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**Eyo Etim Ambrose**
Department of Fisheries and Aquatic Environmental Management, Faculty of Agriculture, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

**Mfon Timothy Udo**
Department of Fisheries and Aquatic Environmental Management, Faculty of Agriculture, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

**Correspondence**
**Eyo Etim Ambrose**
Department of Fisheries and Aquatic Environmental Management, Faculty of Agriculture, University of Uyo, P.M.B. 1017, Uyo, Akwa Ibom State, Nigeria

# Length at first capture for Bonga, *Ethmalosa fimbriata* in Nigerian Inshore waters and management implication

**Eyo Etim Ambrose, Mfon Timothy Udo**

**Abstract**
The Length at first capture for Bonga in Nigeria inshore water was investigated. The selectivity study was done by comparing the catches of gill net with the catches of purse seine net operating in the same area. The length at first capture (Lc) is 21cm, the length at which 75% is retained is 21.7cm while the maximum retentive length (Lm) is 22cm. Bonga grows out of selection range by virture of large size at a total length greater than 23cm (Ld). LC and Lm correspond to age group of 2 and 3 years respectively. This implies that young of the year and one year age cohorts are not recruited into the fishery. Closed season and area in Nigeria inshore waters alone has no conservative effect on inter E.E.Z's migratory species like Bonga. Closed season and area in the lagoon, estuary, and creeks are suggested to protect the juveniles in their nursery grounds as well as the use of gillnet with mesh size >70 mm in the inshore water.

**Keywords:** Bonga, Management, Inshore water, Nigeria

## 1. Introduction
Bonga, *Ethmalosa fimbriata* is a clupeid shoaling pelagic fish. It is a target species in the artisanal fishery of Nigeria and account for about 30,000 metric tones annually (Fisher *et al.*, 1977) [1]. Between 1989 to 2007, Bonga constituted the second most abundance species of fish caught in Nigerian waters (Eels > Bonga > Catfishes > Tilapia) (FDF, 2007) [2]. Therefore, its management cannot be over-emphasized. Longhurst (1960) [3] observed that the occurrence and migration of the species were limited to the extensive estuaries and lagoons (nursery grounds) and the adjacent coastal waters of the Atlantic Ocean. Bainbridge (1963) [4] observed that the distribution of the species along the West African coast shows two main areas of concentration; one from the mouth of River Senegal to the coast of Sierra Leone and the other occurs along the coast of Nigeria and Cameroon to the mouth of Congo River. In the inshore water of Nigeria, Bonga is exploited with drift gill net, cast net and one-boat operated purse seine; Monofilament (PA) gill net with stretched mesh size of 70 mm account for 67.13% of these gear (Ambrose, 1997) [5]. Still in the inshore waters of Nigeria, Moses (1988) [6] estimated the mean catch of Bonga to be 25030 tonnes per year, a maximum sustainable yield of 30075 tonnes and length at infinity of 30cm.
Population parameters like age and length at first capture, recruitment, growth and mortality rates constitute a reliable indices in stock assessment/management, gear design for rational exploitation and fishing effort regulation. These population parameters are inadequate for most tropical species, because of this, length – structured population models in contrast with age-structured models for temperate stock is often use in fishery management decision making. The present paper reports on the length at first capture of Bonga in Nigerian inshore waters (depth 0 – 50m) and its implications in the management of bongs fishery resources.

## 2. Materials and Methods
Four fishing settlements namely; Arunton, Down below, Orimedu and James Town operating both gill net and purse seine gears of similar specifications along the 853km Atlantic coastline of Nigeria (Lat.$4^0$ $6^1$ to $6^0$ 2,$^1$ N and Long. $2^o$ $29^1$ to $14^0$ $37^1$ E) were studied monthly for two years (2013 and 2014) for Bonga fishing techniques and landings. The fish caught were grouped into 1cm length class intervals (13 – 14, 14 – 15…29 – 30cm).The number of fishes

in each length interval were recorded separately for both gear and were pooled for the four settlements and averaged taken.
The selectivity(s) of Bonga was calculated by comparing the catches of gillnet and purse seines (Sparre *et al.*, 1989) [7]

$$S = \frac{\text{Number of Bonga caught in gill net (selective)}}{\text{Number of Bonga caught in purse seine net (non- selective)}}$$

$$Lc = a/b$$

$$L75\% = \frac{(\text{Log. } 3 + a}{b}$$

$$SF = \frac{(Lc}{Nm}$$

Where S = selectivity
Lc = Length at first capture (or L50%)
Nm = Stretched mesh size of gill net (70mm)
SF = Selection factor
a and b = Regression coefficients
The natural logarithm of the fractions retained (Y) and mid-length of Bonga (x) were analyzed to obtain the regression coefficients.
Management options for the fishery were deduced by relating the selectivity parameter (Lc, Lm and Ld) to already published works on Bonga fishery, fisheries resources management and local field observations.

## 3. Results

The fraction retained(s) of Bonga in a 70mm stretched mesh size gill net and 32mm stretched mesh size purse some net fished within the some ecological zone is shown in table 1, while figure 1 shows the selection curve.
The maximum (100%) retentive length (Lm) is 22cm. length at first capture (Lc) of Bonga was found to be 21cm and the length at 75% retention is 21.7cm. Corresponding to Lc of 21cm at 50% retention, the line was extended to touch the descending arm of the "ogive" at a length of 23cm (Ld) which Bonga are selected by virture of large size. The size selection factor (Sf) was estimated to be 0.3.

## 4. Discussion and Management Implication

Whereas trawl selectivity is essentially a one – sided affairs (with only smaller fish having a reduced probability of capture), gill nets tends to select negatively both small and large fishes as shown in figure1. The former simply go through the mesh without getting caught (<21cm), while the later are too big to insert themselves into a mesh (>23cm). Thus when Bonga in Nigerian inshore sea are actually gilled, the resulting selection curve has the shape of a normal distribution and the length at optimum efficiency (optimum length = 22cm) is proportional to the mesh size (70mm). Hamley (1975) [8] highlighted factors affecting gill net selectivity to include; shape of fish, thickness and elasticity of twine in the net, spines and skin texture of fish. Among these, only twine thickness and softness of skin seems to affects Bonga selectivity in this study. Thinner twine was observed to cuts easily into the soft skin of Bonga and reduced its market value and size selection, larger Bonga wedged, were cut into two and falls off from the net. In the catching of Bonga, there was no entanglement due to high hanging ratio of 0.6 to 0.7 which allow for high spread and reduced lift in mesh geometry and also Bonga has no morphometric projections, hence a perfect bell-shaped normal curve.

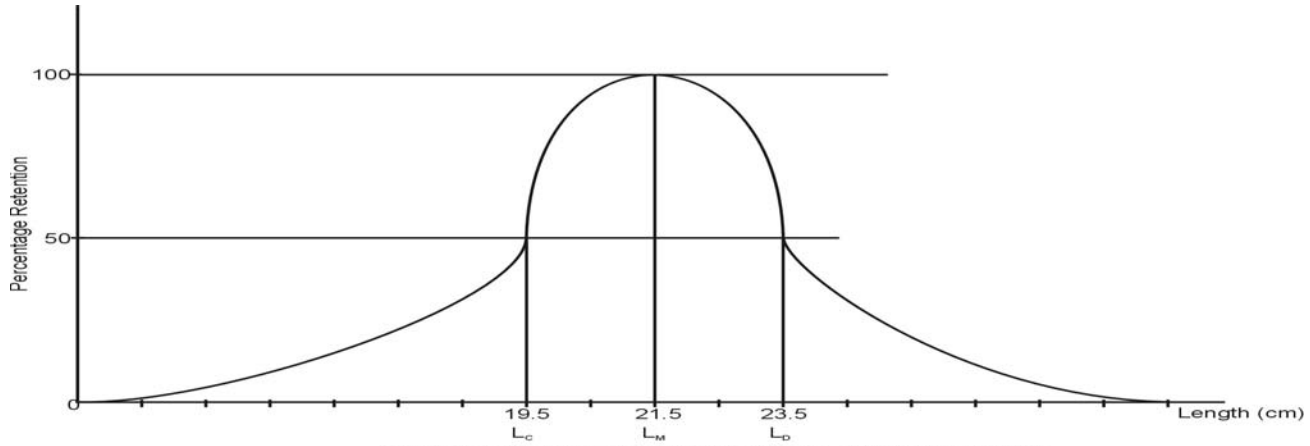


**Fig. 1:** Selection curve of gill net for bonga, *Ethmalosa fimbriata*

Moses (1988) [6] determined the length frequency and age data of Bonga in Nigerian inshore water to be 5-10cm (0 year group), 11-15cm (1year group), 16-21cm (2 years group), 21-24cm (3 years group) and > 25cm (4years group). FAO (1984) [9] gave the following estimates of size range for different year groups of Bonga from Senegambia waters; 9-12cm (0+), 13-16cm (1+) and 18-21cm (2+). In this study, the estimated length at first capture (Lc) and the length with 100% (maximum) retention (Lm) corresponds to 2years and 3 years age groups respectively based on Moses (1988) [6] age estimate and Lc of 2 years age group judging from FAO (1984) [9] estimate. These implies that the young of the year (5-10cm year group) are not recruited into the stock and fishery while one year cohort (11-15cm) of Bonga are recruited to the stock but not the fishery (are not exploited) as their number in gill net landings were relatively few (table 1) and is (< Lc). Bonga (< 13cm) were not found in gillnet landings, negligible number were landed by purse seine operating off the East coast (Niger Delta) where rich nursery grounds abound for fast stock recruitment. These results and observations also implies that the stock is not over-exploited and provides more rooms for further expansion of the fishery like increase in 'controlled' fishing effort and craft motorization. Beyond Ld of 23cm the fish grows out of the selection range. The length at Ld is economically accepted because in Bonga fishing, due to its small size (length at infinity < 30cm) (Moses, 1988) [6], it is the number and not the size of fish landed that determine economic viability (Karlson and Byanasson, 1986) [10]. The biotic potential of Bonga is favourable at Lm of 22cm, this is within the maturity length of Bonga. Blay and Eyeson (1982) [11] reported that Bonga mature at a total length greater than or 22.0cm in the Gulf of Guinea off Ghana.

**Table 1:** Comparison of gill net with a non-selective gear (purse seine,) catches operating in the same area. (N =24)

| Length Interval $L_1$ - $L_2$ | Number in gill net (70mm) (x10)A | No. in purse seine net (32mm) (x10)B | Total No. (x10)A+B | Fraction Retained(s) A/B | Y | X |
|---|---|---|---|---|---|---|
| 13-14 | 9 | 40 | 49 | 0.22 | 1.23 | 13.5 |
| 14-15 | 1 | 35 | 46 | 0.02 | 0.78 | 14.5 |
| 15-16 | 7 | 29 | 36 | 0.241 | 1.14 | 15.5 |
| 16-17 | 12 | 51 | 63 | 0.235 | 1.18 | 16.5 |
| 17-18 | 10 | 38 | 48 | 0.263 | 1.03 | 17.5 |
| 18-19 | 40 | 55 | 95 | 0.727 | -0.9 | 18.5 |
| 19-20 | 72 | 69 | 141 | 1.04 | 0 | 19.5 |
| 20-21 | 53 | 58 | 111 | 0.913 | -2.3 | 20.5 |
| 21-22 | 46 | 63 | 109 | 0.93 | -0.99 | 21.5 |
| 22-23 | 61 | 80 | 141 | 0.762 | -1.16 | 22.5 |
| 23-24 | 78 | 74 | 152 | 1.052 | 0 | 23.5 |
| 24-25 | 56 | 105 | 161 | 0.533 | -0.13 | 24.5 |
| 25-26 | 69 | 96 | 165 | 0.718 | -0.93 | 25.5 |
| 26-27 | 21 | 71 | 92 | 0.295 | 0.8 | 26.5 |
| 27-28 | 18 | 60 | 78 | 0.3 | 0.84 | 27.5 |
| 28-29 | 12 | 58 | 70 | 0.2 | 1.38 | 28.5 |
| 29-30 | 14 | 47 | 61 | 0.29 | 0.89 | 29.5 |
| Total | 589 | 1,029 | 1,618 | | | |

Since zero and 1 year age cohorts are not exploited, it appears that Bonga stock is not over-exploited. Fishing is at Ymax or slightly below it, but this should be avoided to prevent the collapse of the stock because nearly all the inshore artisanal fishing pressure (which provide over 85% of domestic fish production in Nigeria) focused on Bonga exploitation. Longhurst (1961) [12], Bainbridge (1961) [13] reported that Bonga spawn in the lagoon, estuary and creeks. Closed fishing area and season, prevention of oil spillage, wet land reclamation and stupefying fishing methods in these habitats are suggested to protect the juveniles in their nursery ground. Prevention of the use of smaller mesh size (< 70mm) of gill net in the inshore water and changing the status of the fishing from open access to limited entry through the licencing of Bonga inshore purse seine canoes are also suggested for efficient management.

In the classification of marine shared stock for management purposes (Gulland, 1982 [14], Caddy 1982) [15], mature Bonga belongs to the migratory species moving across boundaries of two or more EEZ's and are only available in each zone seasonally. Based on this classification, closed season and area in the inshore water of Nigeria alone is not advocated. International co-operations between Nigeria and adjacent countries in the rational exploitation and management of Bonga resources is required, like; fixing of yearly total allowable catch to collaborative Nations, and rotational closing of the fishing period for 1-2 years among the lower CECAF Nations to allow the stock to rejuvenate whenever over – exploitation is imminent. Such management collaborations which at the moment are lacking can be formed, regulated and enforced by international organizations and programs present within the said region such as, UN/FAO Regional Office for Africa in Ghana, Economic Community of West African State (ECOWAS), Integrated Development of Artisanal Fisheries in West Africa, IDAF Cotonou, and DFID Fisheries Livelihoods Programme. The bureaucracy for such collaboration is time consuming and scientific information on Bonga and allied by-catch species are inadequate. Hence, local and national management efforts for the mean time should concentrate on the juvenile whose habitats are known within the coastal waters of Nigeria and other lower CECAF Nations.

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