruridae(3002) had the highest number followed by the Polypteridae(2,339) and then the Cichlidae (2,171) and the least were the Mastacemblidae(7) and the Clariidae and Mormyridae (12, each).

The family Cichlidae had the highest diversity (8 species) whereas all other families had low diversities as follows; Mormyridae and Claroteidae- 3; Notopteridae, Channidae and Alestidae -2 each and the rest families having 1 species each.

The relative abundance varied from a high of 20.6% for the Cichlids to the lowest of 0.04% for the Clariids.

The abundance score, revealed dominant(D) for most families for instance the Cichlids and rare(R) for a number of families for instance the Clariids . Furthermore, the abundance score revealed that, though certain species such as *Tilapia zilli, Hemichromis fasciatus*, *Chromidotilapia guentheri*, *Tilapia mariae*, *Tilapia guineensis , and Pelvicachromis pulcher*, *Pelvicachromis taeniatus*, amongst others were dominant and common respectively; *Tilapia dageti*, *Syacium guineensis* and *Gnathonemus petersii*, *Aethiomastacembelus nigromarginatus*, amongst others, were few and rare, respectively.

1.1.3. Potential Impacts of Climate Change Related Floods, On Fish Population And Fisheries

Climate change is a challenge to fish populations and fisheries world-wide. Several potential impacts on rivers and fishes world wide have been identified and these can also affect the Upper New Calabar River and its ornamental fish population. Observed /known possible effects of the Climate Change related floods that could also impact the Upper New Calabar River and its fish population are as follows;

i. Submergence of coastal /low lands that serve as breeding sites: This occurrence will be as devastating as the 2012 floods in the south of Nigeria where three quarters of the land mass was submerged. This will lead to the destruction and death of fish ova, fry, juveniles, as well as adult brooders, as they would be easily washed ashore. Massive fish kills will occur; as fish get washed ashore. There will be massive destruction of reproductive gametes (ova, sperm).
ii. Introduction of seawater into fresh water sections of the river: A sea level rise of one metre along the West Africa Coast will result in remarkable salination of river waters far inland. Areas that are hitherto known to have freshwater features will become brackish. This will cause higher salinities and increased or distorted ionic content of the water bodies, resulting in , osmotic in-balance or osmotic failure and death. This salination of the river can also result in deformation of fish gametes- fry, juveniles and adult reproductive systems, and also, a change in the flora of the of the water body destroying habits and food organisms
iii. Newly Introduced Species: New species would be introduced as the ionic balance changes and this will not favour the organisms that were previously in the water. This will inadvertently distort the ecological balance and the food chain.
iv. Predation pressure: Predation will be an issue as new species are introduced.
v. Increased depth of the river will introduce large fish species that ill prey on the original species therein.
vi. Inter/Intra specific competition: This will be of great significance. There will be competition for space, food, mating partners, amongst others, between and within species as habitats become destroyed, altered and so on.
vii. Fishing Pressure: Fish exploitation by locals will be intensified as the search for food and income become intensified due to economic devastation of flooding in fishing communities.
viii. The fisheries of the area will be affected; Rise in sea level will also affect the fisheries as euryhaline species will tolerate the increased salinity while stenohaline species will migrate upstream. Habitat alteration will affect reproductive patterns and hence recruitment into the fisheries. Those whose sole source of income is from the environment will be adversely affected.
ix. Introduction of pollutants and wastes: The composition of flood water is influenced by the features of the soil and human activities in the drainage area. Flood water sweeping over farmlands (especially in the north) will wash off residues of pesticides and herbicides. Flood water over industrial facilities will be contaminated by industrial effluents. These are likely to be washed into the river by flood waters. Toxic components of such materials diffuse into the body tissues and fluids of the fishes.
x. Food organism also become affected. The water may also become toxic or acidic.
xi. Also, non-degradable items get dumped in the water by floods and become an obstruction or eye-sore in the river.
xii. Shoreline erosion and Sea bottom silting and Sea depth increase. The land area/shore line around the seas becomes eroded and shorelines become steep and deep. Flood water contains a large amount of suspended silt materials which are deposited downstream. The sea bottom will become silted by debris and soil wash-offs from surrounding land, which will eventually clog the gills of fishes, increases turbidity, reduce visibility and light penetration, and also increase harmful bacteria and micro-organisms growth. The deposited silt can also smother sessile bottom dwelling animals and the deposition process can alter the depth profile of the water column.
xiii. Destruction of Ornamental fish characteristics features such as fins, skin colour, swimming patterns, breeding behavior, etc, from the different impacts could occur.
xiv. Migration of fishes away from flood affected waters can head to loss of some species.
xv. Extinction is the final blow that can be meted out to fish species. Endangered (few and rare fish species) would be in danger of extinction as a result of all the previously stated factors.

All these will negatively impact the ornamental fish species of the New Calabar river especially, those with low diversity and the threatened (few and rare) species shown in Tables 1and 2.

1.2. Recommendations

There have been known to be several measures adopted by people in flood impacted areas to ameliorate the effects of flooding towards their fish populations world-wide. It is therefore recommended that such measures be put in place to reduce/eradicate the challenges of flooding to the Ornamental fishes in the New Calabar River.

Such measures are as follows;

1.2.1.Adaptation Measures

Adding new or improved physical defences or building seawalls to protect fish against floods washing fish ashore.

Integrate coastal management measures

Management and institutional adaptations

As climatic change increases environmental variation, fisheries managers will have to move beyond static understandings of managing stocks or populations. Inflexible management approaches may no longer apply. There is a need for implementation of adaptive holistic, integrated and participatory approaches to fisheries management, as required for an ecosystem approach.

1.2.2.Mitigation Measures.

Although mitigation of climate change is a global process that will take centuries to effect, it is valuable to take certain mitigation steps now. Reducing the production of greenhouse gases in the Niger delta region will result in immediate improvements in the regional aquatic environment and contribute to better economic efficiencies in the Ornamental business.

The primary mitigation route lies in energy consumption through fuel, raw material use and production. As with other food sectors, distribution, packaging and other supply chain components also will contribute to the sector's carbon foot print reducing greenhouse gas emissions from bush burning

Planting trees that absorb carbon dioxide from the air and store it in their trunks, roots, and soil are also important.

Although a relatively small global contributor, capture fisheries have a responsibility to limit GHG emissions as much. For example, eliminating in efficient fleet structures(e.g. excessive capacity, over-fishing), improving fisheries management, reducing post-harvest losses and increasing waste recycling will decrease the sectors 'CO_2 emissions and improve the aquatic ecosystems' ability or respond (assimilative capacity and resilience) to external shocks.

Other technical solutions to reduce fuel use, subject to clear analysis of options and production returns, might include shifting towards static fishing technologies and to more efficient vessels and gears. In some cases, win-win conditions could be identified, where reduced fuel-use strategies would link with reducing fishing effort, improving returns to vessels, safe guarding stocks and improving their resilience to climate change. These will need to be seen in the context of global forces impacting fisheries, such as changing fuel prices and increasing internationalization of fish trade, especially through air freight. Increases in fuel prices will tend to decrease fuel use while increases in internationalization will tend to increase fisheries' contributions to CO_2emissions.

1.2.3. The Role of Governance in Adaptation and Mitigation

There is a critical need for well informed public policy to address mitigation of GHG emissions to limit and minimize impacts of climate change.

In addition to the good governance principles currently applicable to fisheries, agencies responsible for sectoral support and management would support climate change mitigation and adaptation in the sector by:

- building institutional and legal frameworks
- linking disaster risk management with development planning, especially concerning planning coastal or flood defenses and applying" soft engineering" solutions where possible through conservation of natural storm barriers, floodplains and erodible shorelines in order to manage costs and damage impacts;
- promoting research on short- and medium-term climate change impacts to support the identification of vulnerability hot spots and the development of adaptation and mitigation strategies
- engaging in long-term adaptation planning, to address longer-term trends or potential large-scale shifts in resources or ecosystems.

To ensure all the above mentioned therefore in Nigeria, we need to strengthen our Institutional framework. The directorate for Climate Change in the Federal Ministry of Environment should be strengthened to have a Research Division. The Nigeria Environmental Standards Regulations and Enforcement Agency (NESREA) has an important role in ensuring environmental compliance.

There must be cooperation between various government agencies with responsibilities for data gathering (Nigeria Metrology Agency, Nigeria Institute of Oceanography and Marine Research) and the Federal Ministry of Environment.

Nigeria must establish cordial working relationship and collaborate extensively with international organizations such as World Meteorological Organization (WMO), World Climate Research Program (WCRP), United Nations Environmental Program (UNEP) and the International Geosphere Biosphere Program (IGBP).

The Federal Ministry of Environment must publish regular information about the Nigerian environment

Our State Ministries of Environment must compliment the efforts of the Climate Change Division of the Federal Ministry of Environment

We now have legal instrument that stipulates time frame for elimination of gas flaring in Nigeria. Let us

hope that the provisions of this law will be implemented diligently otherwise we shall still be among the culprit nations guilty of greenhouse gases emission into the atmosphere.

We should have in place a crop of well-trained volunteer personnel who can have coordinated Emergency Response whenever there is a disaster.

Climate change is with us. We must therefore join forces with the scientific community to mitigate observed impacts. While not being alarmist the potential catastrophe is huge if we have in mind the Katrina and Haiti hurricanes and the flood disaster in Pakistan and Nigeria(2012).

The Climatic change related floods will negatively impact the Ornamental fish population of Upper New Calabar River tremendously, if it occurs. Also, the Ornamental fisheries production pattern will alter. The livelihood of those dependent on the fisheries will be affected.

1.3. Conclusion

The New Calabar River located in the Niger delta region of Nigeria has numerous Ornamental fish species in twenty five families. However the diversity is low for almost all the families except for the Cichlids; the abundance and abundance score vary widely with the Cichlids dominant and highly abundant, whilst the Clariids are rare and least abundant.

The Climatic change related floods will negatively impact the Ornamental fish population of Upper New Calabar River tremendously, if it occurs. The livelihood of those dependent on the fisheries will be particularly vulnerable to the direct and indirect impacts of predicted floods associated with climatic changes, whether through changes in physical environments, ecosystems or, through impacts on infrastructure, fishing or farming operations, or livelihood options and most especially loss in aquatic stocks.

However adherence to recommended mitigation and adaptation tools will go a long way in averting such situations. If not attended to, these problems that will emanate from flooding will eventually negatively affect the Ornamental fish population and the growth of the Fishery /Trade in the Rivers State and inadvertently reduce job opportunities and economic growth in the state and Nigeria, at large.

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