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Gymnarchus niloticus (Cuvier, 1830), a treathened fish species in the lower river Niger at agenebode, Nigeria; the need for its conservation

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Abstract
Over the past decade a fluctuation and decline has been recorded by researchers indicating the total loss or decline of some fish species. This decline is a gradual indication that species are becoming threatened, endangered and at the verge of extinction. *Gymnarchus niloticus* is a fish in high demand. It is fleshy, its flesh is tough and tasty which makes it a very important component in the diet, culture and traditions of many Riverine communities in Nigeria. The fluctuation in abundance, decline and total absence at certain months of the year is creating concern for the fisher folks and researchers. *Gymnarchus niloticus* was sampled monthly for 24 months and t-Test was used at 0.05 probability level to test for the variations in abundance with seasons and years. 269 species of *Gymnarchus niloticus* (171 in the first 12 months and 98 in the second) were collected during the sampling period. Only 21 months recorded catch for *G. niloticus*. September and October had little catch while November recorded no catch at all. *Gymnarhus niloticus* is a fish in high demand. It's declined and absence during certain months creates an opportunity for its conservation and management.

Keywords: decline, conservation, *Gymnarchus niloticus*, breeding, culture, management

Introduction
Nigeria is blessed with diverse fish species in its inland water bodies with over 268 fish species in 34 well known fresh water Rivers (Ita, 1993) [7]. Over the past decade a fluctuation and decline has been recorded by researchers indicating the total loss or decline of some fish species. (Solomon *et al*., 2012 and Agbugui *et al*., 2019) [14, 2]. This decline is a gradual indication that species are becoming threatened, endangered and the possibility of extinction. The world's population is geometrically increasing is while the food produce both agriculture and livestock only multiples arithmetically. This constant demand for food and aquaculture produce especially of inland and freshwater fish is overstretching the catch efforts, survival, and management regimens of fishes. Other factors that possibly affect this consumer satisfaction include over overfishing, habitat loss and degradation, pollution and global warming. Stiassny, (1998) [15] estimated that about 300 species will become extinct in the next 20-30 years. This means that if care and management is not taken appropriately this sector will depreciate and not contribute adequately to curbing hunger and meeting the need of mankind. The River Niger is one of the Rivers in Nigeria that has experienced fluctuation in fish fauna. So far there is the inadequacy of data, institutional policies and inadequate conservation methods to alleviate the problem of threatened fish fauna. Furthermore, there is the absence of observed fishing laws and penalties to assist in the drive for fish conservation.

Gymnarchus niloticus is the only species in the Genus Gymnarchus and the family Gymnarchidae with the Order Osteoglossiformes. It is an electric fish commonly called Aba, fresh water rat tail. It is called by Natives of the River Niger at Agenebode and by the Idah people Asa. *G. niloticus* is in high demand by the locals and neighboring markets. It is fleshy, its flesh is tough and tasty which makes it a very important component in the diet, culture and traditions of many Riverine communities in Nigeria. Despite these attributes and imports, the *G. niloticus* has not received any extensive study if its biology and management. Studies have been carried out to document the fish fauna along the river. Such studies have shown fluctuations in the diverse fish fauna that the River is known to habour (Solomon *et al*., 2012; Abiodun and John, 2017 and Agbugui *et al*., 2019) [14, 1, 1, 2]. The fisher-folks along the River have also shown concern regarding the absence of this fish species at certain months thus the need for this research. This study is aimed at investigating the possible causes of the decline in population of *G. niloticus*, threats faced by the disappearance of fish species, understanding the causes of its decline, possible measures towards management and possible conservation strategies.

Materials and Methods.
Study Area Description
The River Niger is the longest River in West Africa discharging into the Atlantic in Nigeria. It rises up to 240km and runs 4180km. The River is known to harbour 36 families of fresh water fish and nearly 250 species of which 20 are found nowhere else on earth but Nigeria. From Lokoja, the Lower part of the River Niger, the River runs through Agenebode-Ida, to Forcados in Delta then Nun River in Rivers and further. The River is clean, relatively clear, carrying only a tenth of much sediment. The River Niger floods yearly beginning from September peaks in November to January. Agenebode is located at longitudes latitude 7.10512, longitude 6.69381 and stretches through an area of 1133km2. Agenebode water front is a very busy part of the Niger located in Edo State, Nigeria, created to the

River supply portable water for domestic and industrial uses to the communities along its course. Active fishing activities takes place along the River for subsistence and commercial fishing.

Sampling

Gymnarchus niloticus was sampled monthly from November, 2017 to October, 2019 using gill nets, hooks, cast nets, lift nets, calabashes and raffia palm traps.

Data Analysis

T-Test (paired two sample for means) using Microsoft Excel (2013) was used at 0.05 probability level to test for the variations in abundance with seasons and years.

Results

A total of 269 species of *Gymnarchus niloticus* were collected during the sampling period (Table 1). 171 species were collected from November 2017 to October 2018, while 98 were caught in 2019. During the sampling period, 21 months recorded catch. *G. niloticus* was caught mainly in the early rains and a decline in catch as from July. September and October had little catch while November recorded no catch at all. The monthly and seasonal variations in the abundance of the species are shown in Fig.1.

Table 1: Monthly and Seasonal Variation of *Gymnarchus niloticus* in River Niger

Month	Season	Abundance	Month	Season	Abundance
Nov, 2018	D	04	Nov, 2018	D	2
Dec, 2018	D	07	Dec, 2018	D	5
Jan, 2019	D	11	Jan, 2019	D	9
Feb, 2019	D	23	Feb, 2019	D	9
March, 2019	D	18	March, 2019	D	11
April, 2019	D	14	April, 2019	D	7
May, 2019	W	27	May, 2019	W	12
June, 2019	W	23	June, 2019	W	19
July 2019	W	25	July 2019	W	13
August, 2019	W	16	August, 2019	W	11
Sept, 2019	W	3	Sept, 2019	W	00
Oct, 2019	W	00	Oct, 2019	W	00
Total		179			91

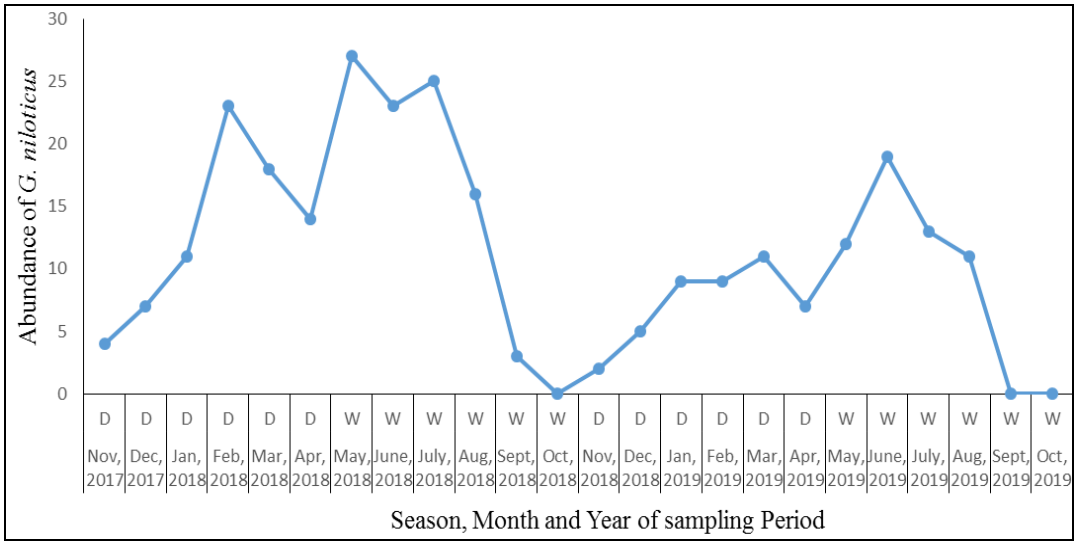

Fig 1: Monthly and seasonal variations and Abundance of Gymnarchus *niloticus*

Discussion

This study revealed a decline in the abundance of *G. niloticus*. The first year of sampling (between Nov, 2017 to Oct, 2018 had higher catch then the second year. The abundance and assemblage of *G. niloticus* in River Niger has been recorded by Solomon *et al*., 2012 [14] and Agbugui *et al*., 2019 [2]. In these reports, fluctuations and particularly a declined is noticed over the past years with not much attention been placed on the decline of this fish species. There is also no previous report presenting the state of decline of *G. niloticus* in River Niger. The persisting decline and total absence of this species in the months of September and October over the two year sampling period is disturbing. Though the fishermen think it is just the depth of water causing the absence, the gradual decline from past reports should not be overlooked to prevent further decline and avoid extinction of this species

The decline observed in the population of *Gymnarchus niloticus* in the River Niger could be attributed to the interactions of many factors among which are:

Overexploitation of the Species

The Aba, is one of the most sought after fish in the River Niger due to its tough flesh, taste, high protein content, cultural and traditional preference and demand. The decline in population if the Aba might have been due to its overexploitation by increasing human population demand and methods used in catching the fish. Again, cages have been set along breeding grounds in most water bodies to harvest fingerlings due to quest for fish protein as and income (Agbugui *et al*., 2019) [2]. Sustainable fisheries requires adequate annual recruitment especially the juvenile stage. This is lacking in this fish species which could cause a balance in population loss hence the reason for decline in population.

Impact of Human Activities along the River side

Communities residing along the water sides often dispose of their domestic waste and excreta in Rives that sustain them. Domestic waste and the Run-off of nitrate phosphate fertilizers causing Eutrophication and subsequently death of

Aquatic zones is pronounced along the river course. Farms along the River sides are a prominent cause of excess nitrate in water. Again, increased use of the river for water transportation to access villages and communities could also affect the inhabitation of *G. niloticus*. The vessels and various mean of transportation are either causing noise pollution, disturbing the favourable turbulence, also releasing CO_2 in the water body which could have affected the population of the fish. The loss in the composition of fish and other aquatic life in reservoirs by the impact of Human activities have been reported by (Mustapha, 2010) [8].

Low Rate of Breeding of *G. niloticus*

The low fecundity of *G. niloticus* and loss of favourable breeding sites and nest could be a very essential reason for the decline in the population. Opadokun and Agani (2015) [6] reported that *G. niloticus* has an unpaired gonad with an average low fecundity of 925.61 eggs, an extended breeding period of 6 months (May to July and November to January); a strategy to ensure that the offspring of *G. niloticus* sufficiently attains the juvenile stage before it is weaned. Global warming, flood and overflow of river banks during peaks of rainfall as well as when the depth becomes too great could also be a reason why *G. niloticus* abandon their nest and young.

Migration of the Species

Fish migrate to water bodies with better spawning sites, shallow water plains for ease of navigation, availability and abundance of diverse food resources. This might be an added reason for the decline in population of the *Gymnarchus niloticus* in the River Niger.

Reduced availability or Competition for Food

Gymnarchus niloticus feeds on crustaceans, insects and fish. These food resources might be reduced in the River thus limiting their growth, reproduction and survival. The over exploitation of the adult could also be a reason why the juveniles are not cared for till mature stages, thus the inability to search for food. Competition for food between *G. niloticus* and other larger Predatory fish species in the River could be a factor for the low abundance of the species.

Loss of Vegetation and Alterations in the Reservoir Habitat

Inland water bodies with dense vegetation is an excellent habitat that provides abundant resources that support the growth and abundance of G. *niloticus*. However, one important activity that affects a good habitat is the trawling and dredging. Dredging activities are often carried in freshwater bodies, its essence is for the creation of new harbours as routine fluvial maintenance (e.g. maintenance of shipping channel depth), or pollution control, remediation of contaminated sediments, dredging for dock building, river banks, pleasure boat access to deep water, agricultural drain maintenance, maintenance of boating channels (NAP 2002; Thrush and Dayton, 2002; Ward-Campbell and Valere, 2018) [9, 16], however a negative effect is often experienced in the fisheries sector of which include alteration of fish productivity, abundance and species richness of fishes, abundance/density/species richness of benthic invertebrates, available fish habitat (depth, water quality, flow, cover, substrate) encompassing spawning Locations, nursery habitat, refuges, and feeding locations. The River Niger is often dredged by the Government of Nigeria to provide all of the above and to forestall flood in riverine communities. More so, individual who dredge the Niger for construction purposes. These are possibilities that could cause decline in fish population.

Presence of exotic or introduced species

There has not been any documentation of the presence of exotic species in the River Niger. Introduced species may cause extermination of native species in various ways by competing for food, changing the food web cycles, predation, transmitting diseases, and degradation of genetic diversity by hybridization.

In view of the various factors operating in the River Niger and the declining population of the fish species, it therefore becomes highly imperative to protect and conserve the species from further decline and save it from disappearance in the water body or total extinction from the freshwater ecosystem. Other reasons for the pertinent conservation of the species include:

Ethical values

It is fair and appropriate that *G. niloticus* should be conserved and sustained in the River Niger so as to preserve the species, maintain and improve its quality and wellbeing.

Economic values

Gymnarchus niloticus is among the most widely valued fish Nigeria because of its high protein content, tough flesh and large size, cultural needs and traditional beliefs. If the species is allowed to go extinct, a large population which depends on the fish for cheap protein, economic gains and employment will suffer. Furthermore the species is considered for aquarium business which could also be successful because the fish is hardy in nature.

Ecological benefits

The Aba, *Gymnarchus niloticus* of great importance in Nigeria (Agbugui, *et al*., 2019) [2]. The disappearance of the species from decline of this species from River Niger will produce a chain of reactions ranging and alterations in feeding ecology, predatory – prey relationship and generally the success of aquatic systems.

Scientific research

There is relatively little research conducted on *G. niloticus*, its biology and aqua cultural technology have not received extensive study. Conserving and protecting the species from extinction will gear scientific research towards developing aqua cultural potentials and further elucidate its biology. Some guidelines and procedures have been document and experiment by (Collareserreira, 2002; Skeleton 2002 and Dudgeon, 2003) [4, 13, 5].

Preservation of its genetics

This species could be managed and preserved to avoid extinction by preserving its genetic variability. The genetic information could be used to develop an aqua cultural program for the species, provide a better understanding of the fish, protect its genetic variability, improve yield, rehabilitate the decimated stock and help to maintain a balanced population of the species.

Improvement of the reservoir fisheries

Preventing further decline of *Gymnarchus niloticus* in the River Niger will not only improve the fisheries of the river but to ensure high fish production and sustained ecosystem. Various ways and strategies by which threatened and endangered fishes could be conserved have been highlighted by WHO. (2019). Although, some of these strategies could be modified and applied for the conservation of *Gymnarchus niloticus* in River Niger.

Among the various ways by which *G. niloticus* could be conserved in the River are:

Education and awareness

Dissemination of ready and reliable information in the best approach to conservation of species. The public: fishermen, fisher folks stakeholders should be educated on the danger of extinction of the species and the need for its conservation. This will help to protect and preserving and conserve the species. Prevention they say is better than cure. There should be a call to biologist, limnologist, environmentalist and geneticist to look for the most appropriate ways to conserve this species. The public should understand its gains and value by conserving G. niloticus.

Regulation of fishing nets mesh size

Having a regulated fishing net mesh size which will only catch adults and exclude juveniles is recommended. This will ensure the full recruitment of the young to adultsta ge. A mesh size of above 17cm is highly advocated. Regulation of the fishermen and prevention of over fishing will also enable the species to be conserved in the reservoir.

Legislations and regulations

Fisheries laws and policies which prohibit obnoxious fishing practices, overexploitation of the species, detrimental human impacts on the watershed and water body, habitat degradation and stock decimation activities should been acted and enforced.

Habitat restoration and enhancement

Prevention of flood, reclamation of lost habitat, provision of breeding sites and better spawning ground will greatly ensure the conservation of *G. niloticus* in the reservoir. In 2009, the Nigerian Government commenced the dredging of the Niger, a move to remove silt from hundreds of kilometers (AnswerAfrica.com 2019). The completion of the project will go a long way to enable the River Niger habour more water and then cases of flood will be prevented.

Intensive breeding and stocking of the species

Conservation of the species could be done by repeated and seasonal stocking of the species juveniles in the River. Another possible venture is the introduction of cage cultures in Rivers where culturing of the species in the River is possible. This will ensure the abundance of the species and yield and the possibility of making it one of the culture-able fish species. Again the possibility of culturing this species in ponds and fed with locally formulated and low cost diets is a promising venture as already reported by Oladosu *et al*., 2002; Falaye *et al*., (2015) [10, 6].

Conclusion

Gymnarhus niloticus is a fish in high demand. The demand by the populace is progressively not met hence it's over exploitation. The decline and gradual total absence during certain months should be looked into. This paper reveals the need for its conservation and management.

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Highlights

The highlights obtained from this research include

1. There is fluctuation in abundance of *Gymnarchus niloticus* along the river.
2. Gymnarhus niloticus is in high demand, the demand by the populace is progressively not met hence it's over exploitation.
3. There is a decline in catch and gradual total absence of G. niloticus during certain months of the year.
4. This paper reveals the need for the conservation and management of Gymnarchus niloticus.

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