# MORTALITY RATES OF FISH SPECIES WITHIN THE ANDONI RIVER, NIGER DELTA, NIGERIA AND MANAGEMENT MEASURES.

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**Abstract**

Pooled one-year (January to December, 1999) length-frequency data of fish species sampled from catches of five randomly selected artisanal fishers, using unmotorized dug-out canoe were fed into FISAT (FAO-ICLARM Stock Assessment Tool) to evaluate mortality coefficients. The resultant natural mortality coefficients of the11 commercially important fish species showed that *Sarotherodon melanotheron* (2.24yr$^{-1}$), *Galeoides decadactylus* (1.96yr$^{-1}$), *Eucinostomus melanopterus* (1.58 yr$^{-1}$), *Tilapia guineensis* (1.44 yr$^{-1}$), *Pseudotolithus elongatus* (1.22 yr$^{-1}$) and *Ilisha africana* (1.08 yr$^{-1}$) had the highest natural mortality rates and indicative of fast growth (i.e. rapidly approaching asymptotic length (Loo); the reverse being true for *Chrysichthys nigrodigitatus* (0.66 yr$^{-1}$); *Pomadasys jubelini (0.74* yr$^{-1}$*);Ethmalosa fimbriata (0.78* yr$^{-1}$*); Lutjanus goreensis* and *Liza grandisquamis* (0.87 yr$^{-1}$). The generally high total mortality values of 0.88 yr$^{-1}$ for *C. nigrodigitatus* to 3.83 yr$^{-1}$ (*P. elongatus*) points to death due not only to legal fishing activities but also great impacts from illegal and obnoxious fishing practices, pollution, environmental degradation, and the consequent need for management of the fishery resource within the Niger Delta of Nigeria. Management measures such as enforced licensing and registration of fishers and fishing craft, establishment of marine reserve areas and fishing registration centers would enhance sustainable use of the economically viable fishery resources within the coastal states of Nigeria and West Africa at large.

## Introduction

Total Mortality (**Z**), the sum total of the rates of fishing (**F**) and natural mortalility (**M**) determine the population dynamics of fish stocks (Buijse, 1992; Gaertner *et al.*, 2006). It is a necessary component of fish stock assessment (Marshall, 1992). In fisheries management, mortality coefficients come into play when optimum levels of efforts are to be set. Causes of fish mortality include oil pollution Ezenwa *et al.* (1987); predation, (Chifamba, (1992); diseases (Marine Biotoxins, 2006; PAHO, 2006), both legal and illegal fishing activities and environmental change (Millennium Ecosystem Assessment, 2006).

Tobor (1991) reported that the value of natural mortality (M) for majority of the Gulf of Guinea fish stocks range from 0.5 - 1.00, and that a value of 0.7 was a good estimate for natural mortality.

Capture fisheries worldwide is undergoing stock depletion (Millennium Ecosystem Assessment, 2006). This has made management of capture fisheries an urgent need. Effective management measures cannot be successfully put in place without accurate statistical data on fish stocks. Though management of the tropical fisheries is made difficult by the multi-species nature of the fishery, concerted effort is imperative to achieve an advancement and sustainability in the nature of fishery exploitation in Nigeria. Much gap exists in fish stock assessment and fisheries as a discipline in Nigeria. The results of this study aims at filling up part of this gap.

## Study Area:

The Andoni River, located on $4^{\circ}28^{1}$ to $4^{0}45^{1}$ North and longitudes $7^{0}45^{1}$ East, is one of the rivers forming the Niger Delta in Nigeria (See Fig1). The Niger Delta itself, one of the world's largest wetlands and covering an area of approximately 70,000km is economically important in terms of fisheries, mineral deposits, gas and biodiversity.

The Andoni River, one of the numerous rivers that drain Rivers Niger and Benue into the Atlantic Ocean is located within the rainforest belt of Nigeria (Francis, 2003). The climate is made up of a short dry season of about four months (November to March). The dry season, however, is usually dotted with rains every now and then. The longer rainy season spans from about April to October with heavy rains experienced from around May. The river itself is brackish in its water content (Yoloye 1976; Francis 2003). Numerous creeks, rivulets, mudflats, sand beaches, *Rhizophora* and *Avicennia spp* mark the river and its banks. The Andoni artisanal fishers land their catches at two main sites: Kaa (Ika) waterfront and Oyorokoto which is closer to the Atlantic Ocean. The Kaa waterfront is more hinterland than Oyorokoto.

## Materials and Methods:

Fish samples used for this study were from the artisanal fishers that land their catches for sale at Kaa waterfront. About 20 non-motorized dug-out canoes are landed daily, out of which five were randomly selected per field trip which was twice a month from January to December, 1999.

Length measurements from the five canoes were done in accordance with Pauly (1983). The measurement with transparent plastic ruler from the anterior-most part of the snout to the tip of the caudal fin formed the total length (TL) in centimeters. The length measurements were then grouped in 1cm class intervals were converted to length-frequencies; sequentially arranged for the year and fed into FiSAT (FAO-ICLARM Fish Stock Assessment Tool) for analysis of mortalities after initially evaluating the asymptotic length (L) and the growth coefficient (**K**).

Total mortality coefficient (**Z**) was estimated through the catch curve method. The formula integrating the interrelationship between mortality, size and temperature (Pauly 1980 quoted in Pauly 1983) was used to calculate Natural mortality (M):

$$\text{Log}_{10}(M) = -0.0066\ 0.279 \log_{10}L + 0.6543 \log_{10}K + 0.4634 \log_{10}T$$

Therefore, Fishing mortality F was thus calculated :

F =Z M; and exploitation rate (E) obtained from E=F/Z.

**Results**

The fish mortality coefficients of 11 commercially important fish species from the Andoni River system is presented in Table 1. The Total mortality values had a range of 0.88yr$^{-1}$(*Chrysichthys nigrodigitatus*), 3.83yr$^{-1}$ for *Pseudotolithus elongatus*; 0.66yr$^{-1}$-2.24yr$^{-1}$ for natural mortality coefficients and 0.22- 2.61yr$^{-1}$ for fishing mortality rates. The natural mortality values can either be approximated to .7 or be above 0.7 while for fishing mortality only two fish species *C. nigrodigitatus* and *Galeoides decadactylus* had values that were below 0.7yr$^{-1}$.

Also, the fish species that suffered death most (i.e. total mortality, both from natural causes and fishing activities) were P*seudotolithus elongatus* followed by *Sarotherodon melanotheron, Eucinostomus melanopterus* and *Tilapia guineensis,* but least in *C. nigrodigitatus* and increasing in order for *P. jubelini, L. grandisquamis* and *E. fimbriata.*

Death from natural causes washighest in *S. melanotheron* followed in descending order by *G. decadactylus and Ethmalosa fimbriata.* Death due to fishing activity (F) was highest in *P. elongatus,* with three fish species having F value of 1.34yr$^{-1}$ each: *E. melanopterus, Ilisha africana* and *T. Guineensis.*

Compared to natural mortality value of 0.7 the mortality values in Table 1 are generally high.

**TABLE 1: MORTALITY RATES OF FISH SPECIES FROM THE ANDONI RIVER SYSTEM (1999).**

| S/N | FISH SPECIES | Z (yr $^{1}$) TOTAL MORTALITY | M (yr $^{1}$) NATURAL MORTALITY | F (yr $^{1}$) FISHING MORTALITY | E EXPLOITATION RATIO |
|---|---|---|---|---|---|
| 1. | *Chrysichthys nigrodigitatus* | 0.88 | 0.660 | 0.220 | 0.25 |
| 2. | *Ethmalosa fimbriata* | 1.64 | 0.78 | 0.86 | 0.52 |
| 3. | *Eucinostomus melanopterus* | 2.92 | 1.58 | 1.34 | 0.46 |
| 4. | *Galeoides decadactylus* | 2.4 5 | 1.96 | 0.49 | 0.2 |
| 5. | *Ilisha africana* | 2.42 | 1.08 | 1.34 | 0.55 |
| 6. | *Liza grandisquamis* | 1.60 | 0.87 | 0.73 | 0.45 |
| 7. | *Lutjanus goreensis* | 1.79 | 0.87 | 0.92 | 0.51 |
| 8. | *Pomadasys jubelini* | 1.57 | 0.74 | 0.83 | 0.53 |
| 9. | *Pseudotolithus elongatus* | 3.83 | 1.22 | 2.61 | 0.68 |
| 10. | *Sarotherodon melanotheron* | 3.27 | 2.24 | 1.03 | 0.32 |
| 11. | *Tilapia guineensis* | 2.78 | 1.44 | 1.34 | 0.482 |

The generally high mortality values of the fish species seem to highlight the effects of ecosystem change, environmental degradation, illegal and obnoxious fishing practices and crude oil spills in the Niger Delta on aquatic fauna. Factors such as ecosystem change brought about by certain direct and indirect drivers (Greenfacts, 2006), affect the fish stock. Legal and illegal fishing practices, diseases and predation are also causes of mortality in fishes. In the Niger Delta, increase in certain activities the past twenty years within the brackish waters such as the use of speed boat as means of transport, oil spills, gas flaring, urbanization and canalization, all of which greatly affect the aquatic ecosystem, can increase mortality rates of the fishes.

These mentioned factors can cause changes in the physico-chemistry of the aquatic environment, leading to changes in the metabolic activities of the fish species resulting in natural mortality. In addition, some factors can affect the turbidity of the water thereby rendering the fishes vulnerable to entanglement or become easy prey to predators and man. Besides, the turbidity can reduce penetration of light, adversely affecting primary productio.

The high natural mortality coefficients of *S. melanotheron, G. decadactylus, E. melanopterus* and *T. guineensis* is indicative of their fast growth rate (Beverton and Holt 1959) which results from high tropical temperature (Pauly,1998) that enhances their metabolic rates when compared to their temperate counterparts.

Correspondingly, the low natural mortality of *C. nigrodigitatus, Pomadasys jubelini, E. fimbriata, Liza grandisquamis* and *Lutjanus goreensis* point to their slow growth in attaining asymptotic length (Beverton and Holt 1959). Slow growth and low natural mortality rates seem to be characteristic of predators.

Furthermore, the high fishing mortality rates recorded for *P. elongatus, S. melanotheron, E. melanopterus* and *T. guineensis* may be the result of an almost all year round spawning, their consequent growth and recruitment to fishing and hence the target of all the year round fishing activities within this river system.

The mortality values in this present study at best can only be compared to those of closely related species since only these were obtained from literature. King (1991) had mortality values of $Z = 0.87yr^{-1}$, $M = 0.663\ yr^{-1}$ and $F = 0.23\ yr^{-1}$ for *Tilapia mariae* captured from Iba Oku Stream in Akwa Ibom State, Nigeria. These figures are in disparity with those of the present study due, may be, to ecosystem differences, selectivity. Abohweyere (1989) reported Z of 0.36 $yr^{-1}$ for *G. decadactylus*. The difference in mortality values between this and the value in Table may also be attributed to the factors earlier mentioned.

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