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Biological Studies of Cyprinid Fish, *Barbus luteus* (Heckel) From Al-Hammar Marsh in Southern Iraq

دراسة النواحي البيولوجية لسمك *(Barbus luteus)* في منطقة هور الحمار بجنوب العراق.

ن .أ. ناصر
N A Nasir
Marine Environment and FishFarming Affairs, Briarcoft Estate
Glasgow G33 1 RA UK

ABSTRACT: This study was carried out over period of one year to investigate some aspects of the biology of *Barbus luteus* (Pisces: Cyprinidae) in the Al-Hammar marsh area of Iraq. The fish are most abundant between Feburary and June, followed by a steady decrease towards the end of the year. A mean monthly mortality rate of 35% per month was recorded. Total length and weight of 1002 fish collected ranged between 120-320mm (mean: 174mm) and 21-275gm (Mean: 79gm) respectively. Numerically, the samples were dominated by females. They accounted for about 52.7% of the total catch. The population of *B. luteus* was dominated by 2+ year-olds for both sexes and they matured at this age. The mathematical relationship between the weight and length of the fish was determined. The values of the exponent (b) showed that females are generally heavier at a given length than males. The food taken by the fish was studied and it was found that the fish is principally a surface phytoplankton feeder.

Key-words: Fresh water fish, Cyprinidae, *Barbus luteus*, Distribution. Feeding, Food, length weight.

المستخلص: استغرقت هذه الدراسة حوالي سنة واحدة لغرض بحث النواحي البيولوجية لأسماك الحمري *Barbus luteus* في منطقة هور الحمار في جنوب العراق، ولوحظ في هذه الدراسة بأن الكمية الكبيرة للأسماك تتواجد خلال الفترة بين شباط وحزيران، وبعد تلك الفترة تبدأ كميتها بالانخفاض تدريجيا. استنتجت هذه الدراسة بأن الإناث تشكل نسبة عالية من الصيد مقارنة بالذكور وبلغت نسبته حوالي ٥٢,٧٪ من المجموع الكلي. كما إن النسبة العلية من الأسماك تصل مرحلة بلوغها عند سنتين من العمر. ومن خلال دراسة القيمة الاسية (b) لمعادلة علاقة الطول مع الوزن، أثبتت بان إناث هذه الأسماك أثقل وزنا من الذكور عند طول معين. كما تم دراسة تغذية هذه الأسماك، حيث أوضحت النتائج بأن الهائمات النباتية المتواجدة عند سطح الماء تشكل الغذاء الرئيسي لها.

كلمات مدخلية: اسماك الحمري، العراق ، بيولوجي، تغذية.

Introduction

Barbus luteus (Heckel), (Pisces: Cyprinidae), locally called Al-Hamrie, plays a significant role in fisheries throughout the freshwater system of Iraq as a source of protein and fishing sport.

References to the morphometric and meristic characters of B. luteus (Khalaf, 1961; Al-Nasiri and Shamsul-Hoda, 1976) are available but little information relating to its biological aspects has been reported (Shamsul-Hoda, 1978). Some biological studies on other important cyprinid species (*Barbus sharpeyi*) have been done by several study groups (Al-Daham, 1977, 1984; Nasir, *et al.*, 1989). Therefore, the present investigation was designed to determine the abundance, length – Weight relationship and food of *B. luteus* in the southeastern part of Al-Hammar Marsh (Fig. 1). This marsh is located in the north Basrah Province, Iraq (Approximately 30 30/ - 30 55/ N and 47 00/ - 47 45/ w). The monthly temperature and salinity of the water ranged from 11.5 c in December to 34.5 c in August and 1.1% in August, to 4.6% in November respectively. It is a highly productive fishery area and is one of the most important areas used for landing freshwater fish in Iraq (Al-Daham, 1984). Other details and description s of this area are well documented by previous studies (Khalaf, 1961; Naama *et al.*, 1988; Nasir, *et al.*, 1989).

Materials and Methods

Sampling was carried out regularly during each month from January 1986 to December 1986 using

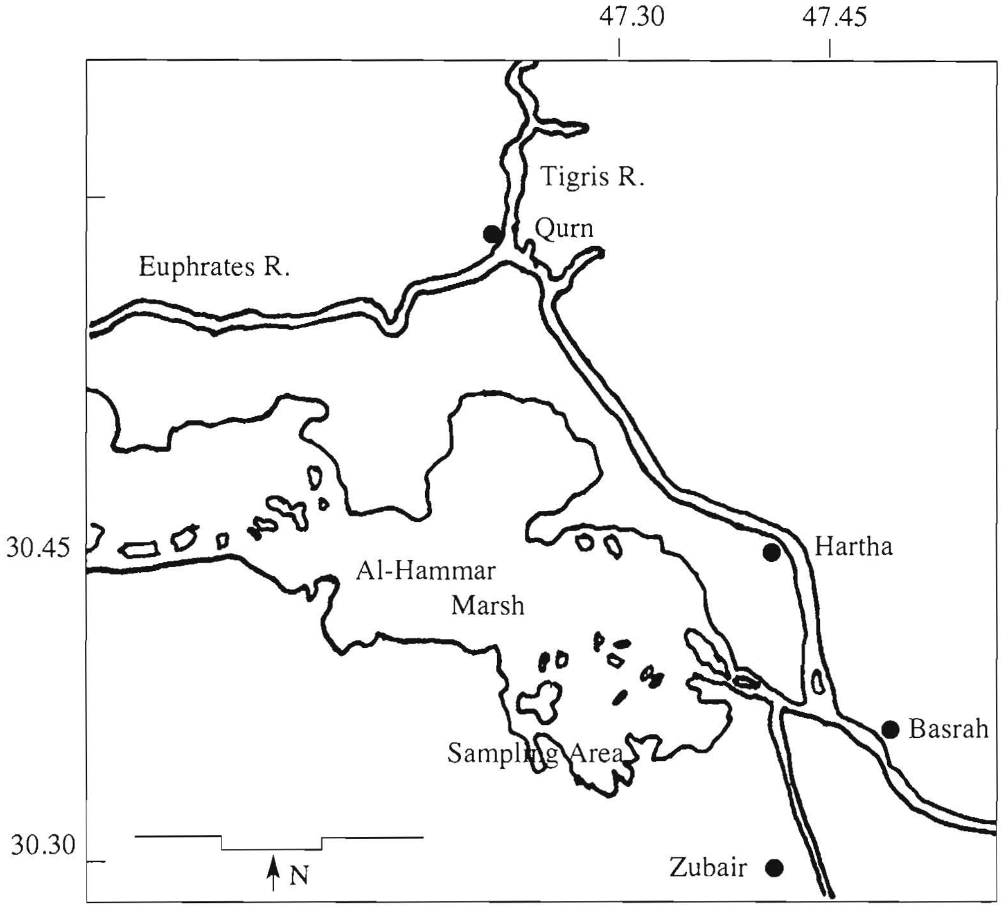

Fig.1. Map of Al-Hammar Marsh showing the sampling area.

a 12 X 70m seine net of mesh size 25 X 25mm (Nasir, *et al.* 1989). Six hauls were done for each survey and carried out in daylight. The fish were weighed, measured and sexed immediately. The age of the fish was also checked by examination of their scales (Nasir *et al.,* 1989).

At the end of each haul the fish were sorted and preserved on ice and transported to the laboratory, where they were measured and weighed. Stomach contents were dissected and kept in 10% neutral formaline. The number of full and empty stomachs were recorded. The stomachs' fullness were assessed and a maximum of 8 points was awarded to a full stomach (Hynes, 1950; Nasir, 2000). The food from each fish stomach was identified and divided into main groups. A proportion of the total points awarded to the stomachs was allotted to each goup according to its relative volume (Hynes, 1950, Lande, 1973, Hyslop, 1980). The results were also analysed by the occurrence method (Hynes, 1950; Lande, 1973; Hyslop, 1980), by which the number of stomachs containing each food group was expressed as a percentage of the total number of stomachs examined.

Radforth (1940) reported that different methods may produce quite different results. Windell (1971) suggested that combined indices are more valuable than single indices. Several combinations have been used by many biologists (Dragovitch, 1970; Tyler, 1972; Lande, 1973). For this work, the relative importance of index (RIa) for food type has been used and calculated as:

$$R/a = \frac{100\ Ala}{Ala \atop A=1} \quad \text{(George and Hadley, 1979)}$$

Where:

Ala is the absolute importance index for a, ala = % frequency of occurrence = % total volume for food type a, and n is the number of different food types.

Total mortality (A) and instantaneous mortality (z) were calculated following Ricker (1975):

$$\frac{N1}{N0} = e^{-z}$$

But

$$\frac{N1}{N0} = S$$

$$S = e\text{-}z$$

Therefore A = 1 – S

Where:

S is natural survival rate, N0 is the number of the fish present at time to and N1 the number of fish present at time t1.

The length-weight relationship of the fish was determined as:

W = a L b (Le Cren, 1951)

Where: W = weight of fish in gm.
L = total length of fish in mm.
a and b are constant.

Results

Distribution

The seasonal variation in the number of *B. luteus* is shown in Table 1. This shows that the fish are more abundant between February and June, followed by a steady decrease in numbers towards the end of the year. The monthly mortality rates ranged from 23% to 43% (Table 1).

As the period between t0 and t1 ranged from 28 to 32 days, it is more appropriate to calculate the instantaneous mortality rate per day (Table I) and to relate them with their initial population densities. This relation is given in the following formula:

Z=0.0216 + 0.0044 p (n = 6. r=0.788, p< 0.001).

Where:

Z = the instantaneous mortality rate per day X 100

P = the population density of *B. luteus*

Table 1. Mortality parameters for Barbus luteus in Al-Hammar marsh.

B. leteus density at the beginning at t = 0		B. leteus density at the present time at t = 1		Z	S	A (1-S x 100
Date	No. of fish	Date	No. of Fish			
5 Jan	0	4 Feb.	32	--	--	--
4 Feb	32	3 Mar.	80	--	--	--
3 Mar.	80	4 Apr.	176	--	--	--
4 Apr.	176	5 May	188	--	--	--
5 May	188	4 Jun.	212	--	--	--
4 Jan.	212	3 Jul.	121	0.561	0.571 (1.870)	43
3 Jul.	121	1 Aug.	72	0.519	0.595 (1.730)	41
1 Aug	72	2 Sept.	47	0.426	0.653 (1.331)	35
2 Sept.	47	1 oct.	36	0.267 (0.890)	0.766 77*	23
1 Oct.	36	2 Nov.	22	0.492	0.611 (1.537)	39
2 Nov.	22	3 Dec	16	0.318	0.727 (0.994)	27

NB: Instantaneous mortality rate / day x 100 are parenthesis.
Z = Instantaneous mortality rate; S = Natural survival rate; A = Total mortality rate.

Table 2. Sex ratio in the different length groups of barbus leteus from Al-Hammar marsh, Iraq.

Length Group (mm)	No. of Males	No. of Females	Sex ratio
120-149	162	144	1:07
150-192	192	144	1:08
180-209	66	174	1:26
210-239	42	84	1:20
240-269	12	0	-
>270	0	12	-
Total	474	528	1:11

This was comparable to the same formula calculated by Nasir *et al.* (1989) for *B. sharpeyi* as:

$$Z=0.7857 + 0.0040 P(n = 8. r=0.804, p< 0.001).$$

A total of 1002 fish were caught, of which 52.7% were female and 47.3 were male (1.1 female: 1 male). When the fish are grouped according to length, females also exceed males in some length groups, especially in the length group 180 – 209 and 210 – 239mm (Table 2).

Age and Maturity

The population of *B. luteus* was dominated by 2+ year-olds for both sexes. The youngest and oldest fish were 1+ and 5+ years old for males and 1+ and 6+ years old for females, though in fact, both sexes matured at two years old.

Length-Weight Relationship

The relationship between the length and weight of the fish is as follows:

Males: $W = 1.809 -05\ L\ 2.943$ ($n = 450$, $r = 0.982$, $p < 0.001$).
Combined: $W = 1.073 -05\ L\ 3.054$ ($n = 450$, $r = 0.979$, $p < 0.001$).
Both sexes: $W = 6.618 -04\ L\ 2.696$ ($n = 900$, $r = 0.956$, $p < 0.001$).

Relationship between Total Length (T.L) and Standard Length (S.L).

It is important to estimate one type of length measurement from another (Carlander and Smith, 1945; Nasir, 1985; Nasir *et al.*, 1989). The relationship between total (T.L.) and standard length (S.L.) was found for *B. luteus* in this study to be:

$$\text{Log (S.L.)} = 0.05952 = 0.8098 \text{ Log (T.L.)}$$
$$(n = 700, r = 0.983, p < 0.001).$$

Stomach Contents

The stomach contents of a total 868 *B. luteus* were examined of which 29% were empty. The average fullness value being 27% (Range = 18 – 50%). The identification of the some food items to the generic/specific levels was difficult owing to the state of the digestion. To investigate possible changes in feeding habit with changes in size, this data was analysed separately for six sized groups of the fish. A summery of percentage occurrence and percentage point values of food items for each size groups of the fish is presented in Table 3. The RIa values for *B. luteus* are also presented in Table 3. These values revealed that phytoplankton predominate in the food of this fish at all sizes and made up approximately 50%, 72%, 55%, 65%, 58% and 68% respectively for the six size groups. The phytoplankton was represented in the stomachs by Bacillariophyta, Chlorophyta, Cyanophyta and Rhodophyta.

Bacellariophyta comprised by far the most important part of the diet for all fish size classes. Their RIa values were about 28%, 26%, 27%, 32%, 46% and 35% respectively (Table 3).

Crustaceans were mainly represented in the diet of the fish by Copepods and Rotifera. Other crustacean components occurred occasionally such as Amphipods and Crabs. Copepods were represented in the stomachs by both Calanoid and Harpacticoid species, which were the most important crustaceans occurring in the stomachs. This may be related both to the activity and the abundance of these species. Individual amphipods only occurred in the stomach of one fish which was 130 mm in length.

Discussion

B. luteus made their first appearance in this place in February. (Nasir, *et al.*, 1989) observed a similar phenomenon in the same area for other cprinid species, (*B. sharpeyi*).

It is clear from these data that the mean mortality rate was 35% per month. Nasir *et. al.* (1989) estimated a mortality rate of about 32% for *B.sharpeyi*. The highest value of instantaneous mortality rate for this study was found during the

Table 3. The percentage occurrence (0) and points (P) Of the common food items in the diet of barbus Leteus from Al-Hammar marsh, Iraq.

Fish length group (mm)	120-149	150-179	180-209	210-239	240-269	>270
No. Stomach examined	182	336	216	110	12	12
No. Empty stomach	70	112	60	10	0	0
% Stomach fullness	20	18	25	20	30	50
Food items	0 P % %	0 P % %	0 P % %	0 P % %	0 P % %	0 P % %
Phytoplankton						
Bacillariophyta	76 27 (28.2)	44 37 (25.6)	62 22 (26.5)	60 30 (31.6)	100 54 (46.1)	100 39 (34.8)
Chlorophyta	38 9 (12.9)	31 27 (18.4)	39 11 (15.8)	40 17 (20.0)	-	100 34 (33.5)
Cyanophyta	25 9 (9.3)	63 10 (23.1)	23 4 (8.5)	30 9 (13.7)	33 8 (12.3)	-
Cyanophyta	-	13 2 (4.8)	8 5 (4.1)	-	-	-
Zooplankton						
Amphipoda	13 6 (5.2)	-	-	-	-	-
Copepoda	50 24 (20.3)	19 8 (8.5)	31 15 (14.5)	20 15 (12.3)	67 27 (28.1)	-
Decapoda	13 9 (6.0)	-	8 10 (5.7)	-	-	-
Rotifrera	-	13 5 (5.7)	23 25 (15.1)	10 15 (8.8)	-	-
Detritus	50 16 (18.1)	31 11 (13.9)	23 8 (9.8)	30 9 (13.6)	33 12 (13.5)	100 27 (31.7)

period between June and July (0.561) and lowest during September and October (0.267). This was also considerably larger than the findings of (Nasir *et. al.*, 1989) for *B.sharpeyi* in the same area. This calculation of the high mortality rate represents the rate of the decline in population and should not therefore be used as a direct measure of mortality. The decline may be due either to a change in the availability of the fish to the fishing gear or to gear, selectivity, or to emigration, or a combination of all these factors. In all cases the effect of mesh selectivity is unknown. There may have been an underestimation of the numbers of larger fish due to gear avoidance, and this could resemble "Lee's phenomenon" (Ricker, 1975), which would suggest a different mortality rate which increased with size. The emigration of Iraqi fishes with increasing size has been previously reported (Khalaf, 1961; Al-Daham, 1977, 1984). A High mortality rate also resulted from high intraspecific predation and starvation. The last was not the cause of death of *B. luteus*, since all the fish caught were in good condition. However, fish weakened by starvation could be taken more easily by predators than healthy fish. Predation of the fish in Al-Hammar marsh may occur by birds and other fish (Khalaf, 1961; Al-Daham, 1977, 1984; Naama *et. al.*, 1986). The population increases initially as a result of the settlement of newly arrived fish. After reaching a maximum towards the end of June, when immigration can be shown to have ceased by the lack of newly metamorphosed fish in the samples, the population then decline.

Present results on the sex composition indicate that for the whole sample the sex – ratio was not significantly different. This finding was comparable to the sex ratio of the mullet *Liza Abu* (Mugilidae) in the same place (Naama *et al.*, 1986). Different results have previously been suggested by Nasir *et al.* (1989) for another Cyprinidae species (*B.*

sharpeyi) in this sampling area. However, the causes of unequal sex are unknown. Both sexes of *B. luteus* matured at two years old. This observation is of some interest as Al-Daham (1977) reported that *B. luteus* matured at 2+ year-olds in Iraqi freshwater. The first appearance of mature fish in the area sampled during this study was in March. This result suggests that Al-Hammar Marsh is the spawing ground for this species, which agrees with the findings of Al-Daham (1977) in Iraqi freshwater. He reported that the earliest spawning of this fish species takes place in March and continues throughout April and May.

The values of the exponent for the length-weight relationship show that females are generally heavier at a given length than males, probably because of the difference in fatness and gonad development (Le Cren, 1951; Nasir, *et al.*, 1989). The correlation coefficient was found to be positively high and to differ significantly for the above relationships. This indicated that the values of the slope (b) were always different from the "ideal" value of (3). In general, the fish showed the isometric condition ($b = 3$) (Tesch, 1968). This relationship and the isometric growth pattern in other cprinid fish from the same area (*B. sharpeyi*) has also been described by Nasir, *et. al.* (1989).

However, both sexes of all fish caught which were matured were larger than 240mm in size. This indicates that *B. luteus* attain maturity at a lesser size than *B. sharpeyi* in Iraqi freshwater systems (Al-Daham, 1977). Variations in fish size could affect the preferred food, Nilson (1978) reported that as fish size increases, energy epent in catching smaller prey becomes uneconomic. This small change in food habits is useful as it reduces intraspecific competition (Hynes, 1961) and allows more efficient utilization of the habitat resources (Sheldon, 1969). However, if intraspecific or interspecific competition in small individual organisms becomes very strong, the older fish are more likely to suffer from malnutrition and may eventually die of starvation or concommitant ills.

The fine flexible teeth that this species possesses and presence of filamentous algae (Phytoplankton) and detritus in the stomach (Table 3), suggest that it grazes on the fine algal growths on the sides of the marsh in which it lives. The food taken by B. sharpeyi was dominated by filamentous algae and diatorms (Nasir *et al.*, 1989). It could be suggested from this study that *B. luteus* might be in direct competition for algal species. Such crustacean food as was present may have been taken incidentally while grazing the algae.

The relationship between total (T.L.) and standard length (S.L.) was also different from the findings by Nasir *et al.*(1989) for *B. sharpeyi* from the same area (Log (S.L.) = 6.9427 + 0.7661 Log (T.L.)).

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