Research Journal of Environmental and Earth Sciences 4(11): 945-952, 2012
ISSN: 2041-0492

Submitted: July 07, 2012 Accepted: August 28, 2012 Published: November 20, 2012

# Effects of Water Pollution on the Condition Factor, Mortality, Exploitation Ratio and Catch per Unit Effort of *Lagocephalus laevigatus* in Koluama Area, Niger Delta Area, Nigeria

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**Abstract:** Effects of water pollution on the condition factor, mortality, exploitation ratio and catch per unit effort of *Lagocephalus laevigatus* in Koluama Area, Niger Delta Area, Nigeria was investigated from April 2012 to May 2012; following an oil blow out in the area. To show the impact of the spill on the environment, catch rates are seasonally dependent and vary between 15-120 kg/day. About 120 wooden canoes were sighted in the communities studied. The canoes are basically in two categories namely, small sized boats of less than 5 m length and medium-sized ones ranging between 5 and 7 m long. There was no temporal variation in the condition of the fish with condition index value ranging from 0.86-1.00 and condition factor value of 0.98. The K value of 0.98 estimated from this study shows that *Lagocephalus laevigatus* from the study area was in extremely poor condition. Total mortality (Z) value was 1.5 yrG1. Natural Mortality (M) value was 0.97; Fishing mortality (F) value was 0.52. Value for the rate of exploitation was 0.35 with corresponding percentage value of 35%. The result shows that *Lagocephalus laevigatus* with an exploitation rate of 0.35 is below the optimal value for sustainable yield, for the exploitation of the fishery. These populations therefore stand the risk of under exploitation if urgent measures are not taken to develop the fishery.

**Keywords:** Koluama area, *Lagocephalus laevigatus*, Niger delta, Nigeria, population parameters, water pollution effects

## INTRODUCTION

Population parameters evaluate the effect of fishing on a fishery as a basis for fishery management decisions (Sissenwine *et al*., 1979). The fundamental models used are based on four parameters: Growth, recruitment, natural and fishing mortality (Ricker, 1975). Age and growth are particularly important for describing the status of a fish population and for predicting the potential yield of the fishery. It also facilitates the assessment of production, stock size, recruitment to adult stock and mortalities (Lowe-McConnel, 1987). Fish mortality is caused by several factors, which include, age (King, 1991); fish predation (Otobo, 1993) environmental stress (Chapman and Van Well, 1978); parasites and diseases (Landau, 1979) and fishing activity (King, 1991). The exploitation rate is an index, which estimates the level of utilization of a fishery. The value of exploitation rate is based on the fact that sustainable yield is optimized when the fishing mortality coefficient is equal to natural mortality (Pauly, 1983). Significant contributions on growth studies have been made by Schaefer (1954), Beverton and Holt (1957), Ricker (1975) and Gulland (1969) among many other scientists, but the studies were concerned primarily with temperate stocks. On the other hand, studies on the population dynamics of tropical fish stock have been limited by the difficulty of ageing tropical fish species, which from the ecological perspective inhabit ‘steady state environment’. The length-weight relationship of fish is an important fishery management tool. Its importance is pronounced in estimating the average weight at a given length group (Beyer, 1987) and in assessing the relative well being of a fish population (Bolger and Connoly, 1989).

Consequently length-weight studies on fish are extensive. Notable among these are the reports of Shenouda *et al*. (1994) for *Chrysichthys* spp from the southernmost part of the River Nile (Egypt); Alfred-Ockiya and Njock (1995) for mullet in New Calabar River, Ahmed and Saha (1996) for carps in lake kapitel, Bangladesh; King (1996) for Nigeria fresh water fishes; Hart (1997) for Mugil cephalous in Bonny Estuary and Diri (2002) for *Tilapia Guinness* in Elechi creek. Following the adoption of Peterson length frequency distribution method for ageing tropical fishes. There have been notable contributions by Longhurst (1964), Gulland (1969) and Pauly (1980) in this area of

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fisheries research. In spite of these efforts, length-weight, Length-breadth, growth, mortality and exploitation rate data on many tropical fish species are still lacking.

Condition factor compares the wellbeing of a fish and is based on the hypothesis that heavier fish of a given length are in better condition (Bagenal and Tesch, 1978). Condition factors decreases with increase in length (Bakare, 1970; Fagade, 1979); and also influences the reproductive cycle in fish (Welcome, 1979). Condition factors of different species of cichlid fishes have been reported by Siddique (1977), Fagade (1978, 1979, 1983), Dadzie and Wangila (1980), Arawomo (1982) and Oni *et al*. (1983). Condition factors reported for some other species include: Alfred-Ockiya (2000) for *Chana* in fresh water swamps of Niger Delta and Hart (1997) for *Mugil cephalous* in bonny estuary.

Age studies of fishes form an important aspect of their biology and relationship with their environment. Lackey and Hubert (1978) observed, that it aids in the productivity, longevity, periods of maturity, recruitment of various year classes and determination of potential yield of fish stock. Information obtained on age could contribute to the optimal, or at least a rational exploitation of a fishery.

The daily life of the people of Koluama in Bayelsa State reflects the daily existence of most people along the creeks and rivers in the Niger Delta. It is a life of extreme struggle, with both the vagaries of nature and man-made obstacles. Most times, communities are far removed from another, connected only by the waters that flow along the extensive creeks into the Atlantic Ocean. Since there are no roads, those who live there and want to reach out to their neighbors, go to market or go fishing, must necessarily move on water, by means of slow-moving dug-out canoes, while some of the more illustrious citizens are able to make use of posh speed-boats for their daily endeavors. Koluama 1 and 2 are part of the eight communities in the State affected by the blowout of gas facility owned by Chevron in January, this year, the others being Ezetu I, Ezetu II, Furoupa, Fish Town, Sangana and Ekeni, with a combined population of about 30,000 people. Access to the communities from Yenagoa, the state capital, takes two and half hours ride by speedboat through the creeks. For other boats, the time can be much longer. The journey can be particularly frightening, especially for non-natives not used to water. For the indigenes, there is nothing to worry about as far as riding the waves is concerned. Life in the waters is normal for them. It is a way of life that they were born into.

In the beginning, in spite of the distances they had to cover in the waters, there was peace, harmony and understanding with nature. But things have been drastically altered, especially with the activities of the oil prospecting companies and their manner of operation in the area. They make good money but are hardly interested in giving back to the communities. It is now common to find oil floating on the creeks, not necessarily from the activities of the oil majors but from the enterprise of Niger Delta indigenes who have established local petroleum refineries along the banks of the rivers and creeks. The base of the mangrove forest bordering the creeks is colored by moulds of oil which will require an unprecedented effort to restore to their natural state. The people burst oil pipelines buried by the oil majors and cause spills in an attempt to siphon the crude for illegal bunkering activities and refine some to dispose of at the readily available markets. The business is risky but who cares? How can oil pipelines pass through their houses and they do not benefit from their content? That is what they seem to think.

Many people do not see how the risky bunkering and illegal petroleum refining and, consequently, the degradation on the creeks, can be stopped in the Niger Delta because of the number of people involved on the one hand and the perceived complicity of the Joint Task Force (JTF) stationed in the area on the other. Apart from the inadequate knowledge of the creeks where the business thrives, the JTF operatives are said to be more interested in extorting money from those in the bunkering and illegal petroleum refining than checking their economic sabotage. Therefore, all along the route to Koluama, thick smoke rises at various positions on the river banks, indicative of the existence of local refineries where business is booming.

Koluama community gained added prominence on the January 16 this year when the Chevron gas facility at its Atlantic Ocean backward exploded, shaking the very foundation of the structures in the community (Plate 1). The blowout released harmful gas into the atmosphere and caused a huge conflagration that burnt in the sea, with concomitant disaster to the aquatic life. The cries of the people for remedy to their plight attracted President Good luck Abele Jonathan who, last Monday, personally undertook an aerial inspection of the affected gas platform in the sea and later met with members of the communities.

Chevron Rig fire search call off for 2 missing workers Daily Time Nigeria. Article | January 20, 2012- 11:07 am | by from the wires

A spokesman of the eight communities affected, Hon. Namibia Yawed, painted a gloomy picture of the disaster to the president, narrating how the incident occurred and how the inhabitants of the area had been neglected by Chevron, the owner of the facility and government. According to him, in the early hours of Monday January 16, 2012, the residents heard a loud explosion from the K.S. Endeavour (Panama) Rig where Fade Drilling Limited, a company contracted by

Plate 1: Chevron gas rig explosion in Koluama communities in the early hours of Monday January 16, 2012

Chevron Nigeria Limited was drilling gas at the North A poi Field, west of Funiwa Field, Koluama Clan about 5 nautical miles from the Koluama communities in Southern I jaw Local Government Area of Bayelsa State. The explosion resulted into a huge gas fire and a massive spill.

The huge flame in the sea which was visible could be sighted from the Koluama River burning uncontrollably and emitting dangerous gases and other toxic chemicals into the environment. The Koluama River directly empties into the Atlantic Ocean and as such, the polluted water is carried into the Koluama Rivers and Creeks and other neighboring communities in the coast line. Yawed told the President that the massive explosions shook the foundations of houses in Koluama 1, Koluama 2, Kalaweiama, Opuama, Tamazo, Kiriseighegbene, Abiakiawei and Lobia, among other communities in the Koluama Clan, saying that "we are worried about this development because it was explosions in the course of seismic activities by Shell Diarchy while exploring for oil and gas in the same area that led to the wiping away of ancient Koluama in 1953."

He emphasized that with this incident, the air space and the ocean had been seriously polluted and the current was carrying the dangerous gases and chemicals into the rivers and creeks of the communities within the coastal areas where the incident occurred. The aquatic or marine life has been adversely affected and dead fishes could be seen floating on the water in the ocean, shore, creeks and rivers of the coastal communities in the area. Dark colored pollutants have been seen spreading on the surface of the ocean from the first day and have been impacting seriously on the people and the coastal shoreline. The health implications of this are no doubt overwhelming, he remarked, as the gases released into the environment such as carbon monoxide, sulphur dioxide, etc, most of which are acidic gases, have wide-ranging implications on the populace. The former lawmaker spoke of incidents of various forms of ailments including vomiting, stomach pains, difficulty in breathing, acute asthma, etc., resulting in a couple of deaths which had been reported, stating that people had been moving out of the communities for the fear of the unknown.

In spite of the dangers associated with the situation, no assistance has so far gone to the people. That is why, he said, they were very angry with Chevron which they believed had demonstrated stark insensitivity to their plight. "We therefore feel insulted by the claim of Chevron that the gases emitted from the blowout which burnt were not harmful to human and the environment. We really feel insulted by this claim because if these gases were not harmful, Chevron could not have immediately evacuated its personnel from its oil facilities around the scene of the accident. The above claim was not only inciting but was aimed at preventing the victims of this unfortunate incident from taking drastic actions against the company," the community spokesman added.

They have now put up a list of demand before the President, including shore protection and embankment, reclamation and sand filling of land, canalization, provision of functional health facilities, implementation of the Bayelsa Central Senatorial road/coastal Ring road, provision of concrete walk ways, provision of potable water, quality education for their people and employment, especially with the multinational oil companies operating in their areas. The Managing Director of Chevron, Mr. Andrew Fawthrope, who was present at the occasion, appeared to be loss for words following the bashing he received from the community and managed to say that the blow-out was dying out down to about 3,000 ft and progressing to put the fire out. While appreciating the community as well as staff of Chevron, he spoke of what seemed to the community like a token effort to provide medical assistance, saying that "there will be some community work going on with medical works starting from Wednesday to improve the quality of life."

The Group Managing Director (GMD) of the Nigerian National Petroleum Corporation (NNPC), Mr. Austen Oniwon, remarked that the rig that exploded was one dedicated to gas, adding that though the incident happened, the Corporation would not be discouraged. "It was an accident. We believe that we have learnt a lot of lessons from it. Immediately it happened, we tried everything possible to control and contain it," he said. Oniwon revealed that there were 154 people on the rig when the incident occurred out of which two, a Frenchman and an Indian lost their lives and their corpses never found. He explained that "because it is a blow-out, it is very difficult to quench the fire, but what we are doing now is to drill another well to try and reach the hole and then block it." Oniwon acknowledged that the communities had been "very magnanimous and very patient with us", saying, "in spite of all the devastation the oil spill would have caused them, they have not taken to the streets to demonstrate."

In his remark, the governor of the state, Seriake Dickson, noted that while the people do not have any problem with the exploitation of oil to sustain the national economy, they however want the oil companies to respect the fragile environment of the area as he observed that what happened in these communities was a common occurrence which the people of the Niger Delta had been contending with. “Mr. President, as we all know, what has happened in Koluama is a very familiar event; it is the same story in the Niger Delta, the same story of sacrifice, the same story of inconveniences, the same story of living with risks day by day to be able to produce the mainstay of the economy of our great country.

What has happened in Koulama is the same story in all our communities, countless communities, villages and settlements in Bayelsa State, the Ijaw nation and across the Niger Delta. We have no problem producing what has become the mainstay of our economy but the least we can ask from Mr. President is respect for our environment, protection of our very fragile ecosystem,” he declared. Dickson was however furious with the people who burst oil pipelines for the sake of bunkering and illegal refining, stating that his government had set up a task force to try to fight the ugly situation. After listening to the people, President Jonathan promised the provision of relief materials and compensation to those affected, assuring the people of government's commitment to tackling environmental management issues, not only in the Niger Delta but also in the extreme north of the country where he observed there was desert encroachment. Jonathan added that the federal government would collaborate with Bayelsa State government and Chevron to provide relief materials for the people and noted: “In terms of other demands that have been documented, I noticed that many issues have been raised and these are issues we are quite conversant with. I can assure you that we will look into it, the company, the state government and the federal government will continue to address them."

The President told the people that "communities impacted must have some relief, some compensation. That is obvious but the quantum will depend on studies that have been carried out by the company and the federal government," adding that "on my own part, I will reassure you that the federal government is totally committed to the issues bordering on environmental management, from the Niger Delta to extreme north where we have desert encroachment." Besides what Chevron and other government agencies would do, he assured that the federal government through the National Emergency Management Agency (NEMA) would provide some of the relief materials sought by the communities. A study of the effects of water pollution on the condition factor, mortality, exploitation ratio and catch per unit effort of *Lagocephalus laevigatus* in Koluama Area, Niger Delta Area, Nigeria will indicate its impact on the environment.

## MATERIALS AND METHODS

The effects of water pollution on the condition factor, mortality, exploitation ratio and catch per unit effort of *Lagocephalus laevigatus* in Koluama Area, Niger Delta Area, Nigeria from April to May, 2012 to determine its impact on the environment. A total of seven sampling stations were established: Foroupa (N4 36.004 E5 39.128); Ekeni (N4 41.659 E5 34.451); Ezetu 2 (N4 43.333 E5 34.640); Koluama 1 (N4 28 433 E5 46.248); Kuluama 2 (N4 25.805 E5 49.582); Fish Town (N4 24.642 E5 51.128) and Ikebiri fishing port (N4 30.374 E5 50.298). Replicate samples were collected and the mean used for further analysis. Fish specimens were obtained from fishers using gill nets, long lines, traps, stakes and local fishponds. Catches were isolated and conveyed in thermos cool boxes to the laboratory. Fish families were identified using monographs, descriptions checklist and keys (Boeseman, 1963; Reed *et al*., 1967; Holden and Reed, 1972; Poll, 1974; Whyte, 1975; Jiri, 1976; Reed and Syclenham, 1978; Otobo, 1981; Alfred-Ockiya, 1983; Whitehead, 1984). Total length and weight of the fish specimens were measured to the nearest cm and g respectively, to obtain the required data. His weight of each fish was obtained after draining from the buccal cavity and blot drying samples. Age was estimated from the length frequency distribution plot using six hundred fish specimens (600), following the integrated Peterson method (Pauly, 1983). The diagram was repeated six times along the time axis and a single continuous growth curve was flitted. The relative age (in years) and the corresponding modal lengths were determined from the plot. Total length and weight of fish specimens were measured to the nearest cm and g respectively, to obtain data on the length-weight relationship. Length-weight and length-breadth relationship of fish specimens were determined using the exponential equation (Roff, 1986):

$$W = al\ b \qquad (1)$$

where, b is an exponent with a value nearly always between 2 and 4, often close to 3. The value b equals to 3 indicates that the fish grow symmetrically or isometric ally (provided its specific gravity remains constant). Values other than 3 indicate algometric growth: If b>3, the fish becomes heavier for its length as it grows larger. The methods used to obtain the growth parameters of the Von Bertalanffy’s Growth Formula (VBGF) were: Ford Walfored plot: Lt+1 were plotted against Lt where Lt+1 are lengths separated by a year interval. The value of Lt at the point of interception of the regression line with the 450 lines gave $L\infty$.

Graphs of length and weight increment ▲L at age against the original length Lt and Wt. The degree of association between the length and weight was expressed by a correlation coefficient “r”. The correlation coefficient could take values ranging between -1 and +1. When “r” is negative, it means that one variable tends to decrease as the other increases; there is a negative correlation (corresponding to a negative value of ‘b’ in regression analysis). When r is positive, on the other hand, it means that the one variable increases with the one (which corresponds to a positive value of b in regression analysis) (Pauly, 1983).

However, whether the correlation that was identified could have arisen by chance alone, the ‘r’ value was tested for ‘significance’. That is, whether the (absolute) value of “r” was higher than or equal to a critical value of “r” as given in a statistical table. Length-breadth relationship was determined using:

$$M = a\,(TL)\,j \tag{2}$$

where,
a = Initial growth constant
J = Growth rate exponent
TL = Total length of fish

Both coefficients were determined by least square regression analysis after logarithmically transforming all data into the from:

$$\text{Log } M = \text{Log } a + J \log TL \tag{3}$$

If J = 1.0 then M growth rate is constant and equal to the initial growth consistent (isometric growth), otherwise there is a negative (J<1.0) or positive (J>1.0) algometric growth.

Length performance index was estimated from the equation (Pauly and Munro 1984):

$$\text{Ø} = \text{Log } k + 2 \log l\infty \tag{4}$$

where,
k & l∞ : Parameters of VBGR

Growth performance index Ø1 was estimated from the equation (Pauly and Manro, 1984):

$$\text{Ø}1 = \text{Log } k + 0.67 \log W\infty \tag{5}$$

where,
k : A parameter of VBGR
W∞ : The mean weight of very old fish

The points at which the growth curve cuts the length axis on the sequentially arranged time scale gave the length at age counted from the origin. The estimation was derived from Pauly (1983). The total mortality coefficient (Z) was estimated from the formula given by Pauly (1983):

$$Z = \frac{nk}{(n+1)(L\infty - 11/L\infty - I)} \tag{6}$$

where,
n = Number of fish in computing the mean length T
1’ = Smallest of fish that is fully represented in the catch
K & L∞ = Parameters of the VBGF

An independent estimate of Z was obtained from the Hoeing formula in Ehrhardt *et al*. (1975):

$$Z = 1.45 - 1.01\ T\max \tag{7}$$

where,
T max = Longevity (years)

Natural Mortality coefficient (M) was estimated from Taylor’s formula in Ehrhardt *et al*. (1975):

$$M = 2.995To + 2.9975K \tag{8}$$

Fishing mortality coefficient (f) was estimated as:

$$E = Z - M \quad \text{(Gulland, 1971)} \tag{9}$$

The exploitation ratio was estimated using the formula:

$$E = F/Z \quad \text{(Gulland, 1971)} \tag{10}$$

The Condition Factor (CF) was calculated from the expression:

$$CF = \frac{100W}{L3} \tag{11}$$

where,
W = The fresh body weight in (g)
L = Total length in cm

## RESULTS

The condition index values and factor of *Lagocephalus laevigatus* from the study area are shown in Table 1 There was no temporal variation in the condition of the fish with condition index value ranging from 0.86-1.00 and condition factor value of 0.98.

Table 2 shows the estimated mortality and exploitation value, of *Lagocephalus laevigatus*. Total mortality (Z) value was 1.5 yrG1. Natural Mortality (M) value was 0.97; Fishing mortality (F) value was 0.52. Value for the rate of exploitation was 0.35 with corresponding value of 35%.

Table 1: Condition index values and factors of *Lagocephalus laevigatus* from the study area

| Fish species | Condition index value | Condition factor |
|---|---|---|
| *Lagocephalus laevigatus* | 0.96-1.00 | 0.98 |

Table 2: Estimated mortality and exploitation values of *Lagocephalus laevigatus* from the study area

| Fish species | Total mortality Z yrG1 | Natural mortality M yrG1 | Fishing mortality E yrG1 | Exploitation rate | E% |
|---|---|---|---|---|---|
| *Lagocephalus laevigatus* | 1.5 | 0.97 | 0.52 | 0.35 | 35 |

**Fishing/catch-per-unit effort:** Fishing effort is defined by the population in the fisheries and the gear deployed. During the study, about 120 wooden canoes were sighted in the communities studied. The canoes are basically in two categories namely, small sized boats of less than 5 m length and medium-sized ones ranging between 5 and 7 m long. Catch-per-unit of effort relates to quantity of catch in kilograms that could be obtained by is defined fish effort in a unit time. Catch rates are seasonally dependent and vary between 15-120 kg/day.

## DISCUSSION

The condition factor is an estimation of the general well being of fish (Oni *et al*., 1983). It is based on the hypothesis that heavier individuals of a given length are in better condition than les weightier fish (Bagenal and Tesch, 1978). Condition factors have been used as an index of growth and feeding intensity. Bagenal and Tesch (1978) posted that condition factors of different populations of same species is indicative of food supply and timing and duration of breeding. Pauly (1983) reported that the numerical magnitude of the condition factors can be influenced by factors such as:

- Sex
- Time of year
- Stage of maturity
- Stomach content of the organism

Comparisons therefore could be meaningful if these factors are roughly equivalent among the samples to be compared. The condition factor of a fish decrease will increase in length (Bakare 1970; Fagade, 1979) and also influences the reproduction cycle in fish (Welcome, 1979). The length weight relationship of a fish is an important fishery management tool. Its importance is pronounced in estimating the average weight at a given length group (Beyer, 1987) and is assessing the relative well-being of a fish population (Bolger and Connolly, 1989). It is advantageous to use two measurable and convertible sizes of fish for estimating the condition factors. In 1902, Fulton proposed the use of a mathematical formula that would quantify the condition of fish:

$$K = \frac{10^N W}{L^3}$$

where,

K = The condition factor or coefficient of condition often simply referred to as the k factor

W = The weight of the fish in grams (g)

L = The length of the fish in millimeters (mm)

N = Five, having weighed and measured thousands of fishes

The value of K is influenced by age of the fish, sex, season, stage of maturation, fullness of gut, type of food consumed, amount of fat reserve and degree of muscular development. In some fish species, the gonads may weigh up to 15% or more of the total body weight. With females, the K value will decrease rapidly when the eggs are shed. The K value can be used to assist in determining the stocking rate of trout in particular water. If the K value reaches an unacceptably low level in water which is totally or partly dependent on stocking, the stocking rate can be reduced accordingly until the K value improves and reaches an acceptable level. On the basis of comparison of the K value with general appearance, fat content etc., the following standards have been adopted:

- Excellent condition, trophy class fish (1.60)
- A good, well proportional fish (1.40)
- A fair fish, acceptable to many anglers (1.20)
- A poor fish, long and thin (1.00)
- Extremely poor fish (0.80)

The K value of 0.98 estimated from this study shows that *Lagocephalus laevigatus* from the study area was in extremely poor condition.

Variation in catch per unit effort of fishers in different water bodies could be attributed to the productivity of the study area. The study area is an estuary (brackish water) which opens up to the Atlantic Ocean hence higher productivity is expected. The catch per unit effort per fisher in the study area explains the living standard of people. The fisher density of three persons per square kilometer was low compared to the fisher density of 9 persons/km$^2$ reported by Sikoki and Hart (1999) in the Brass River. Henderson and Welcome (1974), recommended a density of 2 fishers/km$^2$. The variation in the total estimate values of the study area from elsewhere could be attributed to differences in fishing and industrial activities in the different rivers. The reason for the low estimates in the study area could be as a result of high mortality of both juveniles and brood stock of various fish species as a result of predatory activities and environmental degradation which is typical of the study area. A similar remark was made by, Ssentengo *et al*. (1986). Satia

(1990) also noted the controversy surrounding fish production statistics. In the study area, much of the problem hampering the acquisition of reasonably accurate fisheries statistics and resource appraisal appear to stem mainly from lack of, or inadequate investment and lack of trained personnel to handle data collection.

The exploitation rate assesses if a stock is over fished or not, on the assumption that optimal value E (E opt) is 0.5. The use of E or 0.5 as optimal value for the exploitation rate is based on the assumption that the sustainable yield is optimized when F = M (Gulland, 1971). The result shows that *Lagocephalus laevigatus* with an exploitation rate of 0.35 is below the optimal value for sustainable yield, for the exploitation of the fishery. These populations therefore stand the risk of under exploitation if urgent measures are not taken to develop the fishery.

## CONCLUSION

- The K value of 0.98 estimated from this study shows that *Lagocephalus laevigatus* from the study area was in extremely poor condition.
- *Lagocephalus laevigatus* from the study area with an exploitation rate of 0.35 is below the optimal value for sustainable yield, for the exploitation of the fishery.
- These populations therefore stand the risk of under exploitation if urgent measures are not taken to develop the fishery.

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