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The most important environmental factors affecting the early sexual maturity of *Coptodon zilli* in Iraq

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Abstract

In this study, we try to find the most important reasons for the early sexual maturity of tilapia *Coptodon Zilli* in four different regions of Iraq, and the relationship between these factors, such as some of the biological characteristics of these fish with some biological and biometric characteristics between the four regions. The Red belly tilapia *Coptodon Zilli* is a species of fish in the cichlid family which possesses a great economic significance in fisheries due to its reproduction easiness and speed together with its high capability of adaptation under different environmental conditions. In view of the fact that the abundance studies of *C. zillii* , which has been bred in aquaculture. By contrast, due to the scarcity of studies that deal with the natural fish population. The current study is mainly concerned with collecting samples of *C. zillii* out of Iraqi inland waters (four different governments including Baghdad-Babel-Wassit and Maysan) with the aim of identifying some of its features and characters in the Iraqi environment and investigating the phenomenon of the early sexual maturity of this species. Results show that there are statistically significant differences at a confidence level of about ($P< 0.05$) among the four given areas in the whole morphometric measurements. Thus, Maysan samples surpassed other governments in terms of the overall length, head length, and body weight which amount to (16.59 cm), (12.99) cm, (4.30 cm)and (97.19 gram) respectively. In Babel, means values of the amount of the sample to (14.87 cm), (11.70 cm), (3.79 cm) and (72.67 gram) respectively. Results also show that there are indices of early sexual maturity in *C. zillii* even though the inland waters are of bad qualities in some areas whether by means of distinguishing features or anatomic characters of those gonads.

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Introduction

Fish reproduction, in its real habitats and environment, is regarded as a means of conserving fish species. Thus, the process of fish reproduction is considered biological process which influenced by many environmental and genetic factors. However, these factors might affect negatively upon fish reproduction in the areas of artificial fish breading (especially *Coptodon zillii*) or they could be positive in fisheries or aquaculture Oso (2013) and Meyer (2002).

The *C. zillii* is of widespread distribution and high economic value in Africa especially in Egypt, the Sudan and Ethubia ... etc. and these species took the precedence in fish production, Negassa (2003) and El-Sawy (2006).

The *C. zillii* is characterized by many features. First, its natural habitats are marginal vegetation and seasonal flood plain streams, lakes, and ponds. Moreover, it is of widespread distribution in Africa, especially in inland waters, ponds, streams, lakes and rivers, Akel and Moharram (2007) & Negassa and Padanillay (2008).

There are many influencing factors that affect the biology of its reproduction. These factors include fish lengths, and sexual maturity of this species in aquaculture (as shown by Waheed *et al* (2011), during studying the relationship between the fish length, and the sexual maturity of *C. zillii* collected from the crocodile lake in Egypt. In fact, some species might be influenced by early sexual maturity due to different factors of environmental grounds which affect the biology of aquaculture of breeding for males and females, Both U...Faremo and C-Dellofores (1988), pointed out that more than 50% of male offspring salmon were of high length than its parents. Accordingly, *C. zillii might* be influenced by such factors during early stages of its lives and it acquires different levels of masculine or feminine hormones such as androgen and estrogen which effect on the genes and genetic control in bodies of this species. The phenomenon of early sexual maturity is worthy of study because it can yield positive results in terms of production if the characteristics of this phenomenon were used in *C. zillii* to increase production by the early reconstruction of these fish.

Materials and methods

160 samples of *C. zillii* were collected from four different Iraqi governments amounting to (40) fish out of each government. These governments include (Baghdad, Babel, Wassit and Maysan).These samples were placed in separated aquariums and transferred into research centers or into the Iraqi museum of Natural history in the University of Baghdad to conduct the biological measurements. These measurements include total length, standard length head length and body weight of all these samples selected from the four areas.

Sex samples have been determined by relying on the apparent characters (external sexual organs) and the anatomical examination of aquaculture – a group of apparent features such as colour change, fins shape ...etc. Gonads have been studied and analyzed anatomically in order to investigate the early sexual maturity in the samples of coptodon zillii.

Water quality indices have been measured in each governorate represented by the temperature (C^0), poetential of hydrogen , by using PH meter , translucan (cm) by using translucency scale , total dissolved solids , dissolved oxygen concentration as well as Kh , Gh and Nh3.

The statistical analysis has been carried out by finding out the arithmetic mean, standard deviation , the minimum and maximum of coptodon zillii samples collected from each area .The data has been analyzed by selecting ANOVA and by DUNCAN test to compare the differences in Arithmetic means at confidence level of about 5% ($P< 0.05$) by using SPSS programmes (IBM SPSS.INC).

Results and discussion

Results of the waters quality in the four governments showed that the temperature ranged from 26°C into

29°C and water acidity ranged from temperate into alkaline amounting to (PH) within the field (8-2-7) whereas waters in Wassit governorate exhibited the maximum translucency at (450 cm) whereas Baghdad governorate recorded the minimum translucency at (142 cm) as well as the minimum amount of dissolved Oxygen was observed in Baghdad governorate water (18 mg/L) , whereas Maysan governorate water recorded (225 mg/L) which was the maximum amount of dissolved solids in the waters of the four governorates ranged to the field (550-320) ppm , whereas (KH) was equal in Baghdad and Babel governorates of about (451) ppm whereas in Wassit and Maysan governorates amounted to (340-1) and (322.2) ppm respectively .Moreover (GH) was equal in the four governorates which amounted to (143.2) ppm , furthermore , (NH_3) was equal in governorates which amounted to (0.25) mg/L in Baghdad , Babel and Wassit whereas in Maysan amounted to (0.00) (as shown below) in Fig.1 and Table 1.

Table 1. Water quality parameters.

Water parameters	Baghdad	Babylon	Wasit	Maysan
Temperature (°C)	29	26	26.5	28
pH	8.2	7.2	7.8	7
Transparency (cm)	142	350	540	150
TDS (ppm)	520	550	320	450
Dissolved oxygen (mg/L)	18	20	22	22.5
KH (ppm)	143.2	143.2	143.2	143.
GH (ppm)	451	451	340.1	322.2
NH_3(mg/L)	0.25	0.25	0.25	0.0

Many researches pointed out that the *C. zillii* had the ability to adapt under different environmental conditions and it had also the ability to live to widerange of tempratures, salinity and PH (Chervinski and Hering 1973; Chervinski and Zorn, 1974; Anthoni *et al.*, 1990; Cnaani *et al.* 2000).

Both Chervinski and Hering (1973) and Chervinski and Zorn (1974) confirmed that *C. zillii* had the ability to tolerate a wide range of water salinity since *C. zillii* could live in waters with 0% salinity and it could live in high salinity waters amounted to 95% due to the fact that *C. zillii* possessed high levels of (TMAO) which helped it to adapt with different environmental conditions (Anthoni *et al.* 1990). Thus, the optional temperature of *C. zillii* ranged from (25 into 28 C °) (Wohlfarth and Hulata 1983) whereas it could not live under temperature ranged from (10 -12) °C more than several days (Chervinski 1982). Accordingly, in fig. (2) there is a matching between the ratio of males and females in the sample collected from governorate of Babel similar to a study conducted on coptodon zillii which was collected from Burdur city in Turkey where the ratio of females and males are equal of about (0.7:1) (Innal and Giannetto 2017).

Table 2. The results of morphometric measurements of the samples of coptodon zilli.

Biological Measurements	Average± Standard Deviation	Minimum	Maximum
Total Length (TL)	15.89 ± 1.05	14.10	19.10
Standard Length (SL)	12.49 ± 0.76	11.20	15.00
Height Length (HL)	4.10 ± 0.33	3.50	5.00
Weight	85.35 ± 12.89	46.00	127.00

The results of the morphometric study of the samples of *C. zillii* collected from Iraqi governorates showed that the total length of *C. zillii* ranged from (14.10) to (19.10)cm whereas the standard length of the samples ranged from (11.20) cm to (15.00) cm whereas the average of head length amounted to (4.10) cm and the average of fish weight collected from the four governorates was (85.35) gm .It was noteworthy that there was a great difference between fish weight ranging from 64 mg and 127 mg Table (2).

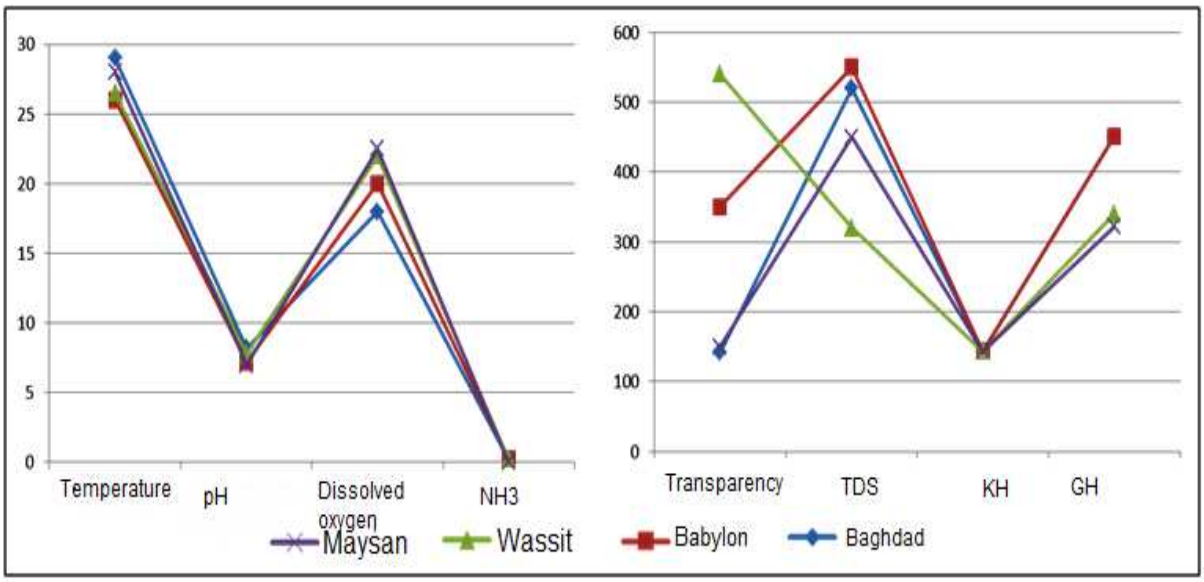

Fig. 1. Parameters of water quality in Baghdad, Babel, Wassit and Maysan governorates.

Fig. 3 shows the average of the total length, standard length, head length as well as the average of fish weight collected from the four governorates for each morphometric parameter at 5% confidence level. The averages of total length of Maysan and Wassit had suppressed, which amounted to 15.76 cm and 14.27 cm respectively. Similarly, the averages of the standard length ad head length of the samples collected from Maysan and Wassit had surpassed its counterpart of Baghdad and Babel governorates.

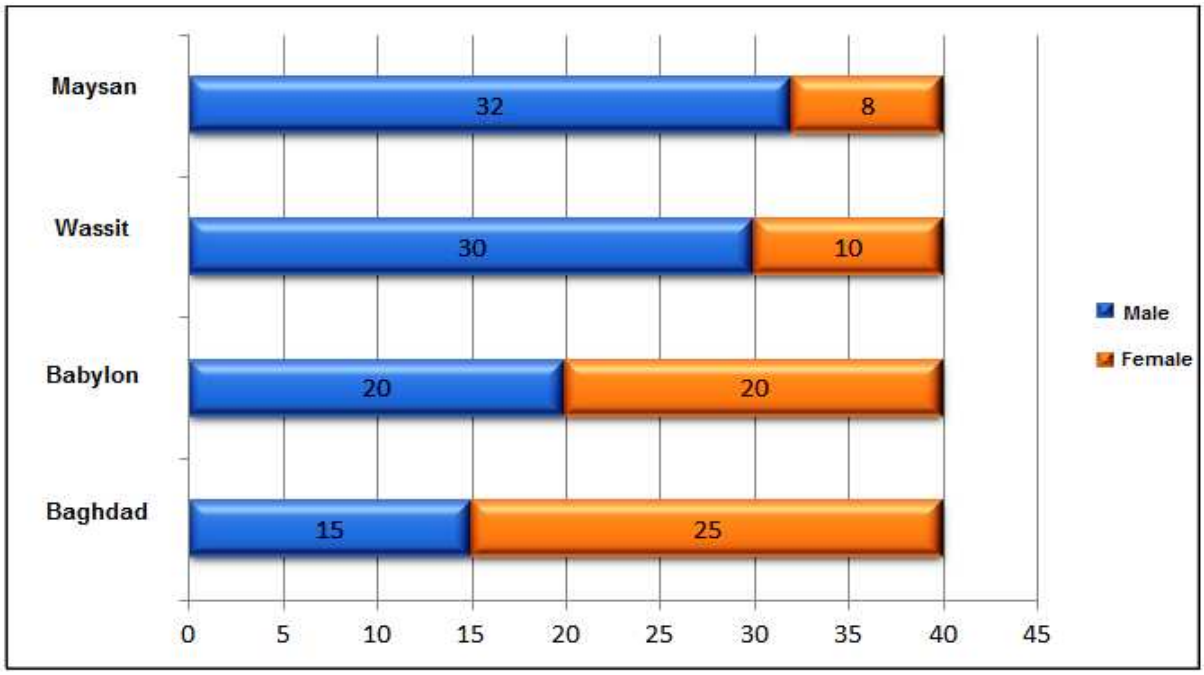

Fig. 2. The number of males and females in the samples collected from the four governorates.

As to the average of fish weight, the samples of Wassit and Baghdad had occupied the second rank after Maysan governorate, and the samples of Babel governorate showed significant decrease in the fish weight with the average of about 72-67 gm.

Innal and Giannetto (2017) found out in their study that the average of the total length of *C. zillii* of different age stages (0-5 years) which was collected out of Burdur lake in Turkey amounted to (8-38 cm) and it was of wide range amounted to (20-5 cm) (2-4 cm) and the fish weight range from (0-16) to (166.10) gm whereas Lalèyè (2006)pointed out that the total length of *C. zillii* collected from Africa ranging from (4.0) cm to (28.0)cm and the standard length ranging from (10 .0) cm to (27.0) Coulibaly (2003).

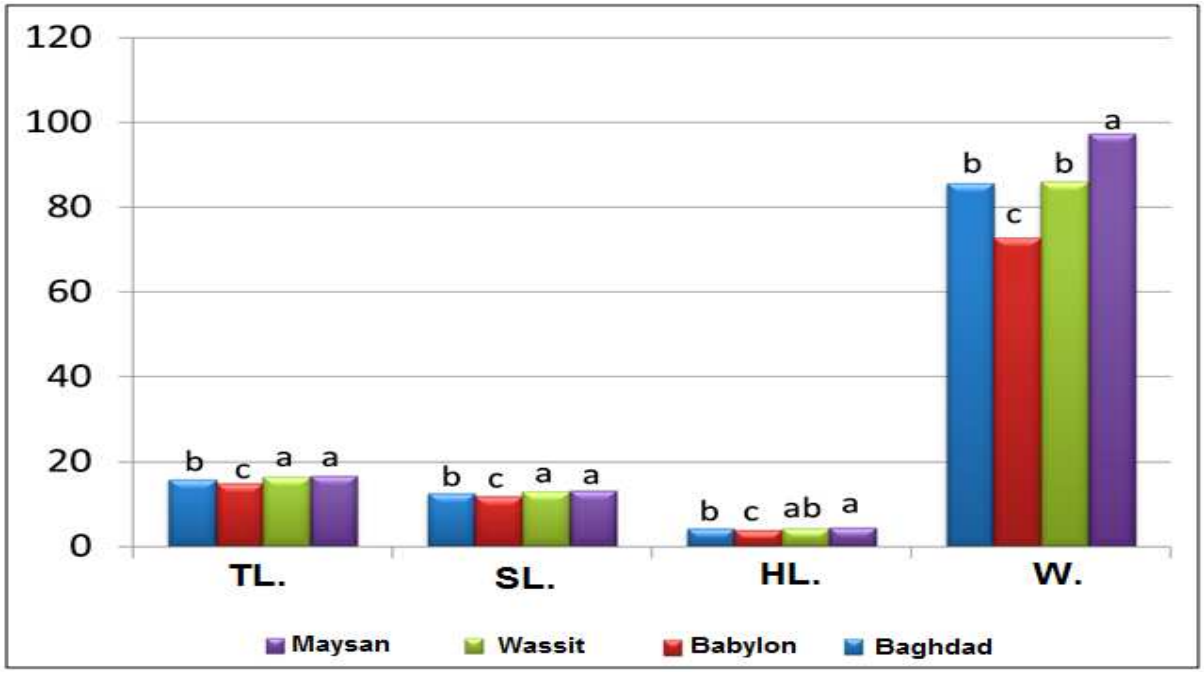

Fig. 3. The average of morphometric measurements of the samples of coptodon zillii in governorates of Baghdad, Babel, Wassit and Maysan.

It is worth mentioning that fish growth was associated with its nutrition activity which was influence by many factors such as the abundance of nutrients in environment and the ability of fish to access to nutriment as well as the energy that fish exerted to collect nutriments (Strauss 1979; Al-Kahem *et al.* 1988; Sulaiman Ai-Akel 2019).

Others pointed out that the relation between fish growth and the average of its nutriment which was related indirectly to the growth of planktons (plants or animals) as well as abundance of nutriments such as nitrates, sulfates, and phosphate. (Qasim 1957; Bal and Jones 1960).

It was noted that Maysan and Wassit waters contained a ratio of dissolved Oxygen higher than other governorates. Thus, this could be a parameter of the abundance of plants planktons. Besides Maysa waters recorded very low ratio of ammonia since the ammonia compound affected negatively on blood ability on Oxygen transformation and could lead to deficit in fish gills and consequently these factors limited the growth and reproduction of fish. Fig. 4 shows the percentage of mature and immature *C. zillii* in the studied governorates. However, Maysan governorate recorded high percentage of sexual Mature *C. zillii* amounted to 80% whereas in Wassit recorded 70% and in Baghdad 60 %.As for Babel governorate which recorded the lowerst percentage among other governorate.

The percentage of sexual mature of male *C. zillii* amounted to 68% whereas the percentage of sexual

immature of male *C. zillii* 29% out of the males of the four samples of four governorates. A s to the total percentage of sexual mature amounted to 45% whereas the total percentage of sexual immature amounted to 18% out of the females of the four samples of four governorates. (As shown in Fig. 5)

The results of the diagaram analysis of the two figures (4) and (5), were consistent with (Dellefors and Faremo,1988) had point out in that the early spotted sexual mature sea male salmon at a total length which was lower than full sexual mature males.

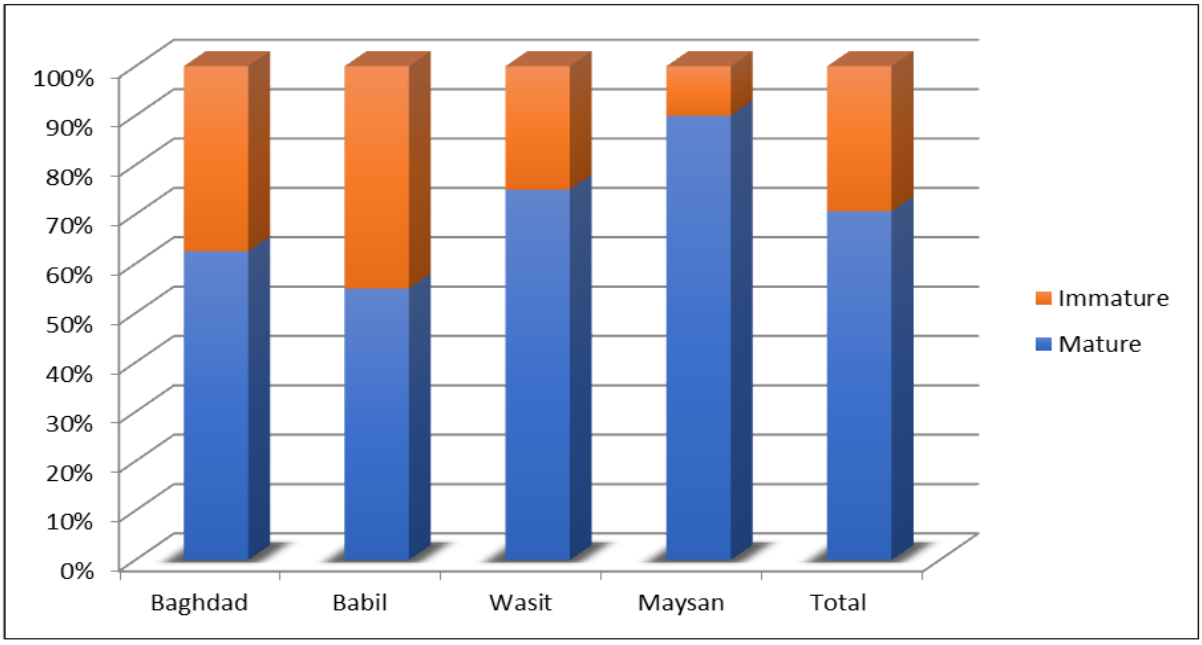

Fig. 4. Percentage of sexual mature ad immature of the four studied governorates.

The results of diagram analysis of Fig. 5 were consistent with (Oso *et al*., 2013) .Oso analysis since the lengths of males and females matched with early fertility for both sexes of *C. zillii* of the four governorates whereas the percentage of the sexual maturation differed from the samples of the four governorates .Thus, the percentage of sexual mature male was (2) and the sexual mature female was (1). (Oso *et al*.,2013) stated that the percentage of male to female was (1 male vs. 3 females) .Additionally , this difference resulted from the reason of a reproduction of *C. zillii* in south west Nigeria .Embryos of fish were influenced during its growth and development by external physical factors in the surrounding environments due to the fact that they were cold blooded fish – one of these factors was temperature .Any fluctuation of temperature could influence the development of embryos , and temperature affected the sexual fertility and maturation of fish (Devlin and Nagahama, 2002) found that the high level of temperatures might enable fish to acquire apparent masculine characters (98%) and acidity level might less affect the sexual limitation of fish (Desprez and Mélard, 1998).

Accordingly, PH was associated with the decline of male ratio (Rubin 1985), Bezault *et al*. (2007) suggested that there were sexual mutations in the samples of *C. zillii* collected from Ethiopia where sexual prematurity of fish had been detected due to the different environmental conditions in terms of maturation and sex differences. (Devlin and Nagahama 2002).

A s a matter of fact sexual mutation was regarded as a developmental response of the local conditions and reproduction of the living organisms .The sexual mutation was associated with many factors such as size and fertility of fish and the social composite of fish communities which play an important role in transforming the sexuality of fish (e.g. the big size female could change its sex in response to the accent

of the male which was responsible of the process of pollination (Warner, 2019).

Results show that there were differences between the samples of *C. zillii* collected from four Iraqi governorates in that the samples of Maysan governorate surpassed significantly the other governors ($p<0.05$) in terms of total length, standard length, weight, ratio of males and females as well as the ratio of sexual maturation whereas the lowerst percentage was investigated in Babel governorate due to the different environmental conditions and water quality.

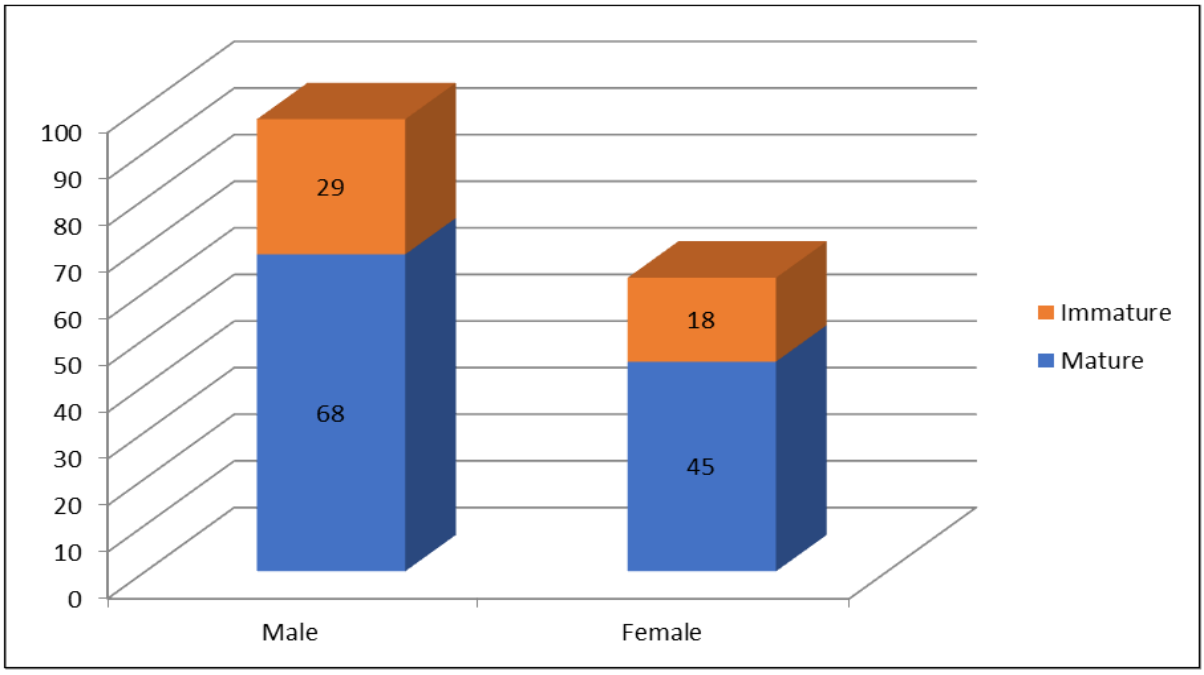

Fig. 5. Percentage of mature and immature coptodon zilli.

Additionally, there was a difference in ratio of males and females in the four governorates since females in Baghdad governorate had surpassed other governorates. As for Wassit and Maysan governorates it was found that males surpassed females remarkably. Results of gonads of the sexual maturation showed that there was not any development of different sexual maturation other than the samples of the four governorates.

Conclusion

It could be concluded that the occurrence of the sexual maturation among *C. zillii* which happened as a result of the Iraqi conditions. It is recommended that there should be a sweeping survey for the rest of the governorates and providing support for the result of an apparent and anatomical investigation by studying the genetic material of fish. The different letter refers to the fact that there are significant differences at confidence level of about 5% among the four governorates – lengths expressed by (cm) and weights by (gm).

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