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The Recruitment Pattern of *Liza falcipinnis* from Elechi Creek, Upper Bonny, Niger Delta, Nigeria

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Abstract

The Recruitment Pattern of *Liza falcipinnis* from Elechi creek of Upper Bonny, Niger Delta, Nigeria was studied from (March 2009-January 2010). The pattern showed all year round recruitment with two peaks (one major and one minor) during the period of the study. The parameters obtained were L_{∞} = 19.96, K = 0.40 y^{-1}, C = 0, WP = 0, t_o = 0. The C indicates the amplitude of seasonal growth oscillations (that is, the magnitude of the growth patterns) and has values ranging from 0 to 1.0. Winter Point (WP) indicates the times of the year during which growth is minimal. The percentage recruitment for the different months were: March 2009 (15.0%); April (23.40%); May (14.0%); June (11.3%); July (10.0%); August (7.30%); September (1.8%); October (0.5%); November (2.2%); December (8.0%) and January 2010 (6.0%). The exploitation rate (E_{max}) that gives maximum relative yield-per-recruit was 0.424. The exploitation rate at which marginal increase occurred in the relative yield-per-yield was 10% of its value at E = 0, whereas ($E_{0.1}$) was observed to be 0.357. The exploitation rate ($E_{0.5}$) which corresponds to 50% of the virgin (that is, the unexploited stock) relative biomass-per-recruit was estimated to be 0.279. The mean ratio of length-at-first capture (L_{∞}) and asymptotic length (L_{∞}) was 0.060, while that of natural mortality (yr^{-1}) and growth rate (yr^{-1}) was 1.00. Yield per increased gradually with increase in exploitation and Biomass per recruit declined with increase in exploitation. An all year round recruitment, with one high pulse arid a low pulse was established for the species. Research should be carried out to ascertain the influence of environmental factors on the growth and recruitment of the species.

Subject Areas

Aquaculture, Fisheries & Fish Science

Keywords

Mullet, Recruitment Pattern, Elechi Creek, Niger Delta

1. Introduction

Recruitment is the entrance of young fish into the exploited fishing area and became liable to contact with fishing gear [1]. It also refers to either the addition of new fish to the vulnerable population by growth from among smaller size to bigger individuals [2]. Recruitment is the major source of variability in fish population [3]. The mean age of fish at recruitment generally depends on the type of mesh size of the gear used in fishing. The recruitment pattern or fish entry into the catch is as a result of the combined effect of recruitment and gear selectivity. The general form of recruitment curve may be determined by a proper knowledge of the biology of the species and estimation of the recruitment pattern obtained by comparing the size composition of actual catches with known selectivity of the gear. Knife edge recruitment model identified in Beverton and Holt [4] yield-per-recruit model [5] predicts all fish of a certain age below the age of recruitment which recruit (enter) into fishery but are not exposed to fishing mortality.

Liza falciinnis (**Plate 1**) belongs to the family Mugilidae. Detailed morphometric and meristic description of *Liza falcipinnis* are given in the FAO identification sheet, 1974 series [6]. The sickle fin mullet *Liza fa1cipinnis* has a prominent adipose tissue which surrounds the eye. It has a pectoral fin with auxiliary scale or without an upper lip lacking papilla and ornamentation, maxilla pad is visible below the corner of the mouth when the mouth closes. The anal fin has 3 spines and 11 soft branched rays and lateral line scale of 35 - 37 cm [6]. According to Idodo-Umeh [6], *L. falcipinnis* is common in the ocean but occasionally found in the rivers. It is also found in surface water of the ocean and also inhabit coastal marine, estuaries and brackish water.

Factors affecting fish distribution and abundance have already been reported by different workers. Availability of food, spawning rates, breeding grounds

Plate 1. *Liza falciinnis* (Mullet).

coupled with shelter, presence of current, vegetation, depth of water, breeding migration and low predation have been suggested as major limiting factors affecting the distribution and abundance of various families by Lelek and El-Zarka, [7]; Kainji Lake; [8] [9] [10] [11] [12]. Allison *et al.* [13] [14] also reported that fish abundance varied with type of gear used, tidal condition and period of capture, diurnally and seasonally. From the works of Ezenwa *et al.*, [15], Tobor [16] [17] [18], it is clear that most commercially and scientifically important fish species occurring in the Niger Delta waters can be landed all year round by artisanal fishers but there are months when they are more abundant. Tobor [19] reported that it was more abundant in the dry season.

Various studies on its morphometric characteristics have been carried out. These include Houde, [19] on *Liza vaigiensis* and *Liza abu* in Caspian Sea, Oren [5] on *Liza saliens* and *L. auratus* in Black Sea and Caspian Sea respectively. Morphometric and meristic characteristics have been the most widely used tools in the studies of fishes [20]. Various studies on fish in different water bodies have been carried out. Most of these studies were on fish species composition, abundance and distribution. Among these are [9]; River Niger, [21]; Odo-ona stream in Ibadan, [22], Otamri River, [23]; Oguta Lake [24]; Bonny River, [25]; Kolo Creek and [26]; Lower Nun River. Others include [27]; Brass River, [28]; Lower Nun River and [29], Elechi Creek.

Most of the literatures of Mugilidae are on places other than the Elechi Creek. Green, [30]; Migdalski and Frichter [31], Thomson [32], King [33] and Ita and Balogun [34] reported on *Mugil cephalus* from subtropical seas, Coast of North America and West Africa, Qua Ibo River and Oguta Lake respectively. Others who also reported on different species of Mugilidae are; Mahmoud [35]; *Mugil saheli* (Suez, Egypt), Fernandez-Delgado and Rossomanno [36]; Sharp nose mullet, Caspian Sea. Magdy [37] and Rahmah [38]; *Liza saliens* (South east Caspian sea). The mugilids are essentially pelagic and scarcely present below a depth of 25 m [39]. Juvenile mugilids prefer dark places in shallow coastal water, thus their distribution is the estuaries [33]. The fish is very popular, well relished and forms a large proportion of the diets of riparian communities. This is probably because of the high quality and highly flavoured flesh of the fish [32].

The Elechi Creek is one of the most important river systems in the Niger Delta providing nursery and breeding grounds for a large variety of fish species. However, owing to industrialization and recreational activities, this creek is fast becoming degraded. In the Elechi Creek, Liza falcipinnis occurs throughout the year. However, this occurrence is predominant in the dry season [33]. They are mostly seen along the banks of creek during high tide and on sandy and muddy substrates [33]. Mugilidae have a world-wide distribution and inhabit mainly tropical and temperate seas [33]. According to Nelson [40], the family Mugilidae includes 17 genera and 80 species in the world. Three mugilid species including golden mullet (Liza auratus), sharpnose mullet (*Liza saliens*), and striped mullet, Mugil cephalus were first transplanted from the Black sea to the Caspian Sea

between 1930 and 1934 by the Soviet authorities [41]. The first two species are now common in the Iranian coast of the Caspian Sea and mature earlier than those inhabiting the Black Sea [42].

Among the family of Mugilidae the species well studied is the *Mugil cephalus* or grey mullet, hence more information about *Mugil cephalus* is available. *Mugil cephalus* is abundant and distributed in the coastal waters of West Africa [32]. In Nigeria, it is widely distributed along the brackish estuaries and coastal waters. It is very popular, well relished and forms a large proportion of the diets of riparian communities. This is probably because of the high quality and highly flavoured flesh of the fish. Eisawy *et al.*, [43], carried out rearing of mullets in Egyptian fish farms. Hamza and Zaki [44] also carried out rearing experiment of some marine fishes in brackish water system including grey mullet (*Mugil saheli*) which also belong to family Mugilidae and their fry are present in big amounts in Gulf of Suez, especially Suez Bay Magdy [38]. Biological studies are particularly important for describing the status of a fish population and for predicting the potential yield of the fishery. It is essential to study the recruitment pattern of *Liza Falcipinnis to provide information for studying its* growth rate, age at maturity, longevity, spawning, production, stock size, recruitment to adult stock and mortalities [45] [46] for management decisions.

2. Materials and Methods

2.1. Study Area

The study was carried out at Elechi Creek, a tributary of Upper Bonny River Estuary, Niger Delta and its adjoining mangrove creeks situated near Eagle Island. It is a stream in Nigeria, West Africa, Africa. It is located in Latitude: 4˚46'3.4" (4.7676˚) north; Longitude: 6˚59'12.6" (6.9868˚) east. Its Elevation is 425 meters (1394 feet). The Bonny River Estuary is between latitude 4˚45'N and 7˚15'N and longitude 4˚30'E and 4˚37'E. The Niger Delta basin covers all land between latitude 4˚15'N and 500˚36'N and longitude 5˚25'E and 7˚37'E with total area of 200,000 km^2 [45]. It extends along the coast from the river basin in the West of the Bonny River and in the East, it encompasses the pro-Niger Delta Basin and, most part of the Delta Basin province of Delta State. It is characterized by extensive interconnection of creeks. It covers about 20% of the surface area of Nigeria [47]. The annual rainfall of the Niger Delta is between 300 - 3000 mm per year [45]. The tidal influence is very pronounced as we experienced two tidal levels daily, high and low tides. The Elechi Creek, a tributary of Upper Bonny River Estuary is situated between longitude 6˚51'E and 7˚10'E and latitude 4040k. The stretch of the river is long and wide with meanders. The vegetation is predominantly mangrove. The low intertidal is dominated mostly by *Rhizophora racemosa*, *Rhizophora mangle* while the high intertidal is dominated by *Avicennia africana*, *Laguncularia racemosa*, *Nypa fruiticans and Aerosticuchum auecum* [48].

2.2. Sample Collection

Sampling was carried out from March, 2009-January, 2010. Specimens were randomly collected from landings from fishers from the Elechi creek. Specimens collected were conveyed in cooler boxes containing ice chips to the laboratory, on each sampling thy. Sampling was carried out twice a month. Fish specimen was properly identified using monographs, descriptions, checklist and keys of Needham and Needham [48]; Reed *et a1*., [49]; Holden and Reed, [50], FAO [51], Leveque *et al*, [52] and Olaosebikan and Raji [53]. In the laboratory, total lengths; were measured with fish measuring board to the nearest centimeter. Girth was measured with tailor tape to nearest centimeter (cm). The weight of each fish was obtained by weighing fish specimen on a sensitive weighing balance (Sartorius model RS, Germany) to nearest gram (g), The female and the male *Liza falcipinnis* were identified through dissection. The female has two ovaries while the male has the testes [54]. The relative yield-per-recruitment (Y/R) and relative biomass-per-recruitment were determined by the knife-edge recruitment approach which is identified by Beverton and HoIt [4] as yield-per-recruit model and incorporated into the recruitment routine in FISAT [5] [55]. In FISAT, the recruitment patterns were analyzed using the maximum likelihood approach of NORMSEP (Separation of the normally distributed components of length-frequency samples) to fit the Gaussian distribution on length-frequency data for the year pooled together [4] [55] [56].

3. Results

The recruitment pattern of *L falcipinnis* from Elechi Creek Bonny River Estuary, Niger Delta is shown in **Figure 1**. The pattern showed all year round recruitment with two peaks (one major and one minor) during the period of the study. the parameters obtained were $L_{\infty} = 19.96$, $K = 0.40\ y^{-1}$, $C = 0$, $WP = 0$, $t_o = 0$. The C indicates the amplitude of seasonal growth oscillations (that is, the magnitude of the growth patterns) and has values ranging from 0 to 1.0. Winter Point (WP) indicates the times of the year during which growth is minimal. The percentage recruitment for the different months were: March 2009 (15.0%); April (23.40%); May (14.0%); June (11.3%); July (10.0%); August (7.30%); September (1.8%); October (0.5%); November (2.2%); December (8.0%) and January 2010 (6.0%).

Figure 2 shows the relative yield-per-recruit (Y/R) and relative biomass-per-recruit (B/R) analysis by the knife-edge selection method. The exploitation rate (E_{max}) that gives maximum relative yield-per-recruit was 0.424. The exploitation rate at which marginal increase occurred in the relative yield-per-yield was 10% of its value at E = 0, whereas ($E_{0.1}$) was observed to be 0.357. The exploitation rate ($E_{0.5}$) which corresponds to 50% of the virgin (that is., the unexploited stock) relative biomass-per-recruit was estimated to be 0.279. The mean ratio of length-at-first capture (L_{∞}) and asymptotic length (L_{∞}) was 0.060, while that of natural mortality (yr^{-1}) and growth rate (yr^{-1}) was 1.00.

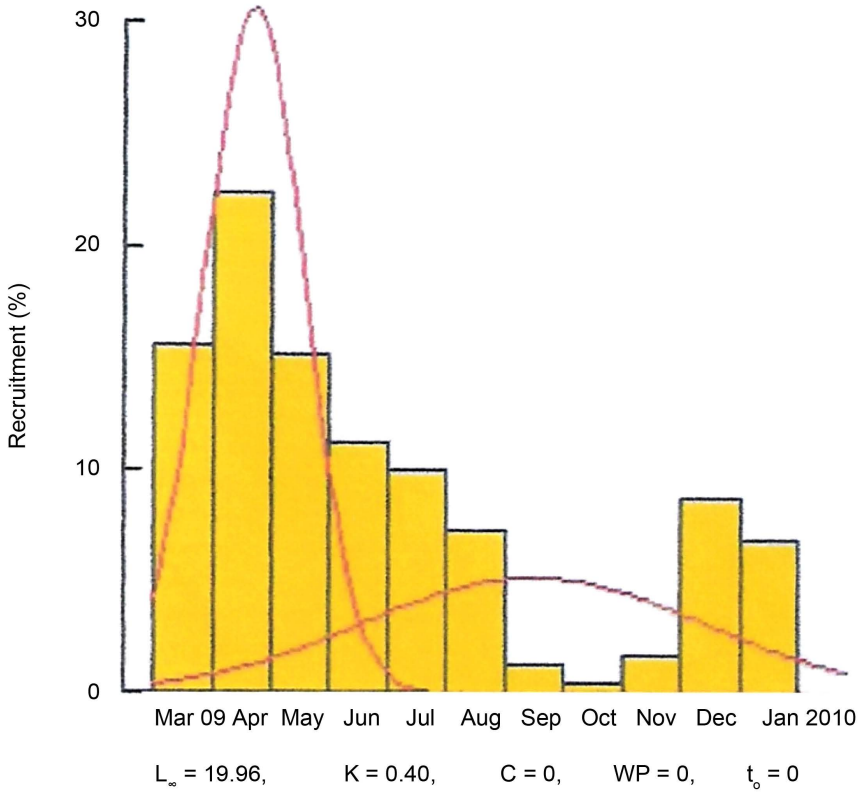

Figure 1. Recruitment pattern of *L. falcipinnis* from Elechi Creek.

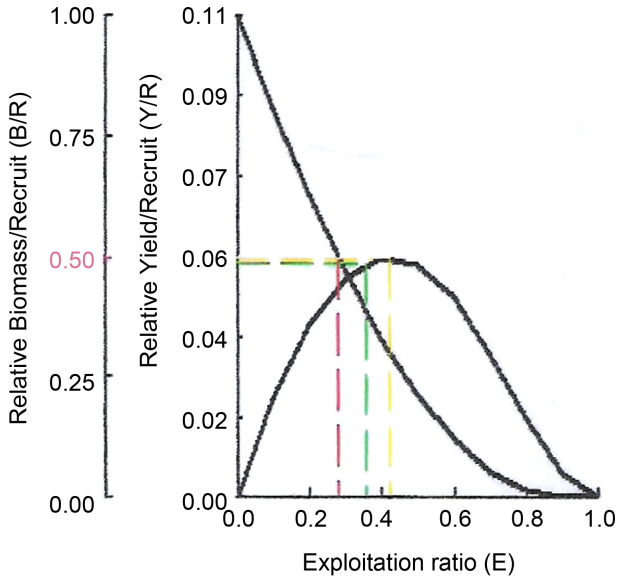

Figure 2. Relative yield-per recruit and relative biomass-per recruit of *L. falsipinnis* using the knife-edge recruitment method.

(Table 1). Table 2 shows the relative biomass/recruit and relative yield/recruit per exploitation of *L. falcipinnis*. Yield per increased gradually with increase in exploitation and Biomass per recruit declined with increase in exploitation.

Table 1. Estimated mortality parameters, Optimum exploitation rate and relative coefficient rate of *L. falsipinnis* from Elechi creek.

Parameters	Z	M	F	E	E_{MAX}	$E_{0.1}$	$E_{0.5}$	LC/L_{∞}	M/K
	1.28	1.00	0.28	0.22	0.424	0.357	0.279	0.060	1.00

Key: Z = Total Mortality, M = Natural Mortality, F = Fishing Mortality, E = Exploitation, E_{MAX} = Maximum exploitation, $E_{0.1}$ = 10% exploitation, $E_{0.5}$ = 5% exploitation, LC/L_{∞} = the ratio of length at-capture to the asymptotic length, M/K.

Table 2. The relative biomass/recruit and relative yield/recruit per exploitation of *L. falcipinnis* from Elechi creek.

Exploitation	Yield/Recruit	Biomass/recruit
0.10	0.022	0.805
0.20	0.039	0.627
0.30	0.050	0.468
0.40	0.055	0.329
0.50	0.053	0.213
0.60	0.046	0.122
0.70	0.033	0.057
0.80	0.018	0.018
0.90	0.005	0.002
1.00	0.000	0.000

4. Discussion

The all year round and double recruitment pattern per year obtained for *L. falcipinnis* of the Elechi Creek conforms to the assertion of Rufli and Van Lissa [57] and Paul [58] respectively that they are characteristics of most tropical fish stocks with seasonal association. The recruitment pattern of this fish showed peak recruitment in April 2009 and another December 2009. Rabuor *et al.* [59] observed a main recruitment pulse from September 2002 to January of the following year and minor pulse in June and suggested that the Nile perch in Lake Victoria probably spawns twice a year. However, for *Oreochromis leucosticus* in Lake Naivasha, Kenya recruitment occurred throughout the year with peaks in February and at the end of July [60]. Aripin and Showers [61] reported an all year round recruitment pattern in seven small pelagic fishes with two peak periods. Francis [62] observed lowest recruitment during periods of least abundance in artisanal catches of the Andoni River and reported recruitment as good guide to knowing periods of fish abundance; that young fishes usually predominate in catches during the recruitment periods which is usually evident from the length-frequency distribution plot. Ikomi and Sikoki, [63] reported a onetime recruitment pattern a year between November and December when there was a dominance of young adults in the population. This conforms to this study which recorded recruitment in April and May 2009. The amplitude of seasonal growth oscillation (C) observed at (0.00) indicated that *L. falcipinnis* from this study

area experienced no seasonality in growth. According to Pauly [64] growth oscillation is due mainly to temperature changes.

5. Conclusion and Recommendation

- An all year round recruitment, with one high pulse arid a low pulse was established for the species.
- Research should be carried out to ascertain the influence of environmental factors on the growth and recruitment of the species.

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