# Lunar Cycle And Bonga Gill Net Fishery In Inshore Atlantic, Off Ibaka, Nigeria

Eyo Ambrose and Happiness Rankin

Department of Fisheries and Aquatic Environmental Management, University of Uyo, PMB 1017, Uyo, Akwa Ibom State, Nigeria
Correspondence: eyoambrose@yahoo.com

**Abstract**: Sea fishing experiments were conducted with monofilament gill net in the inshore Atlantic off Ibaka, Nigeria with a view to finding; a favourable time during the monthly moon cycle to embark on profitable bonga fishing expedition; catch per unit effort of bonga gill net fishing and haul-to-haul variability in the landing of bonga by four boats. Daily fishing was done for six months at depth ranging from 10-20m by three men fishing crew, each in four boats powered by 15 horse power out board engine on an established fishing ground. The result showed that eight species of fishes were caught by the net weighing 22601.08kg out of which the target species bonga, *Ethmalosa fimbriata* was 22556.48kg representing 99.8%. Analysis of variance indicated that the weight of fish caught were significantly different (F-test < 0.05; 0.01) at the various moon phases of new moon/moonless, crescent, half and full moon. The highest weight of 10202.47kg of bonga was caught at new moon/moonless period, while the least weight of bonga (1995.71kg) was caught during full moon. The highest CPUE of 3400.82kg/man was obtained at new moon/moonless period and the least (665.24kg/man) was obtained during full moon. This showed that bonga gill net fishing is more profitable during moonless night. The mean weight of bonga caught by the four boats was 10712.38±155.76kg. The coefficient of variability was computed to be 1.45% showing high degree of uniformity in weight of bonga caught by the four boats. The differences in bonga landings at each temporal scale is discussed in terms of the position of the moon, sun and earth at neap tide and spring tide and the tidal forces generated which pull or repel ocean water for fish to concentrate or disperse for capture. It is recommended that a long term (2-5years) research should be commissioned to study the effect of natural phenomenon (tide, moon phase, current, wave, weather and climate) on artisanal fisheries which is more vulnerable to these factors than industrial fisheries.
[Eyo Ambrose and Happiness Rankin. **Lunar Cycle And Bonga Gill Net Fishery In Inshore Atlantic, Off Ibaka, Nigeria.** *Nat Sci* 2018;16(5):49-54]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). http://www.sciencepub.net/nature. 8. doi:10.7537/marsnsj160518.08.

**Key words**: Moon cycle, Bonga, Gill net, Atlantic, Nigeria

## Introduction

Bonga, is a shad, a clupeid fish, it is supported by a single species *E. fimbriata.* It's found in coastal and estuarine regions, and sometimes also in lower courses of coastal rivers, even more than 300 km up rivers (Froese and Pauly, 2011). It feeds by filtering phytoplankton, chiefly diatoms. It breeds throughout the year in waters of salinities 3.5-38 ppt, but with peaks in at least some areas; spawns in the sea, in estuaries and in rivers (Froese and Pauly, 2011). It is usually around 25 cm long but the maximum length is 45 cm.

In Nigeria, Udolisa *et al* (1994) reported that gill net is a large net wall that hangs vertically in the water. Floats line the top of the net, while weights line the bottom of the net. The net is made of transparent monofilament line, so fish and other animals are unable to see it. Fishermen vary the mesh size depending on the size of the species they want to capture. Small mesh sizes are used when targeting small species and large mesh sizes are used when targeting large species. The mesh sizes are designed to be large enough for the head of the fish to pass through it, but not its body. As a result, when fish swim into the net they are entangled by their gills.

The moon revolves around the earth which results in its many phases. It takes around 29.53 days for the moon to complete it phase cycle; which runs from the new moon to first quarter to full moon to last quarter and finally back to the new moon. The moon moves through it phases in about four week hence, the four phases the moon passes last for approximately a week each. The relative position of the earth, moon, and the sun, and the illumination of the sun on the moon results in the moon's different phases (Aidil *et al*, 2005).

There have been controversies among the artisanal fishermen in the fishing community concerning variation in weekly catch landings of bonga in the inshore Atlantic Ocean. Poor and good landings of bonga fish is alternatively caught per week by gill nets per monthly lunar cycle, and fishermen attributed this observation to the effect of heavenly body (moon phase) on the volume of water in the ocean basin.

The general objective of this research is to investigate the effect of lunar phase or moon phase

(new or moonless, crescent moon, half moon and full moon) on the weight (kg) of bonga caught daily/weekly by monofilament gill net.

**Materials And Methods**

The present study area lies between Latitude 40 $30^1$N and $5^0$ $0^1$N and Longitude $8^0$ $10^1$E and $8^0$ $30^1$E in the lower Cross River. Its comprises of tidal creeks, lagoon and fringing mangrove swamps. The macrophytes of the coastal mangrove swamps are predominated by *Rhizophora harrizonii, Rhizophora racemosa, Rhizophora mangel, Laguncularia racemosa, Aviecenna Africana, Nypa fruiticans.*

Two seasons (dry and wet) are observed in this area. The dry season extends from November to February with peak in January. The wet season ranges between March and October with peak in July (Teugel *et al*., 1992).

**3.2 Description of experimental gill net**

Four gill nets panels were used in an independent fishing operation at the same fishing ground by four boats. The four nets had the same design characteristics as shown in figure 2 below. The common design features include; hanging coefficient of 0.6; mesh size of 50mm; meshes in depth of 200; meshes in length of 1950; number and sizes of rigging materials (plastic floats and lead sinkers) spaced equally and same monofilament netting material.

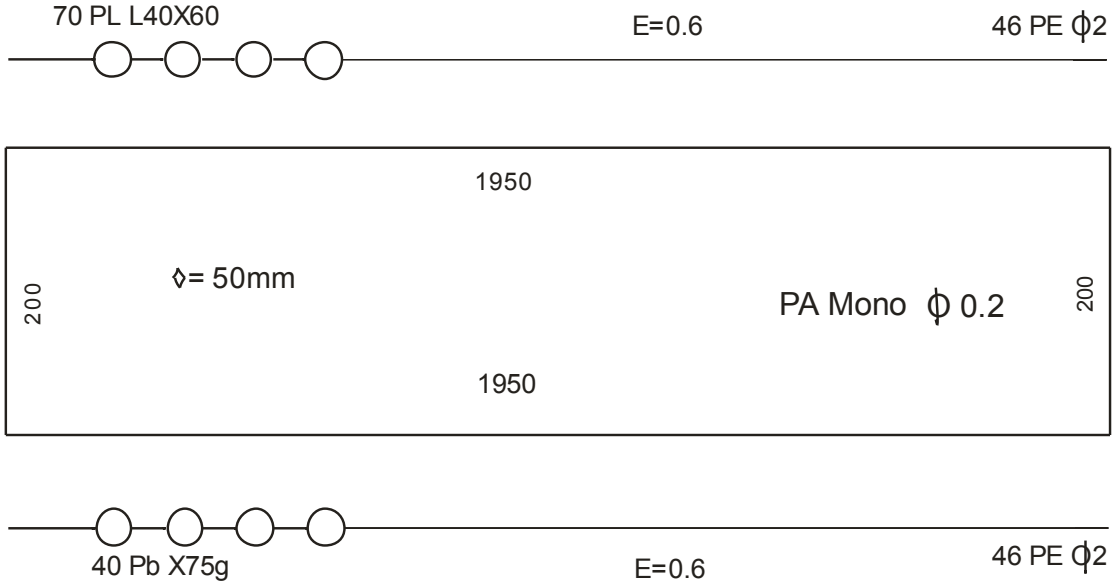


**Figure 2: Design specifications of experimental gill nets**

**Fishing operations**

The fishing operation was carried out with a dugout canoe powered by a 15 horse power out board engine. The operation was usually once a day from 6am to 12noon lasting about 6hrs, and consuming approximately 10litres of fuel. About 2-3 men are usually onboard, with one operating the outboard engine, others throwing and hauling the net to get the fish into the boat. The net was thrown into the ocean at depth ranging between 10-20m and allowed to drift for 4hrs before hauling.

**Identification of bonga**

*Ethmalosa fimbriata* was distinguished from other clupeids by external characteristics such as; the presence of a median notch on the upper jaw, into which tip of lower jaw fits. Its possesses faint dark spot behind gill cover, sometimes followed by others; a black dorsal fin tip; deep chrome yellow caudal fin and golden tints on body as shown in Figure 4. Bonga caught were identified, measured for their lengths and weight. Photograph/drawing of bonga caught was also made. Identification of bonga was based on the compilation of the work by (Schneider, 1990).

**Data collection**

Upon landings, all fishes caught by the net at each moon phase were sorted into species and the weight and number of each species recorded in kilogram. The total weights of bonga fish caught by the net at each temporal treatment were recorded in kilogram. 22 replicate landings of each of the treatments were collected for analysis.

**Analysis of catch data**

A completely randomized design was used. The treatments were assigned completely at random to the experimental unit. The main feature of the design was that it has one treatment as the only experimental factor of variation, which was lunar or moon phases

namely; new moon or moonless, crescent, half moon and full moon.

**Statistical model**

The data collected was subjected to ANOVA test in other to ascertain the relationship between the weight of bonga caught (observations) during each moon phases (treatments). The null hypothesis that the weights of bonga caught during each moon phase do not differ was tested.

**Estimate of catch per unit effort (CPUE) of bonga**

Catch per unit effort of bonga caught by gill net was estimated with the method of Stamatopoulous (2002). This was done by dividing the weight (kg) of bonga caught per moon phase by fishing effort.

$$\text{CPUE}= \frac{\text{weight (kg)}}{\text{fishing effort (F)}}$$

F= Number of fishing crew (3)

**Estimation of haul-to-haul variability**

The degree of non-uniformity of weight of fish caught by four boats using same net specification, fishing effort and operated at the same fishing ground was determined. Each of the four fishing boats completed 181 fishing trips in 6 months. The variance and standard deviation of the total weight of fish from 724 replicate landings by four boats were computed.

Variance for the population $=\Sigma(x_1\text{-}\bar{x})^2$ /N

$X_1$= data set.

N= number of elements in the population or frequency of fishing (724)

Standard deviation = $\sqrt{\text{variance}}$

The coefficient of variability (C.V) or standard deviation expressed as a percentage of the mean was determined as:

$$\text{C.V}= \frac{\text{standard deviation}}{\text{mean}} \times \frac{100\%}{1}$$

**Catch compositions of bonga gill net:**

Apart from the target species, *Ethmalosa fimbriata,* the gill net caught incidentally other eight species of fishes belonging to seven families of species which were of commercial importance to the fishers. The total weight of fish caught by gill net from 88 landings (22 landings by 4 boats) was 22601.08kg, out of which the target species, bonga was 22556.48kg representing 99.80%. Other species contributed 0.20% of the total landings. This showed that the net is highly selective in the catching of bonga. The weight and percentage contribution are elaborated in Table 1 and Figure 3 below.

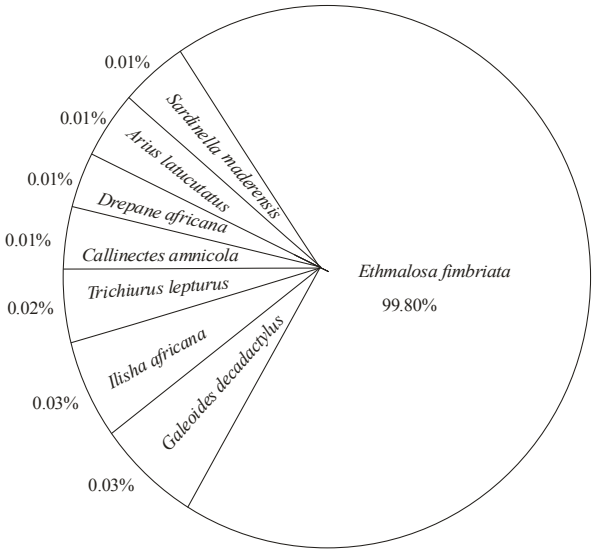


**Figure 3: Pie chart showing percentage weight contributions of all species of fish caught by bonga gill net**

**Results**

**Table 1: Catch compositions of bonga gill nets from 88 landings by 4 boats (22 per treatment)**

| Family | Scientific name | Common name | Weight (kg) | % weight composition |
|---|---|---|---|---|
| Clupeidae | *Ethmalosa fimbriata* | Bonga fish | 22556.48 | 99.80 |
| Clupeidae | *IIisha africana* | African shad | 7.8 | 0.03 |
| Clupeidae | *Sardinella maderensis* | Sardine | 2.5 | 0.01 |
| Trichuiridae | *Trichuirus lepturus* | Silver fish | 5.2 | 0.02 |
| Sciaenidae | *Pseudotolithus elongatus* | Short croaker | 15.0 | 0.07 |
| Drepanidae | *Drepane africana* | Spade fish | 2.9 | 0.01 |
| Polynemidae | *Galeoides decadactylus* | Shiny nose | 6.3 | 0.03 |
| Portunodae | *Callinectes amnicola* | Blue crab | 1.8 | 0.01 |
| Ariidae | *Arius latiscutatus* | Cat fish | 3.1 | 0.01 |
| Total | | | 22601.08 | 100% |

**Weight of bonga fish caught at different moon phases:**

Table 2 is the summary of total and mean weight of bonga caught per treatment (moon phases). More weight of bonga was predominantly caught during the new moon phase (10202.47kg) than other moon phases in the 22 replicate landings. The lowest weight of bonga fish caught (1995.71kg) was during full moon.

Analysis of variance indicates that the four (4) treatments (moon phases) did not catch equal weights of fish. At new moon phase, more weight of fish was caught 10202.47kg, (F-test<0.05, 0.01) than the other three treatments.

**Table 2: Total and mean weights (kg) of bonga caught per treatment (moon phases) that was used in f-test analysis (n= 22)**

| Replication | Moonless or new moon | Crescent | Half moon | Full moon |
|---|---|---|---|---|
| 1 | 466.10 | 300.00 | 216.70 | 114.00 |
| 2 | 421.70 | 301.70 | 239.90 | 89.40 |
| 3 | 450.00 | 311.00 | 225.00 | 87.90 |
| 4 | 644.60 | 319.90 | 199.90 | 73.60 |
| 5 | 410.10 | 285.90 | 210.00 | 65.82 |
| 6 | 480.00 | 314.40 | 195.00 | 92.80 |
| 7 | 465.00 | 267.70 | 230.20 | 79.80 |
| 8 | 600.00 | 240.90 | 240.00 | 69.40 |
| 9 | 555.00 | 225.00 | 242.00 | 95.40 |
| 10 | 375.00 | 240.00 | 210.00 | 89.90 |
| 11 | 406.40 | 205.70 | 200.20 | 107.20 |
| 12 | 645.00 | 213.70 | 227.10 | 71.54 |
| 13 | 465.00 | 258.90 | 194.90 | 93.20 |
| 14 | 290.27 | 255.00 | 196.70 | 61.21 |
| 15 | 375.00 | 275.10 | 147.30 | 93.51 |
| 16 | 435.00 | 230.10 | 132.40 | 109.98 |
| 17 | 310.20 | 375.00 | 127.50 | 65.85 |
| 18 | 467.30 | 270.00 | 124.10 | 87.40 |
| 19 | 750.00 | 246.80 | 123.80 | 110.70 |
| 20 | 330.00 | 315.00 | 180.70 | 118.20 |
| 21 | 495.00 | 375.00 | 131.10 | 101.90 |
| 22 | 365.80 | 297.00 | 240.00 | 117.00 |
| **Total** | **10202.47** | **6123.80** | **4134.50** | **1995.71** |
| Grand total of A, B, C and D | | | | 22556.48 |
| Mean | 463.75 | 278.35 | 187.93 | 90.71 |

**Catch per unit effort (CPUE) of bonga gill net:**

Table 3 below is the CPUE of bonga gill net at different moon phases. It showed that fishing during new moon/moonless night is more profitable with CPUE of 3400.82kg per man. The least CPUE of 665.24kg per man was obtained during full moon fishing expedition.

**Table 3: Computation of catch per unit effort of bonga by gill net at different moon phases**

| Moon phases | Total catch (kg) | Fishing effort (f) | CPUE kg/F |
|---|---|---|---|
| New moon or moonless | 10202.47 | 3 | 3400.82 |
| Crescent moon | 6123.80 | 3 | 2041.27 |
| Half moon | 4134.50 | 3 | 1378.17 |
| Full moon | 1995.71 | 3 | 665.24 |

**Haul–to-haul variability:**

The mean weight of bonga caught by four boats in 724 replicate landings was 10712.38± 155.76kg. This implies that each of the four boats caught bonga fish between 10,712.38kg-155.76kg (10556.62kg) and 10,712.38 +155.76kg (10868.14kg). That also means that most of the boats caught fish ranging between 10,556.62kg to 10,868.14kg. The coefficient of variability was computed to be 1.45%, thus indicating a low haul-to-haul variability in the bonga gill net studied, except boat A, the other three boats have closer range of weight of bonga caught (14,333.38kg; 9506.33kg; 9709.60kg; 9,300.22kg). This is shown in table 4 below.

**Table 4: Differences in the Landings of the Four Sampling Boats (Haul-To-Haul Variability)**

| Boats | Weight of bonga (kg) | % Contribution |
|---|---|---|
| A | 14,333.38 | 33.45 |
| B | 9,506.3 | 22.19 |
| C | 9,709.6 | 22.66 |
| D | 9,300.22 | 21.70 |
| **Total** | **42,849.5** | **100%** |
| Mean | 10,712.38 | |

**Discussion**

Artisanal fishermen in Nigeria believe that their catches are influenced by moon or lunar phases, namely newmoon/moonless, crescent shape, half moon and full moon. Because of this belief, fishing within a month is intermittently conducted, with one week of active fishing and another week of passive or no fishing at all. This project substantiate the fishers hypothesis that more fish are caught at moonless/new moon period than full moon. This hypothesis seem to debunk the principles of fisheries optics, in which light is reported by several scientists to attract fish (Ben-Yami, 1988; Niwa, 1992). During day fishing at each of the temporal treatment sunlight is available, influence of moonlight is only at night and artisanal fisheries is mostly conducted at day time, moonlight is therefore not a fishing ground enhancement techniques in artisanal fisheries studied.

During full moon period or spring tide, the three heavenly bodies of the moon, sun and earth lies in linear direction with maximum attractive forces. The gravitational forces at this period is very strong and pull the ocean water, hence water volume in the ocean basin is increased, fishes are scattered randomly and does not concentrate for more capture, hence poor fishing expedition.

Oceanographers have also reported that during new moon or moonless period, the moon and the earth lies at right angles ($90^0$) to the sun (Duxbury, *et al* 2002; Garrison, T., 2004) This implies that the tide generating force is minimal, because the moon and the earth pull different path from the sun and therefore cancelled each other, no reinforcement because the gravitational forces of the moon and the sun are perpendicular to one another with respect to the earth, this is the neap tide period. It is weak and does not pull ocean water, hence water volume is low, fish concentrated for mass and profitable capture and yielded the highest weight of fish (10202.47kg) reported in this study.

The last publication of Federal Office of Statistics showed that bonga fish production in Nigeria marine water decreased from 29537MT in 1995 to 21,688MT in 2007 (FDF, 2007). This redection is as a result of manmade (gear design, and operation) and natural (lunar cycle, water body) factors. Artisanal fishery employs roughly 18 times more fishers than does industrial fisheries and supports the welfare of over 100millions persons worldwide. These figures assume greater significance when the developing countries of the tropics are considered because majority of artisanal fishers live and operate in the tropics (Moses, 2005). Nearly all the production of artisanal fisheries is used for human consumption, and the production from this type of fisheries provides over 40% of the world total supply of food fish (FAO, 1983). However, the success and productivity of this fishery to meet increasing demands for fish and fish products is determined by the influence of factors such as forces of tides, temperature, climate etc. on the water body. These factors are governed by position and orientation of the sun, the moon and the earth (Aidil *et al*, 2005). The effect of these factors is evident as climate condition, ocean current and precipitation affect the distribution of fishes around the earth. Rain affect the behaviour and abundance of fishes. At down pour, the rain create a thin cool layer when the water is warm, this will lure the fishes to the surface. Position and the phase of moon in the sky greatly determine the feeding behaviour of fishes as fishes tend to feed at night during the night of full moon because they have a good view of baitfish and feed at day during the night of new moon. Seasonal changes provides impulse and biological reaction in fish as they await the time to spawn or migrate. Fishes behave differently at different type of tides. They tend to go near the shore on the rising tide as they move towards the shore in search of food which they were unable to reach before. Tide also affect the efficiency of fishing. For example when the tide is stagnant, fishing line could be positioned accurately without it getting drifted away, while at falling tide, it will be drifted back towards shore and not towards the sea, thus not maximizing the chances of getting fish. At high tide boats could be steered into more area thus giving the fisher more ground for fishing. Net casting is efficient during falling tide, because as the tide is falling, the fishes would gather into groups and the smaller fishes would gather nearer to the shoreline. Tidal current helps drift the fishing line and bait away froms the boat, thereby increasing chance of catching fish. At low tide, net casters could study the shore bed for possible types of fish available and with the knowledge of the structure of sea bed and the type of

soil it has, the kind of fishes available there will be predicted (Aidil *et al*, 2005).

**Conclusion And Recommendation**

From this research work, it is evident that fishing expedition or trip is more profitable at new moon or moonless night than other moon phases. Artisans should embark on fishing trip during new moon or moonless night for profitable (in terms of CPUE) and good landings of bonga to meet its increasing demand. It is observed that gill net is more selective and more efficient for bonga fishery, this is evident from 99.8% of bonga caught compared to 0.2% of other species of fishes caught along side with bonga. Variation in weight of bonga caught by the different fishermen in the area is minimal.

It is also recommended that research (2-5 years) should be commissioned to study the effect natural phenomenon (tide, moon phase, current, wave, weather and climate) on artisanal fisheries which is more vulnerable to these factors than industrial fisheries. And also more research should be carried out on profitability and good landings of other commercially important species in relation to moon phases.

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3/31/2018