Determination of the sexual maturity of Threadfins *Polydactylus quadrifilis* (Cuvier, 1829), *Galeoides decadactylus* (Bloch, 1795) and *Pentanemus quinquarius* (Linné, 1758) of the artisanal marine fishery of Grand-Lahou (Côte d'Ivoire).

ABSTRACT

Reproduction of the threadfins of the costal shelf of Grand-Lahou was studied with a monthly sampling frequencies range from may 2009 to april 2011. 534 specimens of *Polydactylus quadrifilis*, composed of 315 males and 219 females and 648 *Galeoides decadactylus* composed of 420 males and 228 females, then 453 individuals of *Pentanemus quinquarius* composed of 210 males and 243 females were used.

The sexual maturity parameters of threadfins fishes indicate a size of first maturity (L_{50} = 67.5 cm) for females of *Polydactylus quadrifilis* and (L_{50} = 55.5 cm) with their males. Concerning the specimens of *Pentanemus quinquarius*, females present (L_{50} = 15 cm) and their males (L_{50} = 14.5 cm). This parameter has identical values with the females of *Galeoides decadactylus* (L_{50} = 15.5 cm) and their males (L_{50} = 15.5 cm). The individuals of *Polydactylus quadrifilis* and the specimens of *Galeoides decadactylus* and *Pentanemus quinquarius* become mature at 1 year of age. The sex ration determination show that specimens of *Polydactylus quadrifilis* show a predominance of males during the warm season, from October (73.68%) to March (64.28%) which weakens during the cold season, from May (30%) to July (58%). For *Galeoides decadactylus*, the sex ratio shows a predominance of males, from August (88%) to March (94.73%). Concerning specimens of *Pentanemus quinquarius*, the sex ratio is in favor of the females whose lowest value is during the cold season in July (21.74%).

All threafin species reach sexual maturity from their first year of life with different sex ratios variations.

Key words : sexual maturity, sex ratio, *Polydactylus quadrifilis*, *Galeoides decadactylus*, *Pentanemus quinquarius*.

1- INTRODUCTION

Fish are the main source of animal protein consumed worldwide, especially in many developing countries. They also ensure food security for people living near watercourses **[1]**. To increase national production, States define sectoral policies involving the development of marine and lagoon fisheries, by the rational exploitation of all fishing potential, the modernization of artisanal production means, and the pursuit of efforts in fisheries research **[2]**. According to **[3]**, promoting sustainable fisheries can encourage better management of the whole ecosystem. In fact, the exploitation of brackish and marine water fish populations in Africa is intensifying more and more by constantly increasing local populations and especially the alarming acceleration of all the processes of degradation of the natural environment that make consider the major risk of regression and disappearance of species **[4]**. One of the most significant effects of fishing is in terms of demography, reduction of the average size of the species and the disappearance of large individuals **[5]**. Therefore, the knowledge of the reproductive biology of the main species among others, threadfins fishes, *Polydactylus quadrifilis*, *Galeoides decadactylus* and *Pentanemus quinquarius* landed on the Ivorian coast is important.

The present study consists in determining the sexual maturity of these threadfins fishes of the Ivorian maritime artisanal fishery in order to contribute to the preservation of the stocks.

2- MATERIAL AND METHODS

Reproduction was studied by conducting monthly samplings within the catches made by the fishermen. It involved 534 specimens of *Polydactylus quadrifilis* including 315 males and 219 females and 648 of *Galeoides decadactylus* composed of 420 males and 228 females, then 453 of *Pentanemus quinquarius* composed of 210 males and 243 females. Sampling frequencies range from May 2009 to April 2011, for a total of 24 months. At each sampling campaign, a sampling by sex and size class of one cm was carried out. The fish were kept in coolers and brought back to the laboratory. The total lengths (Lt) and standard lengths (Ls) were taken. The identification of the sexes was done after dissection. The proportions of males and females were calculated in relation to the total size within the different size classes.

2.1- Size of first sexual maturity (L_{50})

To calculate the size at which 50% of individuals are mature, individuals of each species were ranked in size classes of one cm. In each class, the percentage of fish whose macroscopic stage of sexual maturity is highier than or equal to stage 3 has been calculated, a stage admitted as corresponding to the stage of ovarian development **[6]**, **[7]**.

The logistic function $P = 1/(1+e^{-(b+aLt)})$ linking the proportions of mature individuals and the total length of fish **[8]** was used.

P: % of mature, a and b: constants, Lt: total length of fish

2.2- Age of first maturation

According to **[9]**, gonad maturation is not achieved at the same age for all individuals in a cohort. The proportion of maturing gonads increases with age from zero to 100% and all individuals are mature from the age at which 100% spawn or spermate for the first time. The histogram or curve that represents these proportions is called the maturation ogive. It determines the age of first maturation (t_{mat}) by calculating the proportions of fish whose macroscopic stage of sexual maturity is greater than or equal to 3 in size classes of one cm. Thus, specimens of age below to t_{mat} are considered juveniles and those of equal or higher age are considered as adults **[9]**. Calculations of the proportions of fish with a macroscopic stage of sexual maturity greater than or equal to 3, by size classes of one cm, made it possible to determine the age of first maturation (t_{mat}) of the threadfins.

2.3- Sex-ratio

The sex ratio reflects the masculinity or femininity rate of the population considered. It is defined as the proportion of male or female individuals respectively in relation to the size of females or males and gives an idea of the gender balance (males and females) within the population.

Sex ratio = Mx100 / F

with; F: number of females and M: number of males

3- RESULTS AND DISCUSSION

The logistic model equations determined for the different sexes of the Polynemidae are presented in the table. Figures 1 and 2 respectively show the graphical representations of the sizes of first sexual maturity of the males and females threadfins. The first maturity sizes obtained with *Polydactylus quadrifilis* are (L_{50} = 67.5 cm) for females and (L_{50} = 55.5 cm) for males. About the *Pentanemus quinquarius* specimens, females have the size of first sexual maturity (L_{50} = 15 cm) while males have a size of first sexual maturity (L_{50} = 14.5 cm). The size of first sexual maturity is identical with females of *Galeoides decadactylus* (L_{50} = 15.5 cm) and their males (L_{50} = 15.5 cm).

Polydactylus quadrifilis individuals become mature at 1 year of age (Figure 3.a). It is the same for the specimens of *Galeoides decadactylus* (Figure 3.b) and *Pentanemus quinquarius* (Figure 3.c).

For the specimens of *Polydactylus quadrifilis* (Figure 4.a), the sex ratio indicates a predominance of males during the period from October (73.68%) to March (64.28%), with a peak of 83, 33% in November. This sex ratio becomes low during the cold season, from

May (30%) to the end of July (58%). According to *Galeoides decadactylus*, the sex ratio shows a predominance of males, from August (88%) to March (94.73%), except for the month of October when females (88.88%) dominate males (11.11%) (Figure 4.b). Concerning specimens of *Pentanemus quinquarius*, the sex ratio is in favor of the females whose lowest value is during the cold season, in July (21.74%) (Figure 4.c).

In order to understand the maturation of thredafins on the costal shelp of Grand-Lahou during their reproductive cycle, this study looked at the size and age corresponding to their first sexual maturity and their sex ratio.

According to [10], knowledge of the size of first sexual maturity is important in the management of fisheries resources. It is essential in determining the minimum catch size. In our study, the size of first sexual maturity was reached at 55.5 cm with males and 67.5 cm for females of *Polydactylus quadrifilis*. About of specimens of *Galeoides decadactylus*, males and females simultaneously reach the size of first sexual maturity at 15.5 cm. As well, males and females of *Pentanemus quinquarius* have respectively a size of first sexual maturity (L_{50} = 14.5 cm) and (L_{50} = 15 cm). Compared with the types of allometries observed with threadfin fishes, differential growth does not influence reaching the size of first sexual maturity. Indeed, specimens of *Polydactylus quadrifilis* and *Pentanemus quinquarius* those do not show differential growth, have different sizes of first sexual maturity between males and females. In contrast, specimens of *Galeoides decadactylus* that show differential growth between their two sexes, reach simultaneously the size of first sexual maturity [11]. Similarly, [12] report that males frequently dominate catches of juveniles because they are younger but live shorter lives. Thus, sizes of first sexual maturity (L_{50} = 15.5 cm) identical to our results were determined by [13] on the Nigerian coasts with males and females of *Galeoides decadactylus*. However, results different from ours were obtained by [14] (L_{50} = 18.5 cm) and [15] (L_{50} = 13.7 cm) with *Galeoides decadactylus*, respectively on the Congolese and Senegalese coasts. Similarly, [16] observed lower first maturity sizes ($L50$ = 12 cm) with *Galeoides decadactylus* at the Guinean littoral. In addition, [7] obtained the fork size of L_{50} = 13 cm with the *Galeoides decadactylus* specimens of the Guinean coastal sea. The sizes of first maturity determined with threadfin fishes correspond to one year of age. That means these fish are able to contribute to restocking from one year of age.

The size of first sexual maturity would therefore be a function of the physicochemical conditions and the availability in primary productions of their living environments. [17] puts forward the idea that reproduction is closely related to the adaptability of breeders to certain factors in their environment, such as temperature, salinity and trophic resources. This would justify size dimorphism between males and females of *Polydactylus quadrifilis* and *Pentanemus quinquarius*. According to [18], the best growth rates are linked to the quality of the diet adopted by the fish and their ability to adapt to the temperature of the environment. [19] adds that temperature promotes metabolic activities and accelerates growth and aging of animals.

The sex ratio of *Polydactylus quadrifilis* specimens indicates a predominance of males during the warm season and becomes low during the cold season. However, the sex ratio remains balanced between males and females during the cold season. According to *Galeoides decadactylus* individuals, the sex ratio shows a predominance of males throughout the fishing season. Concerning the specimens of *Pentanemus quinquarius*, the sex ratio is in favor of females. The sex ratio is favorable for males of *Polydactylus quadrifilis* and *Galeoides decadactylus*. However, it is in favor of females with the specimens of *Pentanemus quinquarius*. According to [15] and [7], respectively at the Senegalese and Guinean seacoasts, there is a sex inversion of the young males of *Galeoides decadactylus* during their life cycle. It would be a gradual transformation of males into females until hermaphroditism is functional. This phenomenon would result in a favorable sex ratio for females. These results are contrary to ours because the sex ratio obtained with *Galeoides decadactylus* is rather favorable to the males. [7] argues that changes in sex ratio and size frequency probably have a significant influence on stock availability. The sex ratio in favor of the males results from the fact that the females of *Polydactylus quadrifilis* and *Galeoides decadactylus*, according to [20], would withdraw from the fishing grounds, to take refuge in marine vegetation 50 meters deep and berries to lay. These females would avoid the fishermen when those do not fish at shorelines and bays.

FIGURES

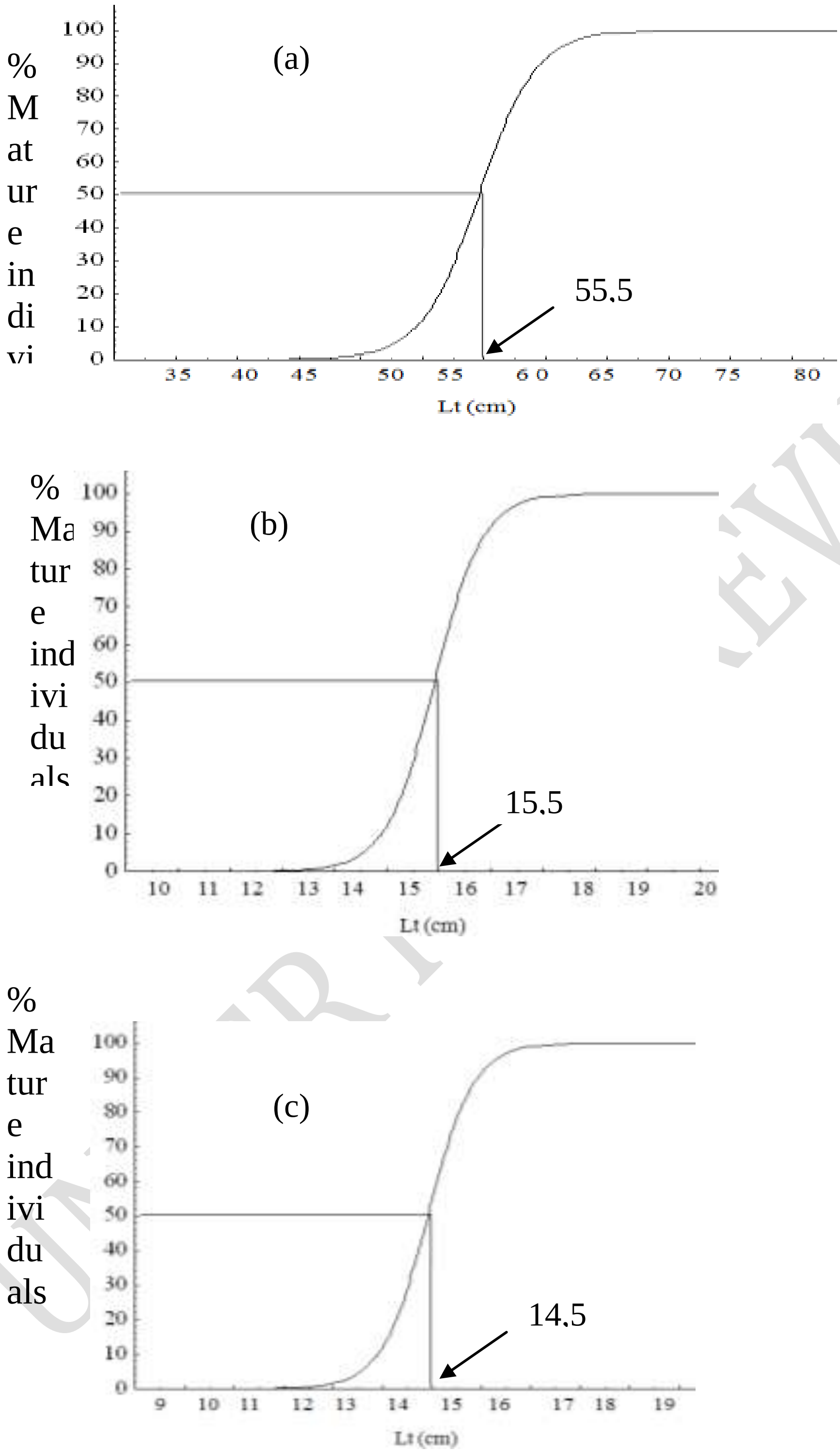

Figure 1. Relationship between proportions of mature males (P) and length (Lt) of threadfins *Polydactylus quadrifilis* (a), *Galeoides decadactylus* (b) and *Pentanemus quinquarius* (c).

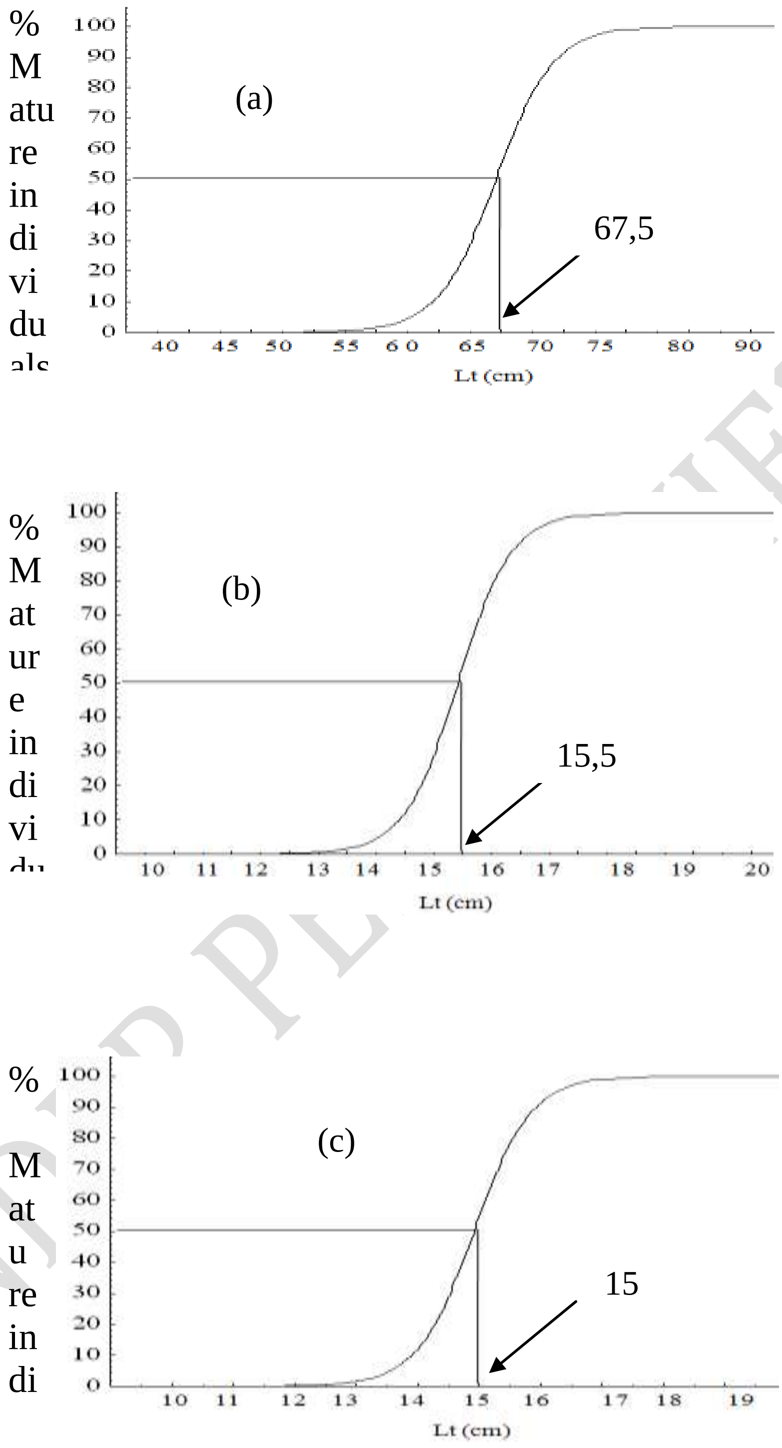

Figure 2. Relationship linking proportions of mature females (P) to total length (Lt) of threadfins *Polydactylus quadrifilis* (a), *Galeoides decadactylus* (b) and *Pentanemus quinquarius* (c).

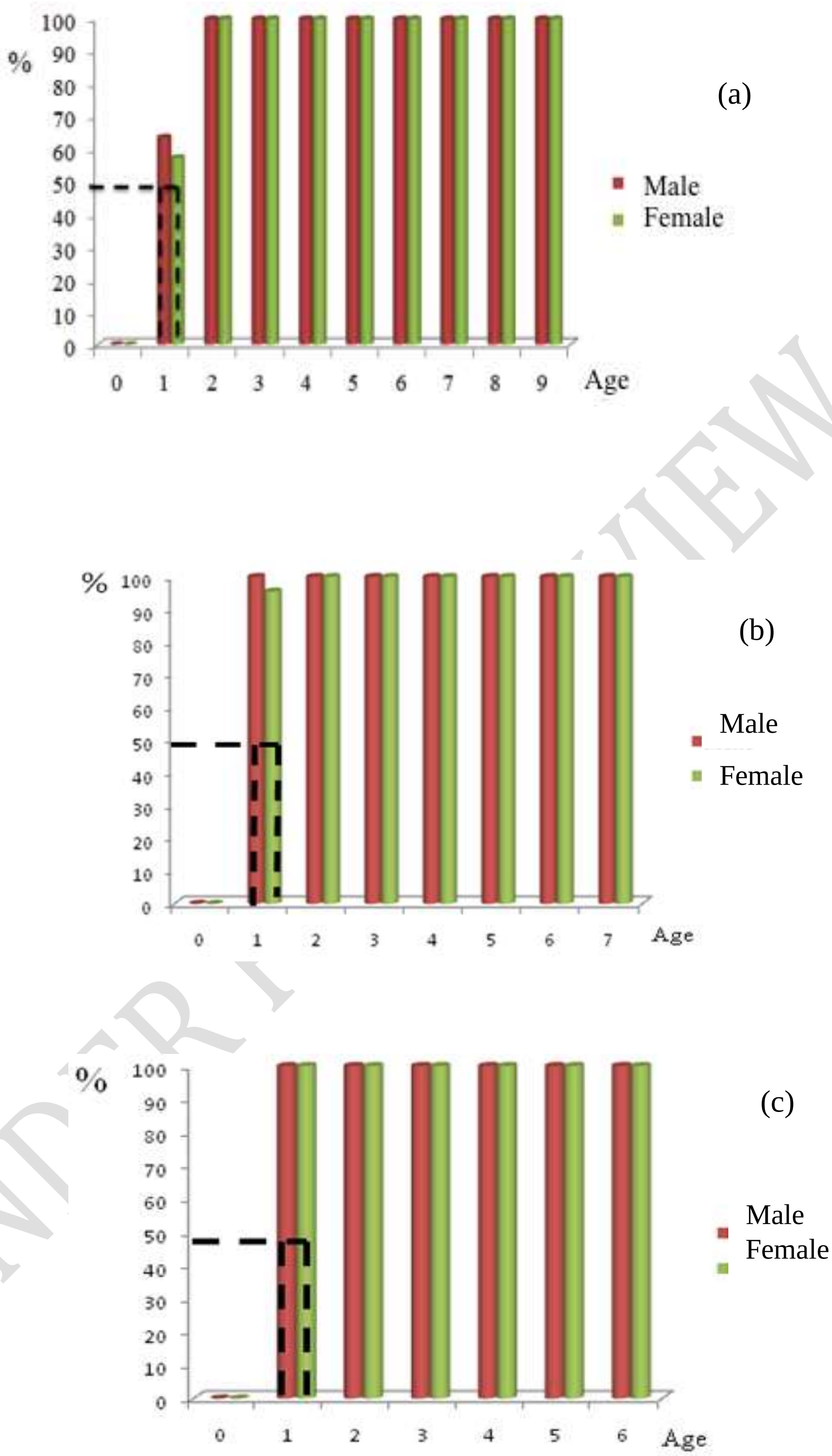

Figure 3. Maturation Ogive of threadfins *Polydactylus quadrifilis* (a) *Galeoides decadactylus* (b) and *Pentanemus quinquarius* (c).

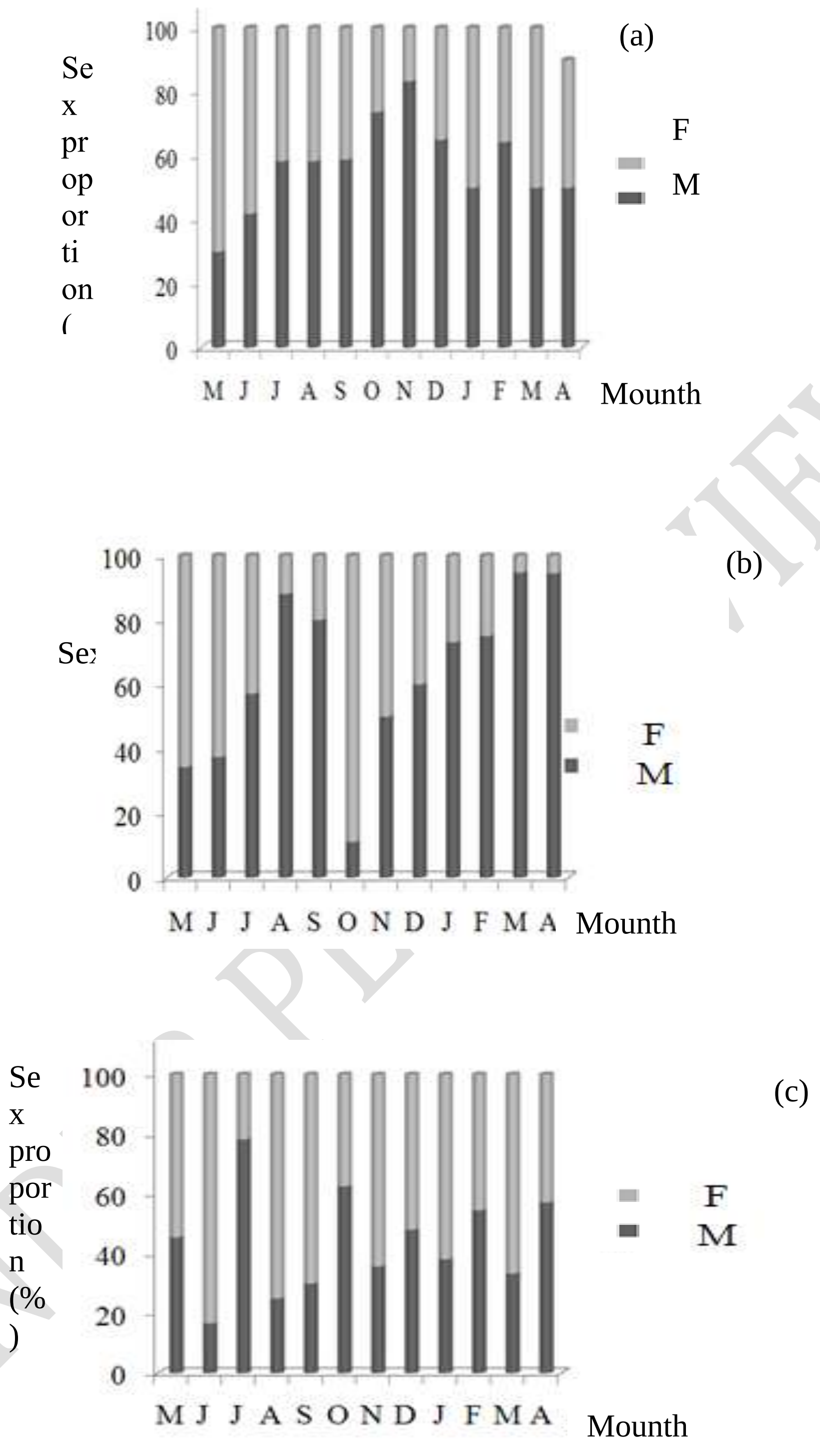

Figure 4. Monthly variation of male (M) and female (F) proportions of thredfins *Polydactylus quadrifilis* (a), *Galeoides decadactylus* (b) and *Pentanemus quinquarius* (c).

TABLE. Size of first sexual maturity (L50) and equations of logistic function P of threadfins *Polydactylus quadrifilis*, *Galeoides decadactylus* and *Pentanemus quinquarius*.

Species	Sex	Effectives	L_{50} (cm)	P Equations
Polydactylus quadrifilis	Male	315	55,5	$P=\frac{1}{1+e^{(-7,44+2,02Lt)}}$
	Female	219	67,5	$P=\frac{1}{1+e^{(-1,18+0,67Lt)}}$
Galeoides decadactylus	Male	420	15,5	$P=\frac{1}{1+e^{(-7,48+2,41Lt)}}$
	Female	228	15,5	$P=\frac{1}{1+e^{(-7,93+2,49Lt)}}$
Pentanemus quinquarius	Male	210	14,5	$P=\frac{1}{1+e^{(-3,64+1,54Lt)}}$
	Female	243	15	$P=\frac{1}{1+e^{(-6,32+2,17Lt)}}$

4- CONCLUSION

This study shows that specimens of *Polydactylus quadrifilis* and *Pentanemus quinquarius* have different sizes of first sexual maturity between males and females. However, the males and females of *Galeoides decadactylus* simultaneously reach the size of first sexual maturity. Specimens of *Polydactylus quadrifilis* show a predominance of males during the warm season, females during the cold season. Males of *Galeoides decadactylus* are predominant while females predominate in specimens of *Pentanemus quinquarius*. Individuals of *Polydactylus quadrifilis*, *Galeoides decadactylus* and *Pentanemus quinquarius* become mature at one year of age.

6- COMPETING INTERESTS,

The authors declare that there is no conflict of interest.

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