

Full Length Research Paper

Declining population density of Silver Catfish, *Chrysichthys nigrodigitatus* in Cross River State, Nigeria

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The study assessed quantitatively the threat status of Silver Catfish, *Chrysichthys nigrodigitatus* (Lacépède: 1803) in Cross River, Cross River State, Nigeria. *C. nigrodigitatus* is a highly valued food-fish in Cross River State and represents the dominant commercial landings exploited in Cross River, Nigeria. To provide useful biological data for management, samples were collected monthly from Cross River over a period of three years, from June 2009 to May 2012, in twelve sampling points along 200 km length of the Cross River. A total of 3351, 1409, and 319 *C. nigrodigitatus* were collected in 2009/2010, 2010/2011, and 2011/2012 respectively, amounting to a total sample size of 5079 for the sampling period. *C. nigrodigitatus* was caught in both dry season (October - March) and wet season (April - September) with the highest abundance in June 2009. The declining population density of the species was attributed to the interactions of many factors in the river such as habitat and breeding ground, low breeding rate, overexploitation of the species, and migration behavior of the species. To stop further decline of the species from Cross River, various conservation efforts are needed. The recommended conservation efforts include stocking of the species, habitat restoration, capture-release mechanism, control of invasive species, fishing legislations and regulations, and public awareness and education. These conservation efforts would enhance the fisheries of the River, improve aesthetical and economic values and preserve the genetic diversity of the species. The result of this work shows that Silver Catfish is endangered in Cross River, Nigeria. Therefore, for the fish to be protected there is a need to place it on the threatened and endangered species list of the Federal and State Endangered Species Acts (ESA).

Key words: *Chrysichthys nigrodigitatus*, fishing, conservation, Cross River, overexploitation.

INTRODUCTION

Silver Catfish, *Chrysichthys nigrodigitatus*, of the family Claroteidae plays a pivotal role in the ecology and fisheries of Nigeria in particular, and West Africa at large. It is a highly valued food-fish in Cross River State, Nigeria and other West African countries (Ezenwa, 1981; Hem, 1986; Obiekezie and Enyenihi, 1988). Because of the high demands, the natural stock has been reduced. Over 230 species of fish have been reported from Nigerian

inland waters (Ita, 1993). The population of many of these recorded species is on the decline, with some falling under threatened or endangered species. The number of fresh water fishes that will become extinct within the next 20-30 years is estimated at 300 species (Stiassny, 1981), making conservation practices seen as a priority throughout the world. Many factors such as over fishing, water withdrawal, habitat loss and degradation, pollution, introduction of exotic and non-native species can be added for this decline.

C. nigrodigitatus is a highly valued food fish in some countries of West Africa (Hem and Nuñez-Rodriguez,

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1995). Hem and Nuñez-Rodríguez (1995) reported that the production of farmed *C. nigrodigitatus* in Ivory Coast increased during 1981 to 1995 to attend 300 tonnes per year. Since 2000, the annual production of this fish is approximately 20 tonnes (FAO, 2005). Deficiency of fry production remains one of the main obstacles limiting the expansion of intensive fish production. Moreover, in *C. nigrodigitatus*, the cycle of marketable fish (350-400 g) production is long (18 months) (Hem and Nuñez-Rodríguez, 1995), consequently increasing the cost of the marketable fish production. Profitability of *C. nigrodigitatus* culturing depends upon maximizing of the production capability.

C. nigrodigitatus is a demersal, potamodromous species. It occurs in shallow waters of lakes (<4 m), over mud and fine sand bottom, in rivers and in swamps. It is an omnivorous fish that feeds on seeds, insects, bivalves and detritus (Reed et al., 1967). Feeding becomes specialized with age and size; larger fish may feed on decapods and fish (Laleye, 1995). Among the most visible species on the decline in terms of population density and catch in Nigerian rivers and lakes is the Silver Catfish. The species is widely distributed among tropical rivers and freshwater lakes of Western and Central Africa (Adite et al., 2006). *C. nigrodigitatus* is an important commercial fish because of its high protein content and hardy flesh, thus forming a very important component in the diet of many Nigerians. In spite of this importance, *C. nigrodigitatus* have not received extensive study of its biology (Adite et al., 2006), while little or no attention is paid to its declining population in freshwater ecosystem and the need for its conservation. According to Araoye (1999) and Craig (2000), the fish represent one of the most imperiled groups of animals and exhibits some of the highest rate of extinction. Dudgeon (2003) reported that freshwater fish in developing countries of Asia and Africa are more at risk of extinction than in other developing countries. In order to forestall the extinction of this fish species, there is the need to study its biology, assemblage, catch statistics and habitats in lakes and rivers. These would provide a guide towards understanding the causes of its declining population to which appropriate conservation measures and management strategies would be directed.

Various threats facing freshwater fish species in tropical waters have been highlighted (Ita, 1993; Al-Kaheem et al., 2008; Richter et al., 1997), while the importance and conservation methods of threatened fishes have also been pin pointed by various workers (Dudgeon and Smith, 2006; Collares-Perreira et al., 2002; Skeleton, 2002). The lack of data, institutional policies, and public awareness on the various threats facing *C. nigrodigitatus* in Nigerian freshwater ecosystems and the lack of conservation could be blamed for the decline and disappearance of the species. This species has a wide distribution, with no respective major widespread threats known. It is therefore a species

listed of least concern; this paper will look at the causes of the declining population density of *C. nigrodigitatus* and the threats of disappearance faced by the species in Cross River, Nigeria with a view to conserving and restoring it. Various ways by which the species could be conserved in the river will be discussed.

MATERIALS AND METHODS

Study area description

The study site is the Cross River, a floodplain river located at the South Eastern part of Nigeria (Figure 1) on Latitude 4°25' - 7°00' N, Longitude 7°15' - 9°30' E. It is bounded in the South by the Atlantic Ocean, East by the Republic of Cameroun, the Nigerian states of Benue in the North, Ebonyi and Abia in the West and Akwa Ibom in the South West. Climate of the study area is defined by dry season and wet season. The mean precipitation during the wet season (April-October) is 3050 ± 230 mm, while the mean precipitation during the dry season (November-March) is 300 ± 23 mm. Mean annual temperature ranged from 15.5 ± 7.6°C (wet season) to 32.6 ± 5.4°C (dry season). For the purpose of this study, twelve sampling sites were selected along the length of the river, with four sites randomly selected in each of the following beaches; Ikom Beach (Station I-IV), upriver; Obubra Beach (Station V-VIII), middle river; and Calabar Beach (Station IX-XII), downriver. Upriver was located 3 km from the river source with rocky, gravel and sandy substratum. The shoreline is covered with savanna grassland. The middle river was 100 km from river source with rocky substratum and shoreline sparsely shaded by forest and savanna grassland. Downriver station had a muddy substratum and opens up into the Cross River estuary, with shoreline thickly shaded with rainforest.

Silver Catfish sample collection

The fish population was assessed from wild fish landed from local fishers at twelve sampling points across the length of Cross River. A total of 5079 (length ranged from 15 - 46 cm and weight ranged from 53 - 256 g) Silver Catfish specimens were collected once monthly over a period of 36 months from June, 2009 to May, 2012. Samples were caught by Afikpo and indigenous artisanal fishermen using gill nets of 3 cm stretched mesh in deep waters, or cast nets, basket traps, and baited long lines near the shores.

Data analysis

Data collected were analyzed using descriptive statistics. Data differences were tested for significance using F-test at 95% confidence level (Hull and Nie, 1981). For multiple comparisons, the Fisher's least significant difference (LSD) was used to separate means at 95% level with the

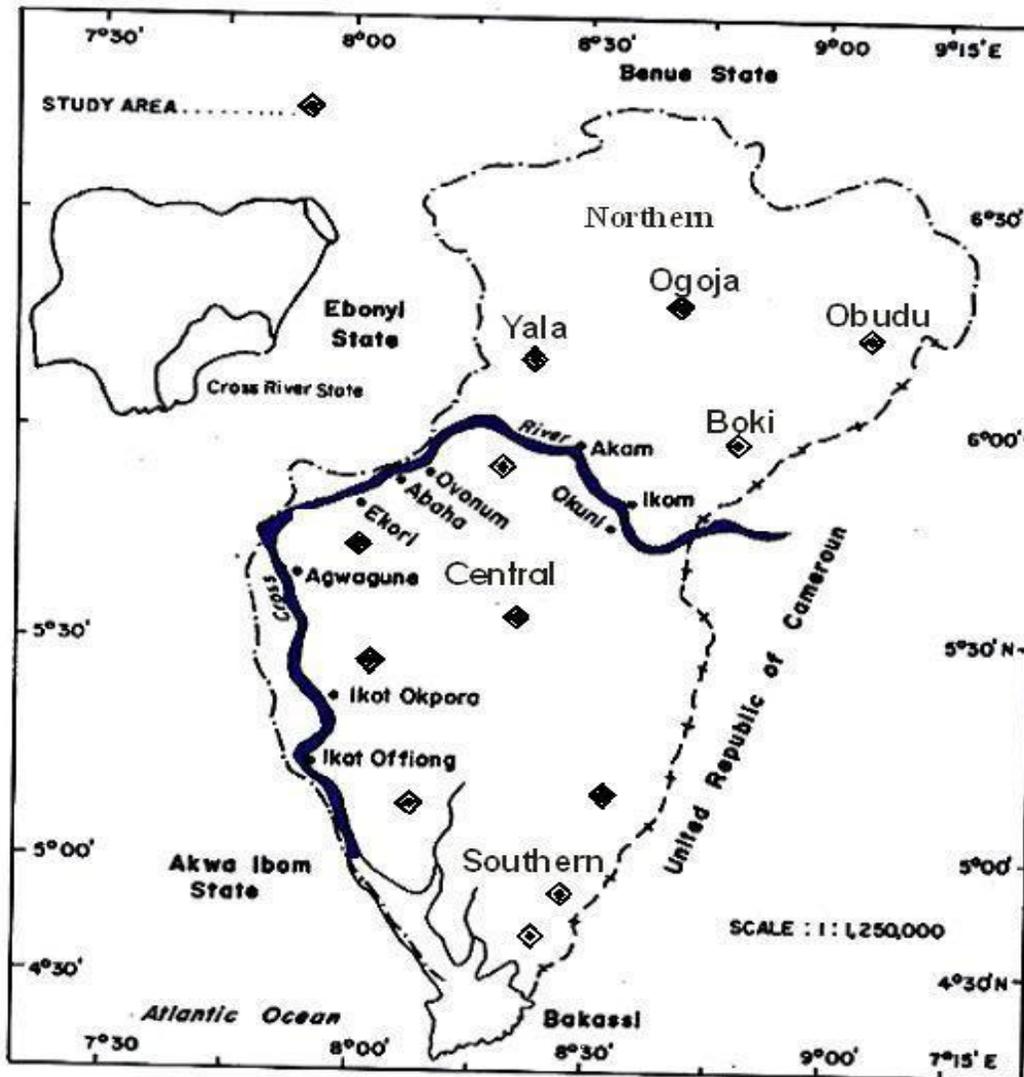


Figure 1. Map of Cross River State showing the study area (Inserted with the map of Nigeria showing Cross River).

Table 1. Summary statistics for 3-year monthly Silver Catfish landings in Cross River State.

Year	Number of months	Mean	Std. deviation	95% confidence interval for mean	
				Lower bound	Upper bound
2009/2010	12	279.25	61.562	240.14	318.36
2010/2011	12	117.42	54.957	82.50	152.33
2011/2012	12	26.58	14.761	17.20	35.96
Total	36	141.08	115.935	101.86	180.31

aid of Statistical package for the social sciences (SPSS) 17.0 for Windows Vista on PC.

RESULTS

The summary statistics in Table 1 indicates yearly

collections of 3351, 1409 and 319 *C. nigrodigitatus* for 2009/2010, 2010/2011, and 2011/2012 respectively and making a total population of 5079 during the sampling period. *C. nigrodigitatus* was caught in both dry season (October - March) and wet season (April - September) with the highest in June, 2009. There is a sharp drop in

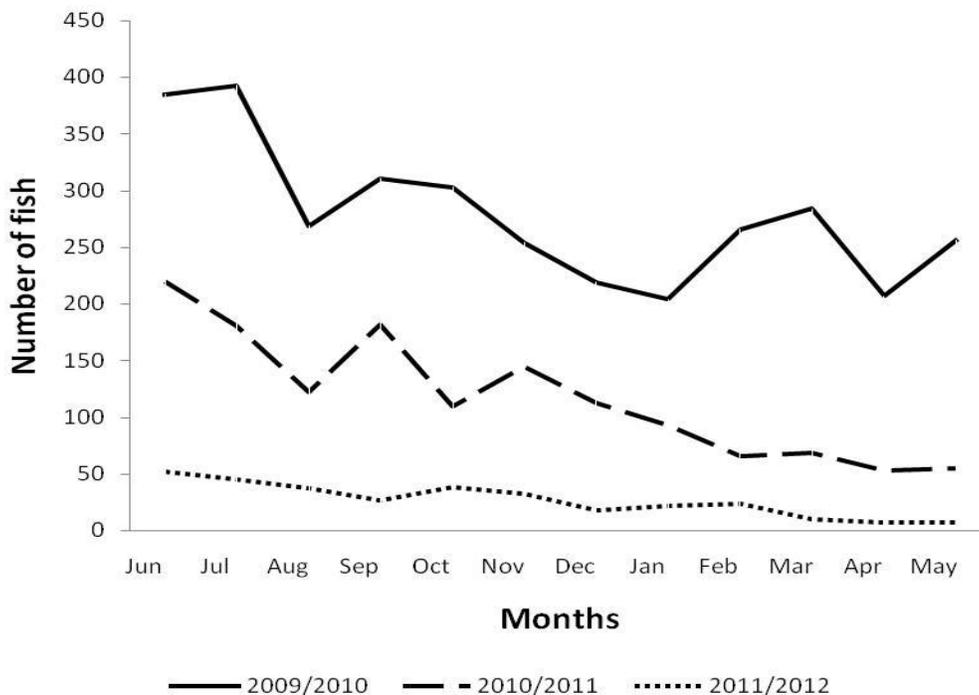


Figure 2. Population decline status of Silver Catfish in Cross River between June, 2009 and May, 2012 in Cross River State, Nigeria.

Table 2. The threat factors causing the decline of Silver Catfish in Cross River, Nigeria.

S/N	Threat	Scale of application
1	Destructions of breeding ground	+++
2	Habitat destruction	+++
3	Over exploitation	+++
4	Migration	+
5	Anthropology	+++
6	Eutrophication	+++
7	Annual migration	++
8	Low breeding	+++
9	Poor availability of food	+
10	Human activity	+++
11	Introduction of exotic species	+
12	Poor water quality	+
13	Water pollution	+

Key: + = Low; ++ = Medium; +++ = High.

the monthly landings from 2009 to 2012, indicated by the wide gap between the annual lines on the graph (Figure 2). This is clear evidence that the species is currently highly endangered. Each of the three lines shows a downward slope to the right due to the usual and expected increase in fish landings during the wet months breeding season (April to September) and a gradual decrease during the dry months (October to March). Analysis of variance shows significant difference in mean

fish landings from one year to the other but the difference in landings from one month to another is not statistically significant at 5% level. Multiple comparison of the yearly means with LSD (least significant difference) shows that the mean difference is statistically significant at 0.05 levels with 2011/2012 ranking the least in mean count.

Table 2 reports the threat factors causing the decline of *C. nigrodigitatus* in Cross River Nigeria including destruction of breeding ground, habitat destruction, over

Table 3. Strategies for conserving Silver Catfish in Cross River State.

S/N	Strategy	Scale of application
1	Habitat restoration	+
2	Close season	+
3	Registration of fishing gears (equipment)	+
4	Education and awareness campaign	+++
5	Protected area establishment	+
6	Security patrol against illegal fishing	+
7	Prohibition of introduction of exotic species	+
8	Capture and release method	+
9	Law and regulation	+++
10	Artificial breeding	+
11	Market control	+++
12	Legislation	+

Key: + = Applicable; ++ = Most Applicable; +++ = Best applicable.

exploitation, anthropic action and eutrophication among others. Table 3 suggests the strategies for conserving *C. nigrodigitatus* in Cross River among other habitat restoration, education and awareness campaign, Law and regulation, Registration of fishing gears (equipment), artificial breeding, restocking, security patrol against illegal fishing and legislation.

DISCUSSION

Fish, apart from providing food and employment are important in recreation such as sport and ornamental fisheries. They are also symbolical culturally and traditionally. Despite their importance economically and socially, fish have received less attention compared to other wildlife mammals and plants. Presently there is no fish protected under national laws. Unfortunately, fish have been recognized as the most threatened, among all vertebrates worldwide (Bruton, 1995). The presented current status of *C. nigrodigitatus* is similar to that obtained by IUCN (2003). In their report among 20 countries, an estimated 17% of freshwater fish species are classified on the IUCN Red List of threatened fishes faced with extinction. A few notable reasons for the sharp decline observed in the status of *C. nigrodigitatus* was likely due to overfishing, habitat destruction and blockages of Cross River. The migrant fisher from Afikpo in South Eastern Nigeria and the indigenous local fishermen block the migratory routes of this fish to their spawning ground at the downstream site of the river. *C. nigrodigitatus* is an annual migratory fish especially for breeding purposes. These migrant fishers take this advantage to block and remove the reproductive stock of the fish. This wrong fishing method and season has led to a collapse of the fish stock reported in 2010/2011 and 2011/2012, consisting of only 1409 and 319 respectively.

The top threat factors causing the decline of Silver

Catfish in Cross River, Nigeria include destruction of breeding ground, habitat destruction, over exploitation anthropology, eutrophication and human activities (Table 2). Undesirable fishery methods were responsible for the decline in fish species abundance. Other noted factors include reduced availability of food, eutrophication, competition between species for food and space, over exploitation of species, loss of vegetation and alterations in the river. Eutrophication was implicated in the decline of fish species because of its ability to destroy food webs, affect dissolution of oxygen, decrease biodiversity (Hanson and Buttler, 1994), and ultimately leading to the disappearance of the population (Gliwicz and Warsaw, 1992) including induced changes in the yield and species composition. The severe decline of *C. nigrodigitatus* to the extent of being tagged as threatened or endangered in the river could be attributed to the combination of these factors. Conservation was the option adopted to restore these endangered species, while fisheries management plans were directed to those species that are not endangered but whose abundance were on the decline. Various strategies employed in the conservation and fisheries management plans include: regulation of fishing nets mesh size, closed fishing seasons, protected fishing areas on the reservoir, intensive breeding and stocking of species, habitat restoration and enhancement, capture-release method, implementation of fishing laws, and public awareness and education about conservation. Conservation and the fisheries management plans if followed strictly will not only protect the fish species from extinction, but also restore and improve the reservoir's fisheries. Overall, conservation and fisheries management plans are the best options for declining and endangered fish species (Collares-pereira et al., 2002; Dungeon and Smith, 2006).

Table 3 suggests the best strategies for conserving *C. nigrodigitatus* in Cross River State and it includes habitat

dissemination of conservation information, education and practices to fishermen and other stakeholders about the danger of extinction of the species and the need for its conservation (Cambrey and Pister, 2002). This will go a long way towards protecting and preserving the species. Prevention now is not only better, but also cheaper than recalling the lost species in the future. Once extinction occurs, it could not be easily reversed or recalled. Therefore, fisheries scientists have a major role to play in creating public awareness and support for the conservation mechanisms of the species. Law, regulation and registration of fishing gears (equipments) will ensure that the young reach their reproductive adult stage. A mesh size of above 17 cm is highly advocated. Regulation of the fishermen and prevention of over fishing will also enable the species to be conserved in the river. Artificial breeding, restocking, security patrol against illegal fishing, legislation, closed fishing seasons, and protected areas will prevent excessive harvesting of the species. *C. nigrodigitatus* was mostly caught in the dry season and found in the small vegetated floodplain areas of rivers; it would therefore be better if the vegetation of the areas is increased and protected from fishing activities. This habitat restoration and enhancement provision of better spawning ground will greatly ensure the conservation of Silver Catfish in the River. This is appropriately applicable because of the lapses in the recruitment of the species as noted by Lewis et al. (1996).

Crivelli (2002) reported that conservation of freshwater fishes would be better served by developing protected areas. Accordingly, intensive fishing of the species in the dry season should be discouraged or totally prohibited. Conserving and protecting the species from extinction will also have benefits by ensuring directed scientific research to develop its aquaculture potential and further elucidate its biology. Preservation of the genetic variability of the species is also important for the development of an aquacultural program for the species (Beadle, 1981). Improvement of the river fisheries, preventing further decline of Silver Catfish in Cross River will not only improve the fisheries of the Cross River to ensure high fish production, but also its ecology.

Conclusion

Relatively few research have been conducted on *C. nigrodigitatus* (Moreau, 1982), leaving its biology and aquacultural technology to still require extensive studying (Adite et al., 2006). The results of this study indicate that the Silver Catfish is endangered in Cross River, Cross River State, Nigeria. This study highlighted the need for stakeholders to watch anthropogenic threats, activities and harmful practices which may cause the extinction of Silver Catfish in the Cross River as well as in the freshwater system of Nigeria, and the effects of this extinction, and the ways by which it could be prevented.

The Federal and State Endangered Species Acts (ESA) allow for the listing of animal and plant species that may become extinct if current trends and activities continue. The ESA specifically prohibits taking, harming or harassing endangered wildlife. Engaging in commerce of any sort involving endangered species is illegal. Before a species is placed on the threatened and endangered species list, all the arguments and scientific information for doing so are required to be placed in the Federal Register. The results from this study could be presented as scientific support for placement as an endangered species.

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