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Study of sexual dimorphism in Iraqi freshwater fish *Barbus luteus*

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Abstract

The comparison between two sexes of Iraqi freshwater fish *Barbus luteus* that was fished from Tigris river at Baghdad during 2005, revealed that: the distance from head edge to the anal orifice & from head edge to the dorsal fin were larger in males than females. Also, the females have dark colored fins with reddish ventral aspect of head and body in comparison with the males during the whole months of study. So, they were considered as permanently sexual dimorphism characteristics . But , during the spawning season (May and June) a more brightening color of male with reddish coloration of both sides of body were noticed in comparison with females with a golden orange corneal coloration in both sexes. Thus they were considered as temporary sexual dimorphism characteristics.

Key words: Sex, Dimorphism, *Barbus luteus*, Iraqi fish.

Introduction

Fisheries is one of the important natural resources, as it fill the shortfall in food sources for many peoples and face the population increase . The family Cyprinidae is one of the most important and largest freshwater fish families spread all over the world (Al–Sabti, 1991) including Iraq , were it occupies the first place in terms of their species number that spread in most Iraqi schedules , lakes and rivers (Khalaf, 1961; Mahdi, 1962). It also occupies the first place in Iraq economically and the favorite common cyprinidae species to Iraqi peoples are *Barbus esocinus, B. xanthopterus, B. sharpeyi, B. grypus.*

The sexual dimorphism or dichromatism phenomenon is common in fishes and the differences between two sexes may involve secondary sex characters necessary for the accomplishment of copulation, oviposition or incubation or may be so–called accessory characters, witch may not be directly involved in the mechanics of reproduction but are important to recognition, courtship or other reproductive behavior (Bond, 1979).

morphological recognize between two sexes useful when the fishes are present in polluted water , because many studies have shown that the pollution effect not only fish physiology and reproduction but, it cause sex reversal in fish (Borton *et.al.*,1989; Jones and Reynolds, 1997; Edmunds *et.al.*, 2000;bÖrn *et.al.*,2003; Ankly and Johanson, 2004). This morphological differences might be permanent or temporary related to the spawning season (Reimchen and Nosil, 2004) or to growth stages & environment (Chellappa *et.al.*, 2003; Fuller and Travis, 2004; Hilton and Fernandes, 2006).

The studies that interested with sexual dimorphism in Iraqi fishes were few, including a study of *Barbus sharpyei* and *B. grypus* (Al–Hakeem, 1976) and a study of *Silurus triostegous* (Al–Sayab, 1988) and *Varicorhinus damascinus* (Al–Dori and Ghanim, 2001). But universally many studies on this subject have done and recorded differences between males and females in terms of size, fins shape, jaws, snout & permanent extra autosomal structures, it also included temporary characteristics observed during spawning season like nuptial tubercles, fin rays shape, shape or color patterns and coloration (Berglund *et.al.*, 1986; Johanston, 1989; Brodziak and Mikus, 2000; Goforth, 2000; Chen *et.al.*, 2001; Hatch, 2004; Phillips, 2004; Brian, 2004a; Brian, 2004b; Vainikka *et.al.*, 2005) .

Due to the importance of this subject and the few studies in this side, the present study aimed

to record or determination of permanent and temporary characteristics in *Barbus luteus* fish.

Materials and Methods

In the present study 199 fish of *Barbus luteus* were used, the total length of males range from (10.6 cm) to (23 cm) and weight range from (17.2 gm) to (149.2 gm) while, total length for females ranged from (9.8 cm) to (23.8 cm) and weight between (12.6 gm) to (170.3 gm). Age in males ranged between 4 & 5 years as well as in the females.

The samples have been fished from Tigris river in Baghdad starting from January 2005 until the end of December of the same year twice per month during all months of study. In the present study 199 fish of *Barbus luteus* were used , the total length of males range from (10.6 cm) to (23 cm) and weight range from (17.2 gm) to (149.2 gm) while, total length for females ranged from (9.8 cm) to (23.8 cm) and weight between (12.6 gm) to (170.3 gm). Age in males ranged between 4 & 5 years as well as in the females. The samples have been fished from Tigris river in Baghdad starting from January 2005 until the end of December of the same year twice per month during all months of study. The permanent and temporary sexual dimorphism characteristics were identified depending on the characteristics referred by other researchers, as well as other characteristic proposed in this study:

First–permanent standard characteristics:

1 – Total length .
2 – Standard length .
3 – Fork length .
4 – Snout length .
5 – Barbles length .
6 – Eye diameter .
7 – Fin base length .
8 – Number of fin rays .
9 –The distance from head edge to the anal orifice
10 – The distance from head edge to the dorsal fin
11 – The distance from the end of dorsal fin to the base of caudal fin .
12 – The distance from pectoral to the pelvic fins .
13 – The distance from pelvic to the anal fin .
14 – The distance from dorsal fin base to the lateral line .
15 – Body depth .
16 – Lateral line scales number .

Second – permanent descriptive characteristics :

1 – Shape & color of body .
2 – Shape & color of fins .
3 – Head shape .
4 – Mouth shape .
5 – Barbles color .
6 – Color of the eye cornea .
7 – Coloration certain eras of the body .
8 – Fin rays shape .

Third – temporary descriptive characteristics :

1 – Body color .
2 – Appearance of nuptial tubercles .
3 – Appearance of extra coloration structures in body .
4 – Coloration certain eras of the body .
5 – Fin rays shape .
6 – Fin color .
7 – Barbles color .
8 – Lips color .
9 – Color of the eye cornea .

Results and Discussion

The comparison between males and females of *Barbus luteus* in some body measurements represented by the snout length, barbles length, eye diameter, number of scales in the lateral line, fin base length and number of fin rays (Table 1) and the distance from head edge to the anal orifice, the distance from head edge to the dorsal fin, the distance from dorsal to caudal fin, the distance from dorsal fin base to the lateral line, the distance from pectoral to pelvic fins, the distance from pelvic to the anal fin and body depth (Table 2) showed no difference between both sexes, where values were recorded close or nearly identical, with the exception of (the distance from head edge to the anal orifice and the distance from head edge to the dorsal fin) has been found it larger in males than females. Study of the significant difference for these two characteristics using F- test (Table 3) showed that the differences in the distance from head edge to the anal orifice was significant degree confidence of 95% in most study months exception of months (May, November and December). The difference was significant whether the rate of total length for the males higher than females as in the months (January and July) or less than in females as in the months (Jun, August and September). A proportion study this character of the total length, the ratios in males (61.9–67) higher than females (49–61.2) in most months and less differences between them recorded in months (January, October and December). Either the difference between two sexes in the distance from head edge to the dorsal fin, was significant degree

of confidence 95% in the months (January, Jun, July and November) and the percentage of this characters from the body total length in males (42.2–53.2) higher than females (37.5–41.8), the high difference was recorded in months (January, May, Jun, July and November), less difference was recorded during the months (August , September , October and December). Depending on this results, the distance from head edge to the anal orifice and the distance from head edge to the dorsal fin can be considered as permanent sexual dimorphism characteristics in *Barbus luteus.* Also in this study we observed difference in some descriptive characteristics , as it found that the color of fins in females dark than males (Figs. 1, 2, 3 and 4) and the ventral aspect of females head was more redness than males (Figs. 5 and 6) as well as the ventral side of female body (Fig. 7). During spawning season (May and June) we observed that body color in the male was more brightness (reddish golden) compared with female and both sides of the body more redness than female and eye cornea color was orange to golden in both sexes (Figs. 8 and 9), so these characteristics might be temporary sexual dimorphism characteristics in *Barbus luteus.*

The present study recorded for the first time number of characteristics not referred in the previous local studies , which adopted the shapes and length of fins and the distance between pelvic and anal fins acting as permanent sexual characteristics in *Barbus sharpeyi* fish (Al–Hakeem, 1976). Shape of genital papilla in *Silurus triostegous* fish (Al–Sayab, 1988) . Shape of body , head, fins as a permanent characteristics and appearance of nuptial tubercles as a temporary characteristic in *Varicorhinus damascinus* fish (Al–Dori and Ghanim, 2001). Bond (1979) was conclused that the differences between male and female may involved secondary sex characters necessary for the accomplishment of copulation , oviposition or incubation, which may not be directly involved in the mechanics of reproduction but, are important to recognition , courtship or other reproductive behavior. Berglund *et.al.* (1986) suggested that the sexual dimorphism may result from three basically different forces: first, natural selection acts on fecundity and may produce different patterns of size–specific fecundity in the two sexes. It's for instance, common to many species that a larger size in female increases their fecundity, while the same may not be true in males.

The second force is natural selection for reduced food competition between the sexes , so that , for instance, the larger sex exploits larger food items. Third, sexual selection for enhanced mate acquiring ability, where many animal males compete in order to get females, so they have to show sexual pro forma or color patterns when competing (Berent *et.al.*, 1998). The female is more accurate in mate selection compared with female , as well as the males competition in order to achieve mating with females , which are either fighting among themselves or coloring (Harvey, 2002). It's well known that secondary sexual characteristics representing sexual signal appear in sex, which declares its ability to reproductive and not the sex who is selection (Vinikka *et.al.*, 2005). So , it can representing the female of *B. luteus* as the sex who select appropriate mate for reproduction & the male is the sex which declares itself through discoloration of the body or parts of it by brighter colors compared to the female during spawning season.

It was previously noted that the difference in the distances recorded between certain types of fins, size of the fin base and fins lengths between the sexes is due to the effect of sex hormones on these characteristics (Al-Hakeem, 1976) based on this, it could be that the explanation of the difference recorded in somatic measurements in *B. luteus* males.

It was reported that change of body color or parts of it are known condition in cyprinidae family and was attributed this situation to the impact of the environment which the fish were present (Fuller and Travis, 2004). Can prepare this explanation of discoloration ventral aspect of the head and body in the *B .luteus* female.

The lack of continuation appearance of the temporary sexual dimorphism characteristics during all months of 2005, and its appearance only during spawning season and due to the fact that the appearance of secondary sexual characteristics linked to sexual steroid hormone (Nikolsky, 1963; Hilton and Fernandes, 2006). So the appearance of temporary sexual characteristics during spawning season due to the effect of environmental factors that often vary depending on the season , so an influential on sex hormones responsible for the appearance of secondary sexual characteristics in fish (Quintana *et.al.*, 2004).

Fig. (1): The pectoral fins color of *Barbus luteus* female darker than male in the photo bottom.

Fig. (2): The anal and caudal fins color of *Barbus luteus* female darker than male in the photo bottom.

Fig. (3): The pelvic fins of *Barbus luteus* female dark colored.

Fig. (4): The pelvic fins of *Barbus luteus* male light colored.

Fig. (5): Redness of ventral aspect of the *Barbus luteus* females head.

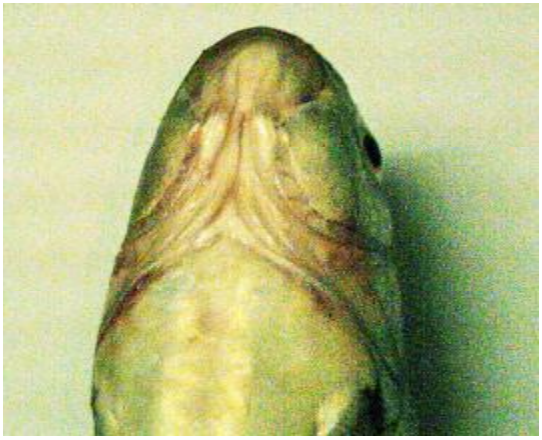

Fig. (6): The ventral aspect of the *Barbus luteus* males head not reddish.

Fig. (7): Reddish colored of *Barbus luteus* females ventral body compared with the male in the photo bottom.

Fig. (8): Brightness body colored with reddish of both body sides & orange cornea colored in *Barbus luteus* male during spawning season.

Fig. (9): Normal body colored with no reddish of both body sides & orange cornea colored in *Barbus luteus* female during spawning season.

Table (1): Special morphological characteristics of *Barbus luteus* fish during 2005.

Sampling months	Fish sex	Fish number	Snout length (cm)	Barbles length (cm)	Eye diameter (cm)	Lateral line scales number	Fin base length (cm)				Fin rays number				
							Dorsal	Pectoral	Pelvic	Anal	Caudal	Dorsal	Pectoral	Pelvic	Anal	Caudal
January	Male	9	0.9	0.3	0.7	82	2.4	0.7	0.6	1	1.8	13	12	10	9	23
	Female	6	0.9	0.3	0.8	28	2.5	0.6	0.5	1	1.9	14	12	10	9	23
May	Male	23	1	0.3	0.8	29	2.5	0.6	0.5	1	1.9	14	12	9	9	23
	Female	15	0.9	0.3	0.8	28	2.5	0.6	0.6	1	1.9	14	12	10	9	23
June	Male	25	1	0.3	0.8	30	2.5	0.7	0.6	1	1.8	13	12	10	9	23
	Female	10	1	0.3	0.8	28	2.4	0.6	0.6	1	1.8	13	12	10	9	23
July	Male	7	0.9	0.3	0.7	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23
	Female	9	0.9	0.3	0.7	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23
August	Male	7	1	0.3	0.8	29	2.5	0.7	0.6	1	1.9	14	12	10	9	23
	Female	6	1	0.3	0.8	30	2.4	0.7	0.6	1	1.9	14	12	9	9	23
September	Male	15	1	0.3	0.8	28	2.4	0.7	0.6	1	1.8	14	12	10	9	23
	Female	15	1	0.3	0.8	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23
October	Male	10	1	0.3	0.7	29	2.4	0.6	0.5	1	1.9	13	12	10	9	23
	Female	6	0.9	0.3	0.7	30	2.4	0.6	0.6	1	1.9	14	12	10	9	23
November	Male	4	0.9	0.3	0.7	28	2.4	0.6	0.6	1	1.8	14	12	10	9	23
	Female	13	1	0.3	0.8	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23
December	Male	8	1	0.3	0.8	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23
	Female	11	1	0.3	0.8	28	2.5	0.7	0.6	1	1.9	14	12	10	9	23

Table (3) : permanent sexual dimorphism characteristics in *Barbus luteus* fish during 2005.

Fish sex	Fish number	Total length average	The distance from head edge to the anal orifice	Percent from total length	The distance from head edge to the dorsal fin	Percent from total length	Sampling months
Male	9	17.3	11.2 * ± 0.282	64.7	7.4 * ± 0.239	42.7	January
Female	6	16.5	10.1 * ± 0.1	61.2	6.2 * ± 0.214	37.5	
Male	23	16.6	10.5 ± 2.31	63.2	7.5 ± 1.593	45.1	May
Female	15	18.4	10 ± 1.93	54.3	7 ± 1.426	38	
Male	25	13.1	8.6 * ± 0.687	65.6	7 * ± 0.651	53.4	June
Female	10	15.1	7.9 * ± 0.368	52.3	6.1 * ± 0.541	40.3	
Male	7	17.6	11.2 * ± 2.019	63.6	7.7 * ± 0.996	43.7	July
Female	9	16.4	9.3 * ± 1.231	56.7	6.3 * ± 0.866	38.4	
Male	7	18.4	11.9 * ± 0.297	64.6	7.8 ± 0.251	42.3	August
Female	6	19.1	10.2 * ± 0.228	53.4	7.2 ± 0.985	37.6	
Male	15	20.6	12.9 * ± 0.701	62.6	8.7 ± 0.477	42.2	September
Female	15	21.6	10.6 * ± 0.561	49	8.2 ± 0.545	37.9	
Male	10	14.9	9.4 ± 1.24	63	6.8 ± 0.607	45.6	October
Female	6	14.6	8.8 ± 1.008	60.2	6 ± 0.515	41.7	
Male	4	19.1	12.8 * ± 0.2	67	9 * ± 0.635	47.1	November
Female	13	19.8	12 * ± 0.525	60.6	8 * ± 0.329	40.4	
Male	8	17.6	10.9 ± 1.098	61.9	7.7 ± 0.525	43.7	December
Female	11	17.2	10.5 ± 1.994	61	7.2 ± 1.296	41.8	

* detects to the significant differences at level (p = 0.05)

Table (2) : Special body measurements of *Barbus luteus* fish during 2005.

Fish sex	Fish number	The distance from head edge to the anal orifice (cm)	The distance from head edge to the dorsal fin (cm)	The distance from dorsal to the caudal fin (cm)	The distance from dorsal fin base to the lateral line (cm)	The distance from pectoral to the pelvic fins (cm)	The distance from pelvic to anal fin (cm)	Body width (cm)	Sampling months
Male	9	11.2	7.4	3	3	3.6	3	6	January
Female	6	10.1	6.2	2.8	2.8	3.4	3	6	
Male	23	10.5	7.5	4.1	3.3	3	2.8	6	May
Female	15	10	7	4.3	3.4	3	2.6	6	
Male	25	8.6	7	3.2	3	2.8	2.6	6	June
Female	10	7.9	6.1	3.4	3	3	2.5	5.8	
Male	7	11.2	7.7	4.1	3	3.5	3	6.3	July
Female	9	9.3	6.3	3.9	3	3.2	3	6.5	
Male	7	11.9	7.8	4	3.5	4	3	7	August
Female	6	10.2	7.2	4.2	3.4	4	3	7	
Male	15	12.9	8.7	5	3.8	4.2	3.4	7	September
Female	15	10.6	8.2	5	4	4	3.3	7	
Male	10	9.4	6.8	3.6	3.4	3	2.8	6	October
Female	6	8.8	6	3.7	3.5	3	2.8	6	
Male	4	12.8	9	4	3.8	3.5	3	6.6	November
Female	13	12	8	4.3	4	3.6	3	6.5	
Male	8	10.9	7.7	4.1	3.8	4	3.5	7	December
Female	11	10.5	7.2	4.3	4	4	3.4	7	

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