Research Application Summary

# Recruitment pattern and abundance of the black tiger shrimp in Andoni River System, Niger Delta region of Nigeria

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## Abstract

The investigation on the recruitment pattern and catch per unit effort of the black tiger shrimp(*Penaeus monodon*) was conducted over the period of twelve months in Andoni River System, Niger Delta region of Nigeria. Total weight, length of sampled *P. monodon*, number of fishers, fishing duration and temperature were sampled monthly. Total weight of *P. monodon* landed, number of fishers and fishing duration was used to determine catch per unit effort in kg/man/hr while United Nations Food and Agricultural Organization fish stock assessment tools II (Fisat II) software was used to analyze recruitment pattern using the length frequency data of the stock. Recruitment pattern was continuous and higher during the rainy season with a peak in June. Catch per unit effort was lowest (46.09 kg/man/hr) in January and highest (78.11 kg/man/hr) in September. Mean temperature ranged from $27 \pm 0.32^{\circ}C$ to $31 \pm 0.89^{\circ}C$ which was suitable for the stock. A positive moderate correlation existed between recruitment and catch per unit effort (r = 0.50) while a positive weak correlation occurred between recruitment and temperature (r = 0.21). The study concluded that a rise in the recruitment of *P.monodon* suggests a rise in catch per unit effort and that temperature was not the only factor necessary for recruitment.

Key words: Andoni river, *Penaeus monodon*, shrimp

## Résumé

Une enquête sur le mode de recrutement et l'effort de capture par unité de la crevette tigrée *(Penaeus monodon)* a été réalisée au cours période de douze mois dans d'une la rivière Andoni, région du Delta du Niger. Le poids total, la longueur du *P. monodon* échantillonné, le nombre de pêcheurs, la durée de la pêche, et la température ont été échantillonnés mensuellement. Le poids total de *P. monodon,* le nombre de pêcheurs, et la durée de la pêche ont été utilisés pour déterminer la capture par unité d' effort en kg/homme/h tandis que le logiciel d'évaluation des stocks de poissons de l'Organisation des Nations Unies pour l'Alimentation et l'Agriculture (Fisat II) a été utilisé pour analyser le mode de recrutement en utilisant les données sur la fréquence de longueur du stock. Le mode de recrutement était continu et plus élevé pendant la saison pluvieuse avec un pic en Juin. La capture par unité d'effort était la plus faible (46,09 kg/homme/h) en Janvier et la plus élevée (78.11 kg/homme/ h) en Septembre. La température moyenne variait de $27 \pm 0.32^{\circ}C$ à $31 \pm 0.89^{\circ}C$, ce qui était appropriée pour

le stock. Il y avait une corrélation positive modérée entre le recrutement et la capture par unité d'effort (r = 0,50), tandis qu'une faible corrélation positive a été observée entre le recrutement et la température (r = 0,21). L'étude a conclu que l'augmentation dans le recrutement de *P.monodon* suggère une augmentation des captures par unité d'effort et que la température n'est pas le seul facteur nécessaire pour le recrutement.

Mot Clés : la rivière Andoni, *Penaeus monodon*, la crevette

## Background and Literature Summary

It is known that changes in fish populations are primarily driven by variability in recruitment-a concept that is defined as the number of fish surviving to enter the fishery or has grown to maturity which eventually can be harvested at the fishing ground. Recruitment is influenced by the number of offspring produced as well as the effect of density independent (temperature and food condition) and density dependent (competition for food or refuge) factors which occur at different pre-recruit stages. Recruitment being a determining factor on the abundance of a species influences the efforts exerted by fishers in catching the target species of fish. Hence, catch per unit effort (CPUE) in fisheries and conservation biology is an indirect measure of the abundance of a target species. Changes in the catch per unit effort are inferred to signify changes to the target species' true abundance (Pablo and Bodmer, 2004). There is paucity of knowledge on how recruitment of shrimp relates with CPUE and temperature in Andoni River systems hence the rationale for this study.

The black tiger shrimp (*Penaeus monodon*) is a marine crustacean that is widely reared for food. It is an invasive species to Nigerian coastal water, first reported in 1999 by a trawl fishing company (FAO, 2000). The natural distribution is Indo-West-Pacific, ranging from the eastern coast of Africa, the Arabian Peninsula, South-east Asia and the sea of Jordan as well as eastern Australia and the Mediterranean Sea. Further invasive populations have become established in Hawaii and the Atlantic coast of the USA - Florida, Georgia and South Carolina (Fuller *et al.,* 2014; Suthep, 2015). A recent study shows that *P. monodon* has a higher natural mortality than fishing mortality in Andoni River (Komi *et al.,* 2013), a situation implying that the shrimp may be under-fished.

In producing recruitment patterns in a normal distribution as described by Pauly (1986), two assumptions are made. First is that all fish in a given set of data grow as described by a single set of growth parameters and secondly that recruitment occurs in eleven months only, in a-twelve-month data sampling (Gayanilo *et al.,* 1989). However, productivity of a river is also influenced by physical factors, especially temperature of the river.

Water temperature is critical in aquatic ecosystems. It limits the migration, spawning, egg incubation, growth and metabolism of aquatic organisms (Kelly and Linda, 1997). The Andoni River being a system of flowing river tributaries maintain a suitable surface

water temperature for *P. monodon* at the fishing grounds (Komi and Sikoki, 2013). However the relationship between recruitment and temperature of the  River  is not clear. This paper therefore  examines the relationship between recruitment pattern and catch per unit effort (CPUE) of *P. monodon* in the Andoni River System as well as temperature influence on recruitment of the species.

**Study Description**

The Andoni River, which is one of the numerous rivers through which River Niger and River Benue drain into the Atlantic Ocean, is located within the rainforest belt of Nigeria (Francis, 2003). The River lies between latitudes 4028' to 4045' N and longitudes 7045'E. It is a major fish nursery in the Niger Delta region of Nigeria.

The length –frequency data collected from sub-sample of *P. monodon* landed by artisanal fishers of the Andoni river system at Kaa landing site were subjected to the recruitment procedure. FISAT II - FAO-ICLARM Stock Assessment Tool, a program was used for analysis of fishery data was used as described by Pauly (1983), Moreau  and Cuende (1991), and Gayanilo and  Pauly (1997).

There was an average of 350 Artisanal shrimp fishers, fishing for an average of 8 hr on each active boat days (4 active boat days per week) in the Andoni estuaries. Catch per unit effort was determined by dividing the total monthly catch by the effort (number of fishers per boat) and by the number of hours of fishing.
CPUE=*(Total catch / Number of fisher / fishing hours)*……………………… (1)
CPUE=kg/man/hr (King, 1995; Francis, 2003).

Monthly Catch per unit effort (MCPUE) = ( kg/man/hr) x 16. ………………… (2)
Where M = monthly active boat days = 16 (number of active boat days).
Kg = Weight of black tiger shrimp landed
Man = No. of fishers involved
Hr = fishing hour

Temperature was measured using a thermometer with the probe inserted into the river and the value at the pointer of the scale was read off and recorded. Units were in degree Celsius ($^o$C).

**Data analysis**
Correlation between recruitment and catch per unit effort as well as between recruitment and temperature was determined using excel package (2007).

**Results**

There was all-year-round recruitment of the black tiger shrimp with  a peak in June (Fig.1). However the rate of recruitment over the period of study did not automatically determine

the catch per unit effort of the fishers but recruitment and CPUE were both higher during the rainy season and lower in dry season. The highest catch per unit effort was recorded during the rainy season from May to October with a value of 78.11 kg/man/hr in September; the least 46.09 kg/man/hr was recorded  in  January.
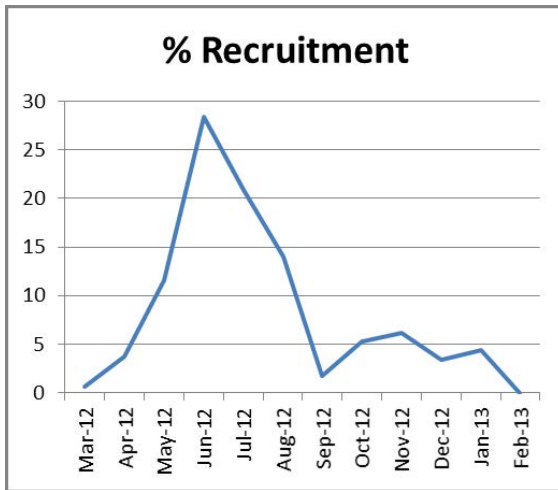


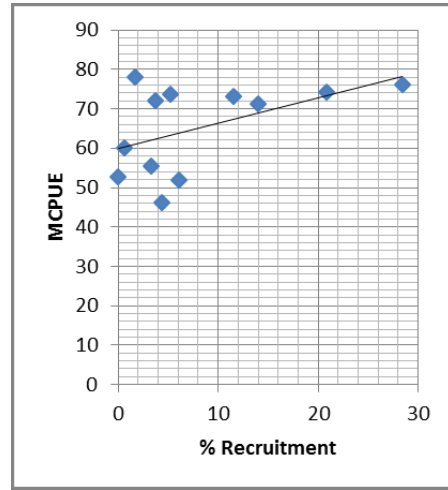Fig. 1: *P. monodon* recruitment pattern in Andoni River System



Fig.2: Correlation of % recruitment and Catch per unit effort of *P. monodon* in Andoni River System

In terms of the correlation between percentage recruitment and monthly Catch per unit effort (MCPUE) of *P. monodon* in Andoni river system. There was a linear relationship between both parameters (Fig. 2). The correlation is positive implying that as recruitment of *P. monodon* increases, catch per unit effort tends to rise. The coefficient of correlation (r) being 0.5, indicates a moderate positive correlation but a weak positive correlation (r = 0.2) occurred between temperature and recruitment. The water temperature which ranged from 27± 0.32$^o$C to 31± 0.89$^o$C was within FAO limit of temperature suitable for shrimps (Fig. 3).
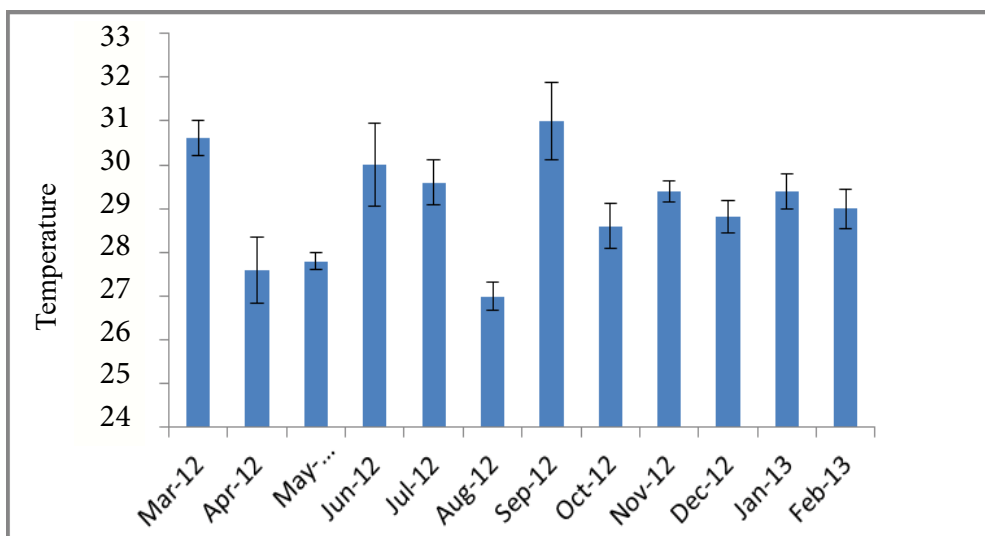


Fig.3: Mean Temperature values of  the Andoni river system

**Discussion**

Recruitment being continuous with a single peak, is a good index for fisheries management as this enables law makers to make informed decisions on when to impose a closed season, when shrimp fishers are not allowed to fish to allow breeding. The findings also show higher Shrimp harvest during the raining season. This agrees with the findings of Francis and Sikoki (2005) who worked on recruitment of other fish species in Andoni River. The temperature of Andoni River system is generally  favourable for the growth and metabolism of *P. monodon.* This finding is  consistent with the findings of Ansa (2004) and Francis *et al.* (2007).

**Acknowledgement**

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