STOCK ASSESSMENT AND POPULATION DYNAMICS OF SENEGAL JACK, *CARANX SENEGALLUS* CUVIER, 1833, FROM INDUSTRIAL FISHERY OF COTE D'IVOIRE (WEST AFRICA)

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ABSTRACT

Monthly data of *C. senegallus* length composition, was recorded from the continental shelf of Côte d'Ivoire from March 2016 to February 2018. The population parameters such as length-frequency distribution, length-weight relationship, growth, mortality, exploitation ratio and length at first capture of this species were investigated to get information for effective management of this fish, by applying Beverton and Holt (1957), virtual population analysis (VPA), using the FISAT Tool II. The length-frequency distribution of 804 samples showed polymodal distribution. The folk length ranged from 16.10 to 47.00 cm with a mean equal to 25.68 ± 0.23 cm. The statistical analysis shows that the combined sexes ("b" = 2.9793), and male ("b" = 3.0199) growth is isometric. However, female ("b" = 2.9489) growth is negative allometric. The estimated growth parameters were: FL_∞ = 51.45 cm, K = 0.46 $year^{-1}$ and t_0 = -0.31 $year^{-1}$. The length at first capture was 19.04 cm (FL). The current exploitation rate (E = 0.33), was lower than the optimum level (E = 0.36). VPA indicate that the fish which die by natural mortality are higher than those which die by fishing mortality. These results show that the current stock of *C. senegallus* is not overexploited.

Keywords: Carangidae, *Caranx senegallus*, Stock, Population parameters, Fishery

RESUME

GESTION DES STOCKS ET DYNAMIQUE DES POPULATIONS DU CARANGUE DU SÉNÉGAL, CARANX SENEGALLUS *CUVIER, 1833, DE LA PÊCHE INDUSTRIELLE DE CÔTE D'IVOIRE (AFRIQUE DE L'OUEST)*

Les données mensuelles sur la composition en taille de C. senegallus*, ont été enregistrées sur le plateau continental de la Côte d'Ivoire entre mars 2016 et février 2018. Les paramètres de population tels que la distribution des fréquences de taille, la relation longueur-poids, la croissance, la mortalité, le taux d'exploitation et la taille de première capture de cette espèce ont été étudiés pour obtenir des informations permettant une gestion efficace du stock de ce poisson, par la méthode de Beverton et Holt (1957) et l'analyse de population virtuelle, grâce au logiciel FISAT II. La distribution des fréquences de taille de 804 individus a montré une distribution polymodale. La longueur à la fourche variait de 16,10 à 47,00 cm avec une moyenne égale à 25,68 ± 0,23 cm. L'analyse statistique montre que la croissance des sexes combinée ("b" = 2,9793) et des mâles ("b" = 3,0199) est isométrique. Tandis que, la croissance des femelles ("b" = 2,9489) est allométrique négative. Les paramètres de* *croissance estimés ont été les suivants : FL* ∞ *= 51,45 cm, K = 0,46 an*$^{-1}$ *et* t_0 *= - 0,31 an*$^{-1}$*. La longueur à la première capture a été de 19,04 cm (FL). Le taux d'exploitation actuel (E = 0,33), était inférieur au niveau optimal (E = 0,36). L'Analyse des Populations Virtuelles indique que les poissons qui meurent par mortalité naturelle sont plus élevés que ceux qui meurent par mortalité par pêche. Ces résultats montrent que le stock actuel de* C. senegallus *n'est pas surexploité.*

Mots clés : *Carangidae,* Caranx senegallus*, Stock, Paramètres des populations, Pêcherie*

INTRODUCTION

Caranx senegallus is marine, brackish water and benthopelagic fish (Sanches, 1991). It inhabits coastal waters (Schneider, 1990) in west coast of Africa, from Mauritania to Southern Angola (Bauchot, 2003). *C. senegallus* occurring from the surface to at least 90 m depth (perhaps even to 200 m) (Smith-Vaniz *et al*., 2015). This species is reported within *Caranx* species and are mainly caught in the inshore fishery using trawl fleet in industrial fisheries and purse-seines in artisanal fisheries in Côte d'Ivoire. Ivoirian fish production in 2012 tripled compared to the previous year in the trawl fishery (DAP, 2014). However, without rational fisheries management, production could decline. Therefore, for effective sustainable management of fish stocks, it is important to know all the fish exploited in ivorian continental shelf, especially *C. senegallus*. There are many tools for assessing the exploitation level and stock status. FISAT (FAO-ICLARM Stock Assessment Tools) has been most frequently used for estimating population parameters of different fish species (Al-Barwani *et al*., 2007). Despite its wide geographical distribution and its commercial value, few studies on stock assessment and population dynamics of this species have been conducted in West Africa.

Data on population parameters aspects in West Africa waters are very scarcely or no; but *C. senegallus* specie were identified in certain studies such as the study of Faye (2015) on recovering effects on fish assemblage functional diversity of Bamboung protected area (Senegal, West Africa) and that of Sylla *et al*. (2016) on the spatial distribution of coastal fish assemblage in Côte d'Ivoire. To date there is no information published on population dynamics of *C. senegallus* in Côte d'Ivoire. Knowledge of various population parameters such as asymptotic length (L ∞), growth coefficient (K), mortalities (natural and fishing) rate and exploitation level (E) are necessary for planning and management fish resources (Sylla *et al*., 2017). According to Nasser (1999), population dynamics of fishes are studied with the major objective of rational management and conservation of the resource. Due to the demand and the limited biological information for this species, the present study on population dynamics of *C. senegallus* was conceived for providing requisite information for the sustainable management of this resource.

MATERIALS AND METHODS

STUDY AREA AND SAMPLING PROTOCOL

The Ivorian oceanic zone is bordered to the north by the Gulf of Guinea shoreline stretching from the Cape Palmas (7°30W) and the Cape Three Points (2°W) (Figure 1). The shoreline is 550 km long with a narrow continental shelf of 10, 200 km² and is characterized by a series of sandy beaches forming a wide arch opened to the Atlantic Ocean (Le Loeuff & Marchal, 1993). It is influenced by two marine seasons: The cold season start from January to February and then from July to September. However, the warm season is extending from March to June and November to December (Djagoua, 2003). According to Colin (1988), the coastal upwelling occurs seasonally along the shoreline from July to October which is the major event and from January to February (the minor event). Senegal jack specimens come from the industrial bottom trawlers catches, caught along the coast of Côte d'Ivoire. Those specimens were collected from March 2016 to February 2018 in continental shelf of Côte d'Ivoire fishery at the fishing harbour of Abidjan through the industrial fishing carried out by trawlers.

The total and fork lengths of 804 individuals of species were measured to the nearest 0.1 cm. And then total body weight of each specimen to the nearest 0.1 g was determined using a weighing balance (Sartorius electronic model) after excess water on each has been drained with filter paper. The length measurements were grouped into 1 cm class intervals to make monthly length distribution.

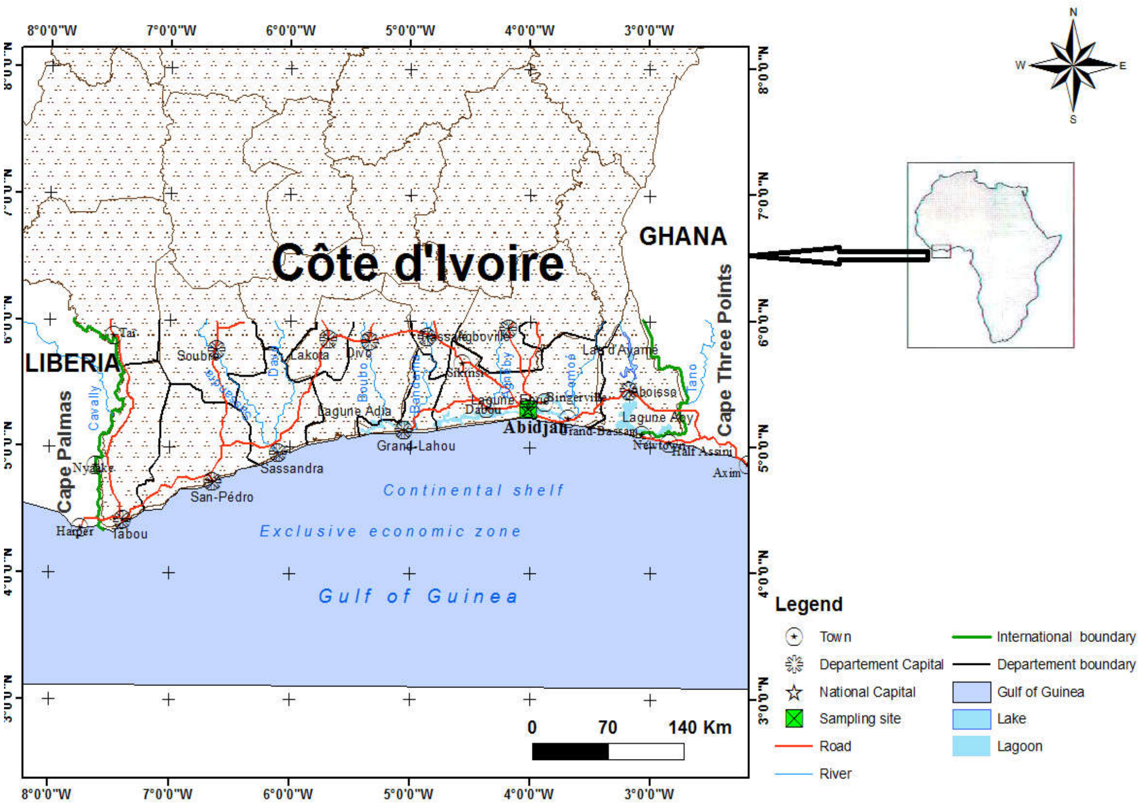


Figure. 1: Map showing the sampling zone (Continental shelf of Côte d'Ivoire).

Carte montrant la zone d'échantillonnage (plateau continental de la Côte d'Ivoire).

DATA ANALYSIS

Length-frequency distribution

The fishes were grouped into different size classes of 1cm interval. And then, the percentage frequency and fork lengths were used for the length frequency distribution.

Length-weight relationship

The fork length and body weight of fish were used for the length-weight relationship. The length-weight relationship was estimated using regression equation of Pauly (1983):

$$W = a \times FL^b \quad (1)$$

where W = total body weight of fish (g), FL = fork length of fish (cm), "a" = regression constant,"b" = regression coefficient; it's also allometric growth coefficient.

The association degree between Length–Weight variables was calculated by the correlation coefficient (R^2) and its statistical significance level was estimated (Santos *et al.*, 2002). The values of constant "a" and "b" were estimated using the least-square method applied to the log transformed data (Ricker, 1973) as:

$$logW = \log a + b \times \log FL \quad (2)$$

If b = 3, it means that the growth is isometric and when b $\neq$ 3, the growth is allometric (negative allometry if b < 3 and positive allometry if b > 3). All the statistical analyses were considered at significance level of 5% ($p < 0.05$). For this species, the length-weight relationship for all individuals grouped, males and females are determined.

Growth parameters

To estimate the von Bertalanffy growth (VBG) parameters (L_∞, K and t0) of *C. senegallus*, Von Bertalanffy Growth Formula (Sparre and Venema, 1998) was used by means of ELEFAN-

I routine of FAO ICLARM Stock Assessment Tools II (FiSAT II) (Gayanilo *et al.* 1996), expressed as:

$$FL_t = FL_\infty(1 - e^{-K(t-t_0)}) \quad (3)$$

Where, FL_t is the predicted length at age t; t_0, the theoretical age at length zero; FL ∞, the asymptotic length; and K the growth coefficient.

The t_0 value estimated using the empirical equation of Pauly (1979):

$$log_{10}(-t_0) = -0.392 - 0.275 log_{10} FL_\infty - 1.038 log_{10} K \quad (4)$$

The growth performance index (φ') of *C. senegallus* population in terms of length according to the method of Pauly and Munro (1984) was compared as:

$$\varphi' = log_{10} K + 2 log_{10} FL_\infty \quad (5)$$

Maximum age (tmax) according to Pauly (1983) was estimated as:

$$tmax = \frac{3}{K} + t_0 \quad (6)$$

Determination of length at first capture (FLc)

The mean fork length at first capture (FLc or FL50%) defined as the mean fork length at which 50% of the fish entering the gill nets were caught. It was estimated by the procedures of Pauly (1984) and Sparre and Venema (1992); it was determined by using the equation of Beverton and Holt (1957):

$$FL_C = \frac{FL - K(FL_\infty - FL')}{Z} \quad (7)$$

Where: FLc is the length at first capture, FL' is the mean length of fish in the catch sample, FL ∞ and K are parameters of the von Bertalanffy growth equation and Z is the instantaneous mortality rate.

Mortality parameters and exploitation rate

The natural mortality (M) was estimated using the empirical equation of

Pauly (1980) as follows:

$$log_{10} M = -0.0066 - 0.279 log_{10} FL_\infty + 0.6543 log_{10} K + 0.4634 log_{10} T \quad (8)$$

Where, T is the mean annual temperature of surface water (being 26°C in this case).

Fishing mortality (F) was obtained by subtracting M from Z and exploitation rate (E) was estimated using the Beverton and Holt's equation (Gulland, 1971) as:

$$E = \frac{F}{Z} \quad (9)$$

Estimation of relative yield and biomass per recruit

According to Beverton and Holt (1957), the relative yield per recruit (Y'/R) and biomass per recruit (B'/R) were estimated using the Knife-edge methode:

$$\frac{Y'}{R} = EU^{M/K}[1 - \left(\frac{3U}{1} + m\right) + \left(\frac{3U^2}{1} + 2m\right) - (\frac{U^3}{1} + 3m)] \quad (10)$$

Where: $: m = \frac{1-E}{\frac{M}{K}} = K/Z \quad (11)$

$$U = 1 - (\frac{FL_C}{L_\infty}) \quad (12)$$

$$\frac{B'}{R} = (\frac{Y'}{R})/F \quad (13)$$

RESULTS

LENGTH-FREQUENCY DISTRIBUTION

The folk length of *C. senegallus* (N = 804) collected during March 2016 to February 2018 ranged from 16.10 (65.22 g total weight) to 47.00 cm (1375.5 g total weight) with a mean equal to 25.68 ± 0.23 cm. The length-frequency distribution showed polymodal distribution. The modal size class was [19-20[cm with frequency 15.67% (Figure 2). Three (3) size groups were clearly defined in the continental shelf of Côte d'Ivoire such as: The small size group (38.43%) was represented by specimens measuring 16 to 21 cm total length, medium size (32.34%) included specimens that measured 22-29 cm long and large size (29.23%), included specimens that were within 30-49 cm total lengths.

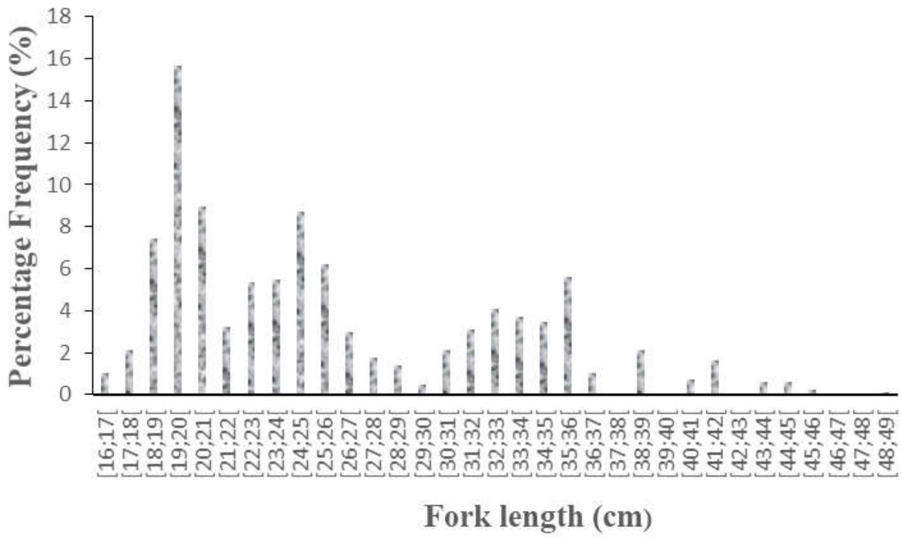
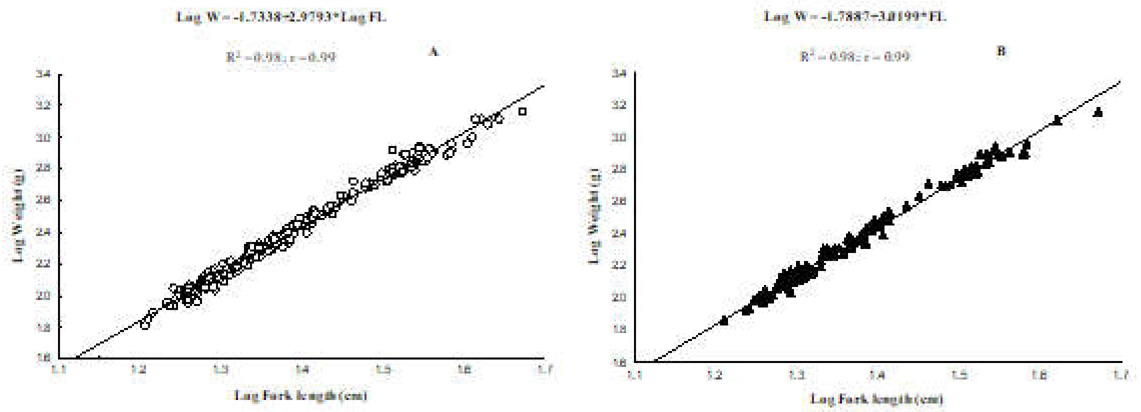


Figure 2: Length frequency distribution.

Distribution des fréquences de taille.

Length-weight relationship

All Length-Weight Relationship of *C. senegallus* were statistically highly significant (P< 0.01). The determination coefficients (R^2) of all population (N = 804), male (N = 391) and female (N = 413) of *C. senegallus* were 0.98, 0.98 and 0.99 respectively. The statistical analysis shows that The "b" value was not different from 3 for combined sexes ("b" = 2.9793) , and male ("b" = 3.0199); therefore the type of growth is isometric (t < 1.96; at p < 0.05). However, "b" value ("b" = 2.9489) of female was statistically different from 3 (t > 1.96; at p < 0.05); so growth is negative allometry (Figure 3).



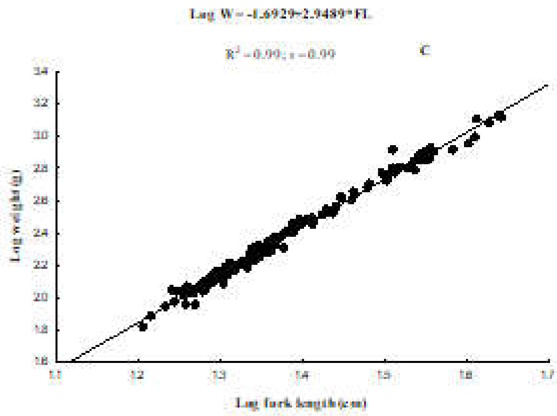


Figure 3: Length - Weight Relationship for combined sexes (A), males (B) and females (C) of *Caranx senegallus* of Ivorian continental shelf.

Relation longueur - poids pour les deux sexes (A), les mâles (B) et les femelles (C) de Caranx senegallus *du plateau continental ivoirien.*

Growth parameters

Von Bertalanffy growth function (VBGF) parameters were estimated ($FL\infty$ = 51.45 cm and K = 0.46 $year^{-1}$) and the age at zero length (t_0) of *C. senegallus* was estimated as -0.31 $year^{-1}$; which gave the von Bertalanffy growth equation for this species as:

$$FL_t = 51.45(1 - e^{-0.46(t+0.307)}) \quad (14)$$

The length-weight relationship was used to convert the asymptotic length ($FL\infty$ = 51.45 cm) to the corresponding asymptotic weight ($W\infty$ = 2322.21 g) (Figure 3). Therefore, the von Bertalanffy equation for growth in weight was described by the following equation:

$$W_t = 2322.21(1 - e^{-0.46(t+0.307)})^{2.978} \quad (15)$$

The growth performance index (φ') was 3.08. It was found that the maximum age (t_{max}) of *C. senegallus* is 6.21 years.

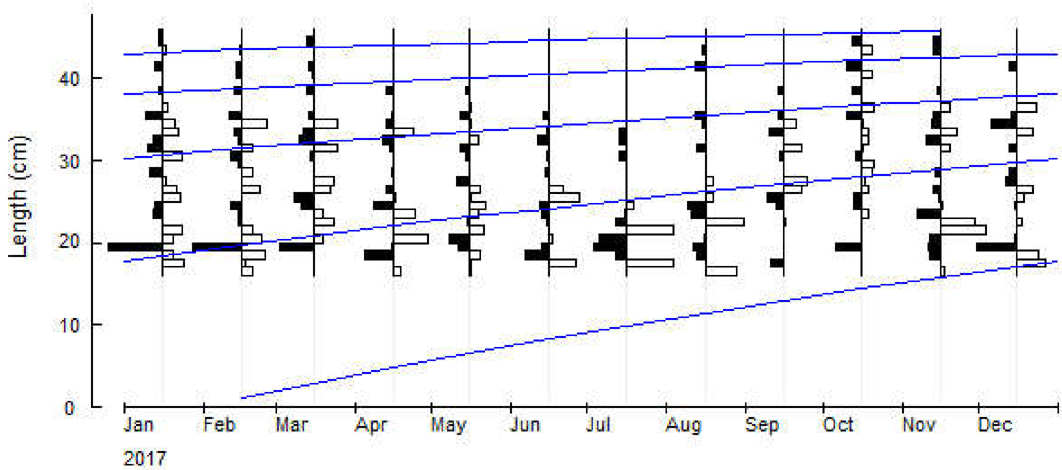


Figure 4: The length-frequency data and the growth curves estimated for *Caranx senegallus* (2017).

Les données sur les fréquences de taille et les courbes de croissance estimées de Caranx senegallus (2017).

Determination of length at first capture (FLc)

The typical selectivity for *C. senegallus* caught by trawl showed that at least 25% of fish of 16.75 cm (FL), 50% of the fish of 19.04 cm (FL) and 75% of all fish of 21.33 cm (FL) were retained by trawl. The length at first capture was 19.04 cm (FL) (Figure 5A; Table 1.).

Mortality parameters and exploitation rate

The total mortality (Z), the natural mortality (M) and the fishing mortality (F) were respectively 1.33, 0.89 and 0.44 year^{-1}. The exploitation rate (E) was 0.33 (Figure 5B; Table 1).

Recruitment pattern

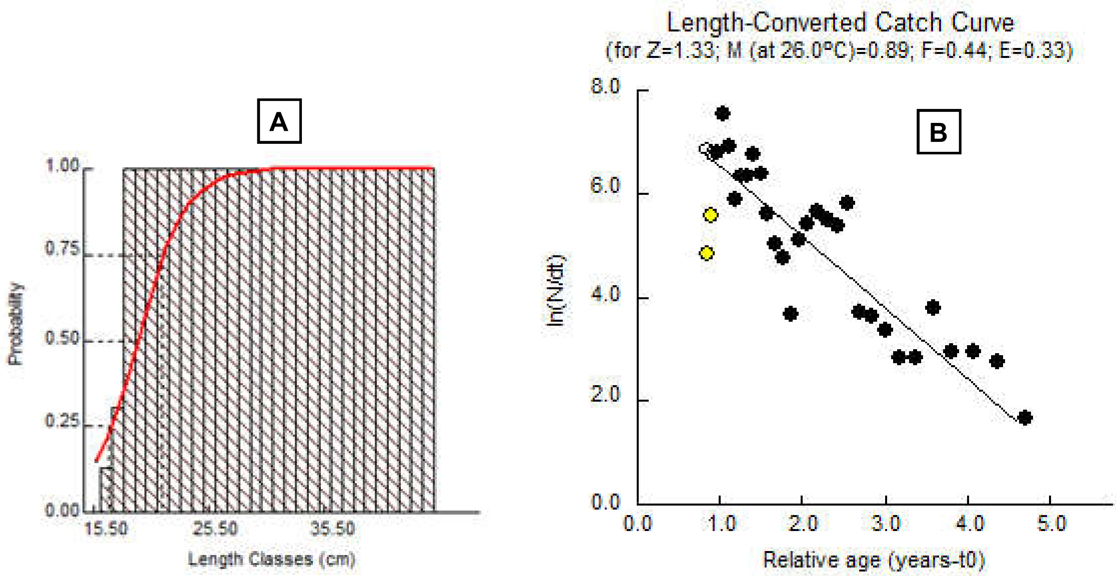
The recruitment patterns exhibited by the fish are shown in Figure 6. Recruitment occurred in almost all months of the year; However, the recruitment was more intense at certain periods than at other. The result in Figure 5C reveal that *C. senegallus* had Two distinct peaks observed during March and August and two peak recruitment periods of January to June and July to December. Recruitment of young fish into the fishery shown that the major pulse is in August (16.11% recruitment); but the minor mode was in June (3.20%).

Virtual population analysis

The virtual population analysis of *C. senegallus* showed that the minimum and maximum fishing mortalities were recorded for the mid-lengths 16.5 and 35.5 cm as 0.06 and 1.84 year^{-1}, respectively (Figure 5D). The mean fishing mortality for the exploited mid-length groups was 0.603 year^{-1}. The fish which die by natural mortality are higher than those which die by fishing mortality.

Estimation of relative yield and biomass per recruit

The relative Y/R and B/R of *C. senegallus* were computed using knife-edge procedure assumptions in FISAT tool II. The maximum exploitation rate (E_{max}) was found to be 0.75 (Table 1). The exploitation rates responsible for 10% ($E_{0.1}$) and 50% ($E_{0.5}$) reduction in the virgin stock were estimated as 0.62 and 0.36 respectively (Figure 5E).



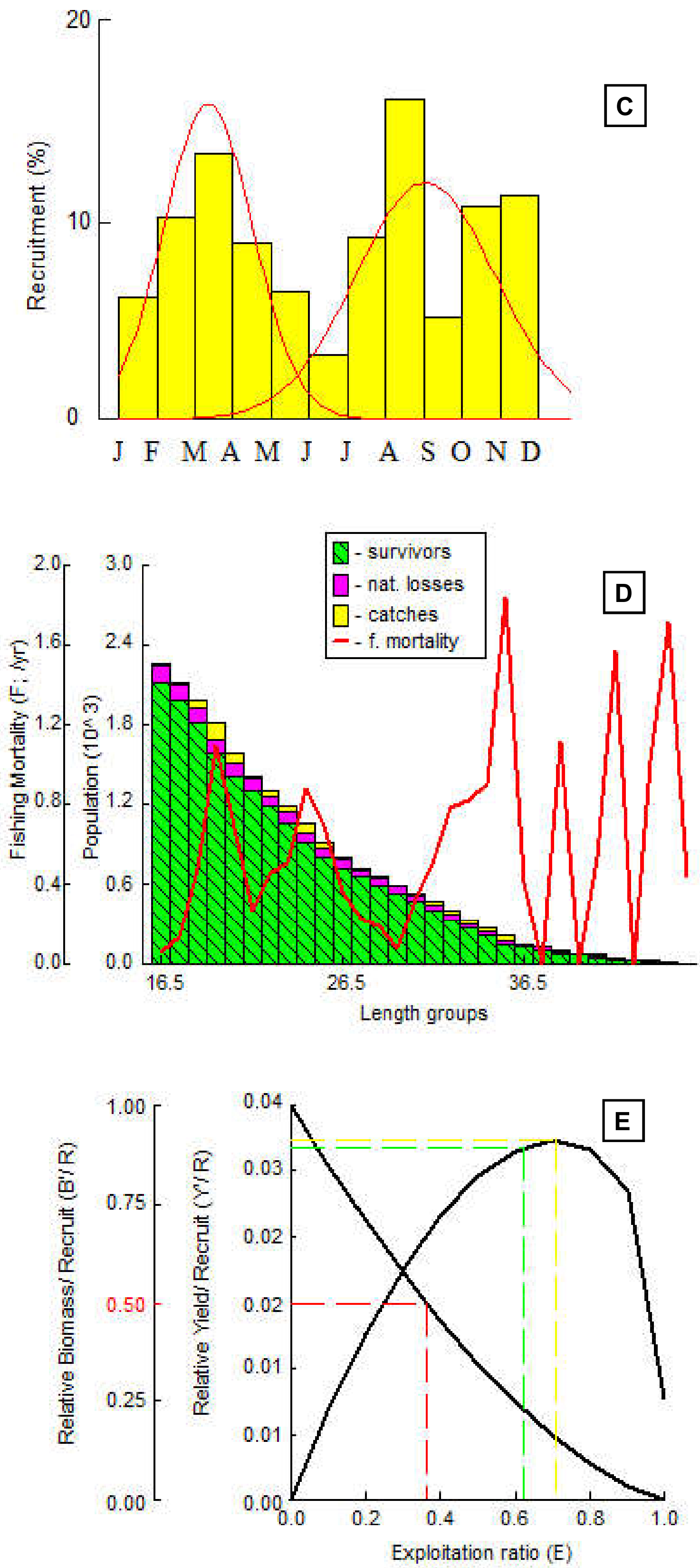

C
Recruitment (%)
20
10
0
J F M A M J J A S O N D
D
- survivors
- nat. losses
- catches
- f. mortality
Fishing Mortality (F; /yr)
2.0
1.6
1.2
0.8
0.4
0.0
Population (10^3)
3.0
2.4
1.8
1.2
0.6
0.0
16.5
26.5
36.5
Length groups
E
Relative Biomass/ Recruit (B'/ R)
1.00
0.75
0.50
0.25
0.00
Relative Yield/ Recruit (Y'/ R)
0.04
0.03
0.02
0.02
0.01
0.01
0.00
0.0 0.2 0.4 0.6 0.8 1.0
Exploitation ratio (E)

Figure 5: A) Probability of capture; B) Length converted catch curve; C) Recrutment pattern; D) Length based virtual population analysis; E) Relative yield per recruit (Y'/R) and biomass per recruit (B'/R).

A) Probabilité de capture ; B) courbe de capture ; C) modèle de recrutement ; D) analyse de la population virtuelle basée sur la longueur ; E) Rendement relatif par recrue (Y '/ R) et biomasse par recrue (B' / R).

Table 1: Estimated population parameters of *C. senegallus* from Continental sheft of Côte d'Ivoire.

Paramètres estimés des populations de C. senegallus *provenant du plateau continental de Côte d'Ivoire.*

Population parameters	*C. senegallus*
Predicted extreme length (FL_{max}) in cm	51.35
Predicted extreme age (t_{max}) in year	6.21
Age at zero (t_0) in year	-0.31
Asymptotic length (FL_∞) in cm	51.45
The Fork length at first capture (FL_c)	19.04
Growth co-effcient (K $year^{-1}$)	0.46
Response surface (Rn)	0.16
Growth performance index (φ')	3.08
Natural mortality (M $year^{-1}$)	0.89
Fishing mortality (F $year^{-1}$)	0.44
Total mortality (Z $year^{-1}$)	1.33
Exploitation level (E)	0.33
Z/K ratio (if Z/K >2; mortality dominated)	2.89
M/K ratio (1-2.5)	1.93
Allowable limit of exploitation (E_{max})	0.75
Sample number (N)	804

DISCUSSION

Existence of three size groups in the continental shelf of Côte d'Ivoire was the consequence of trawl's fishery. This result showed that length-frequency graph was polymodal. It indicates that *C. senegallus* have a protracted spawning all the year. This assertion was reported by Rao and Dwivedi (1989) in their study on *Cynoglossus macrolepidotus*. The absence of fish below 16.0 cm fork length may be associated with the selectivity of the trawl. However, Fisheries by trawl showed that there was one dominant group which is the small group of fish. This means that the diameter of the trawl mesh was small. Therefore, there are many juveniles in the fishery than subadults and adults. In this study, the presence of many juveniles in the catch might be the fact that the diameters of the trawls are small.

High correlation coefficient of all population, male and female implies that the fish lengths and weights were growing proportionately. A similar result was observed by Lawson *et al.*, (2013) and Arra *et al.*, (2018). The calculated growth parameter b was within the limits observed by Tesch (1971), Bagenal and Tesch (1978) and Koutrakis and Tsikliras (2003). The coefficient «b» of the Length-Weight Relationship for combined sexes and male fish are very close to 3, reflecting isometry. Isometry growth is an indication that the species had symmetrical growth (Rahim *et al.*, 2009). However, female showed negative allometric growth. It means that females are lighter than their body weights. The Length-Weight relationship parameters may vary within the same species due to feeding, reproduction and fishing activities (Bayhan *et al.*, 2008), environmental changes, individual metabolism, sexual maturity and age (Franco-Lopez *et al.*, 2010).

The FL_∞, t_{max}, the exploitation level (E), total(Z) and fishing (F) mortality obtained in this study were lower than another Carangidae, which is *Trachinotus teraia* studied in Côte d'Ivoire lagoon by Sylla (2010). However, K value, natural (M) mortality, growth performance index (φ') and t_0 were close to those of Sylla (2010).

Using M and Z estimates, comparing the estimated values for M and F, we can conclude that the natural mortality was the most important source of mortality (M > F) for *C. senegallus*.

This result was different to that of Da Costa *et al.* (2018), which showed that the fishery was the most important source of mortality (F > M) for *Caranx crysos* the same genre of species in Itaipu coastal zone of Rio de Janeiro, Brazil. And then, Higher values for Z, M and F of *C. crysos* were reported by these authors. Also, higher values for Z, M and F of *Decapterus russelli* which is in the same family as *C. senegallus*, were reported by Panda *et al.* (2012) from Mumbai waters. This difference in fishing mortality may be attributed to lesser effort during the study period (Panda *et al.*, 2012).

Higher mortality parameters and exploitation rate (Z, M, F, E) of *Trachinotus teraia* and *C. crysos* indicated that *C. senegallus* showed lowest mortality than both species. This difference may be due to certain factors such as: the difference in species, difference in environmental condition and difference in catching.

The estimates of exploitation ratio (E) revealed that *C. senegallus* stock was facing less fishing pressure than *Trachinotus teraia* (Sylla, 2010) which is another Carangidae in Côte d'Ivoire.

According to Amponsah *et al.* (2016), estimated values of the asymptotic length ($FL\infty$) growth rate (K) varied from other studies. Variation in estimates may be attributed to factors like sampling methods, nature of data, computation methods used and the obtained length frequency (Amponsah *et al.*, 2016).

For mortalities of *C. senegallus*, the natural mortality was higher than the fishing mortalities; according to Mohd Azim (2017), this indicates an imbalanced stock position.

The FL_{max} of *C. senegallus* and the corresponding age, indicating the fishable life span of this specie in continental sheft of Côte d'Ivoire. These values where higher than those that Panda *et al.* (2012) reported for *M. cordyla* (Carangidae) in Mumbai water.

Z/K value of *C. senegallus*, indicating that the stock of this specie as mortality dominated. Panda *et al.* (2012) observed in the population of *D. russelli* and *M. cordyla* species of the same family which is a few similar to the findings of this study. According to Panda *et al.* (2012), the stock of both the species as highly mortality dominated.

M/K ratio of *C. senegallus* within the range. A similar finding was reported by Panda *et al.* (2012) through two species of Carangidae family, as 1.91 and 1.95 for *D. russelli* and *M. cordyla* respectively. According to Panda *et al.* (2012), the estimates were considered reasonable.

The computed length at first capture, FL_{50} or FLc of *C. senegallus* was great than those of *D. russelli* and less than those of *M. cordyla* reported by Panda *et al.* (2012); both species were Carangidae family.

This study showed that the recruitment pattern of *C. senegallus* is likely continuous but with two major peaks per year, in March and August, that can potentially produce two major cohorts in Ivoirian continental shelf. Similar observations were also made by Panda *et al.* (2012) in Mumbai water and Sylla (2010) in Ebrié lagoon (Côte d'Ivoire). This double recruitment peaks from the present study confirmed the assertion by Pauly (1984) that the double recruitment pulses per year are a general feature of tropical fish species. The presence of all year-round recruitment showed that spawning occurs throughout the year and that recruitment is not dysfunctional (Amponsah *et al.*, 2016).

The results obtained from virtual population analysis (VPA) or cohort analysis indicate that the fish which die by natural mortality are higher than those which die by fishing mortality. According to Cushing (1975), the fluctuation of fish populations may be affected by many factors besides fishing mortality such as water temperature, shift of currents and changes of sea level and wind stress.

As the exploitation rate (E), the fishing mortality was lower than the natural mortality. It means that the stock was not exploited to its potential along the coast of Côte d'Ivoire.

According to Sylla *et al.* (2017), the Y/R depends on the exploitation pattern or fishing regime and natural mortality. It increases with the fishing mortality up to a point where the maximum sustainable yield is obtained. In this study, the exploitation level ($E_{0.1}$) at which the marginal increase in relative yield per recruit is 10% was 0.62; whereas the maximum allowable limit of exploitation level (Emax) that gives the maximum relative Y/R was 0.75 and the exploitation level ($E_{0.5}$) which corresponds to 50% of the relative B/R of an unexploited stock was 0.36. However, the current exploitation rate (E) was estimated as 0.33, which was lower than the optimum level of exploitation estimated by the Beverton and Holt's method. It means that the stock of this species from continental shelf of Côte d'Ivoire is under-exploited. A similar result was reported by Mohd Azim *et al.*, (2017) with the specie *Atule mate* in Marudu Bay of Malaysia. But it is important to increase the diameter of trawl mesh in order to catch only the higher sizes than 19.5 cm FL, to avoid the decline of the stock. So, it is also important to check the trawl mesh.

CONCLUSION

In general, the study has revealed that, *C. senegallus* is a protracted spawner. The presence of many small length fish in fisheries indicate a strong fishing pressure on the population of *C. senegallus*. Combined sexes and male fish showed symmetrical growth, but females are lighter than their body weights. *C. senegallus* showed lowest mortality than *C. crysos* and *Trachinotus teraia* which are same genre and another Carangidae respectively; and its stock was facing less fishing pressure than *Trachinotus teraia*. The estimates of *C. senegallus* stock were considered reasonable. The computed length at first capture was FLc = 19.04 cm. the recruitment pattern of *C. senegallus* produce two major cohorts in ivoirian continental shelf. Spawning occurs throughout the year and that recruitment is not dysfunctional. Virtual Population Analysis indicate that the fish which die by natural mortality are higher than those which die by fishing mortality. At this time, the stock of *C. senegallus* from continental shelf of Côte d'Ivoire is under-exploited.

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