Study of some Reproductive Characteristics of Cyprinus Carpio (L., 1758) from Main Outfall Drain in Al-Qadisiyah City, Iraq.

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Abstract

Sex ratio and gonadosomatic indices of fish give important indexes about the reproductive biology for the species. This study was conducted to investigate the reproductive dynamics of the common carp (Cyprinus carpio) species in the MOD, middle Iraq, for a period between January and December 2017. Where the sex ratio, fecundity and gonadosomatic index (GSI) were assessed and calculated throughout the year. Fish samples were captured by using the different fishing traditional methods to get all the sizes without bias. Total mean of the female to male sex ratio was 1:1.22 and ranged from 1:0.67 in December to 1:1.75 in April. The highest average of fecundity was for the female and male at the age of 3 and 2 years respectively. The monthly combined values of GSI for both sexes indicated that the peak breeding season to the species of C. carpio occurred in February in the study area and lowest in the female and male in August and July, respectively. This study provided a baseline assessment of the case of reproduction to the species of C. carpio to contribute to the evaluation of the potential long-term consequences for this species of fish.

1. Introduction

Middle East is among the biodiversity hotspots of the world, especially fish, which is the basis of livelihood and extremely important for the human communities [1]. The common carp (Cyprinus carpio) is a freshwater fish, which has been successfully introduced into freshwaters throughout the world [2]. Despite that of C. carpio, is classified as an ecologically injurious species [3,4], it is considered as one of the most commercially important fish species and the most desired fish species by the local community in Iraq [5]. Two carp fish species were introduced to the Iraqi water for breeding in 1955. The first species was brought from Indonesia and the second was from the Netherlands into Zaafaraniya fish farm in Baghdad, and then were released to the water bodies [6]. Fish fertility is defined as the number of mature eggs produced in the female ovaries that are ready to be released during the spawning period. The success of reproductive process lies in passing the genes to subsequent generations that, in turn, pass through to subsequent generations [7]. Gonad Somatic Index (G. S. I.), which is one of the important biological indicators used to understand and know the effectiveness of reproduction, which ensures the survival of common carp. It has been observed that the common carp grows during March and early Summer and also during Autumn and late Winter at some Lake Victoria locations [8]. Also [9] Found that the breeding period in Europe extends from May to June, and in the southern parts of the United States, extends from February to June; as for [10] explained that carp puts the eggs in May in Lake Habbaniya (Iraq) and there is no rest for carp gonads. There are no any previous studies about the fish community in the Mid sector of MOD near Al-Qadisiyah city middle Iraq, especially it is considered as the main source of water including its content of fish to the area of Hawr Ad Dalmaj marsh. The aim of this study was to provide information on some aspects of the reproductive biology for the species of C. carpio, subsequently reducing the mortality by using various measures to improve the reproduction with maintaining the ecological balance.

2. Mineral and material

2.1. Study area

Outfall Drain (MOD) is a river located between Tigris and Euphrates. Its main function is to wash out the salty soils of Mesopotamia, and discharge the waste due to the small industries such as fish farms, slaughterhouses, and others. Two locations were selected to obtain the samples along a downstream gradient of sites in the MOD from the area between the two-point 32°26'58.0"N 45°06'17.3"E. At kilometer (360) represents the entrance to the city of Al-Qadisiyah north, southeast of the city of Hilla, and 32°11'12.5"N 45°19'33.9"E. At kilometer (360) and represents the main source of feeding to Hawr Ad Dalmaj marsh. Figure 1.
2.2. Sample Collection and Measurements

Samples of *C. carpio* were collected monthly over a year, from January to December 2017 by using diverse methods of traditional fishing, net seine, gill nets, and cast nets. The nets were at different sizes to get the samples without bias. All the samples of males and females were weighed to the nearest mg before the dissection and removal of ovaries. Ovaries were removed gently, after that, the total number of eggs in each sample was counted and recorded after weighed. The proportion of the two sexes relative to one another was used to calculate the sex ratio by comparing the number of male fish with female fish and according to [11].

\[
X = \frac{M}{F}
\]

where: \( X \) = sex ratio; \( M \) = number of male fish; \( F \) = number of female fish

The gonadosomatic index (GSI), which considers as an index of reproductive activity, was calculated as follows:

\[
GSI = \frac{\text{wet wt. gonads} \times 100}{\text{wet wt. fish - gonads}} [12].
\]

To estimate the fecundity, which considers as an index of an individual’s (or population’s), the mathematical model was used:

\[
F = n \times \frac{G}{g} [7].
\]

Where “\( F \)” is fecundity, “\( n \)” is the average number of eggs in sub-sample, “\( G \)” is eight of the gonads and “\( g \)” is the weight of the sub-sample.

3. Results and discussion

Out of 111 individuals of *Cyprinus carpio* species, which were collected during this study, 44.14 % were males, and 54.05 % were females (male: female = 1:1.22). Females are clearly prevailed during the period of spawning, occurring in March, with a value of (1:1.75). Table (1). Also, the results for the samples of common carp, caught have proved to be distributed between the ages I-IV, as shown in Figure 2.
Table 1. Number and sex ratio of *Cyprinus carpio* during the study period.

| Month | Number | Males | Female | Sex ratio |
|-------|--------|-------|--------|-----------|
|       | Number | %     | Number | %         | (F:M)     |
| 1     | 7      | 3     | 42.86  | 4         | 57.14     | 1 | 1.33 |
| 2     | 8      | 3     | 37.5   | 5         | 62.5      | 1 | 1.67 |
| 3     | 11     | 4     | 36.36  | 7         | 63.64     | 1 | 1.75 |
| 4     | 13     | 7     | 53.85  | 6         | 46.15     | 1 | 0.86 |
| 5     | 4      | 2     | 50     | 2         | 50        | 1 | 1   |
| 6     | 10     | 4     | 40     | 6         | 60        | 1 | 1.5 |
| 7     | 17     | 7     | 41.18  | 10        | 58.82     | 1 | 1.43 |
| 8     | 9      | 3     | 33.33  | 5         | 55.56     | 1 | 1.67 |
| 9     | 9      | 5     | 55.56  | 4         | 44.44     | 1 | 0.8 |
| 10    | 13     | 5     | 38.46  | 7         | 61.54     | 1 | 1.4 |
| 11    | 0      | 0     | 0      | 0         | 0         | 0 | 0   |
| 12    | 10     | 6     | 60     | 4         | 40        | 1 | 0.67 |
| Total | 111    | 49    | 44.14  | 60        | 54.05     | 1 | 1.22 |

Knowledge of sexual traits and behaviors of the species, one of the factors that cannot be dispensed with in understanding strategies in any fish community, also sex ratio for any species of fish varies in varying degrees from one place to another and from one year to another in the same place depending on a number of factors such as the intensity of the fishing effort and the food availability [13, 14]. The results of the sex ratio in this study showed a tendency towards females, overall, and the values have reached their maximum in the reproductive season. These differences recorded in the sex ratio may have occurred due to an increase in the male mortality rate as a result of the competition between males to nests-guarding and that lead to exhaust their energy reserves, and subsequently may result in higher male mortality, and that does not happen with the females [15]. On the other hand, this deviation can be explained in the sex ratio to the small size of the trap sample, or to the small number of males who were captured during the experiment [16].

Figure 2. Distribution graph for the age and sexuality for the males and females to *C. carpio* species.
Monthly variations of the male and female Ganado-somatic-index (GSI) values of *C. carpio* were dissimilar. Observations GSI in each ages groups of captive fish showed a similar trend with the highest level in February and March then the values begin to decline gradually to register the lowest values in the months of July and August ,Figure 3.

The results for sexual maturity have shown that maturation was started in the first year for each of the males and females with percentages 81.35 and 10.53 respectively table 2.

![Figure 3. Monthly variation of gonado somatic indices of the sampled *C. carpio*.](image)

**Table 2.** The distribution of sexually mature and immature individuals of *C. carpio* age groups in the study area.

| Age | Females | | Males | |
|-----|---------|---|-------|---|
|     | N mature | % | Immature | N Maturo | % | Immature | % |
| I   | 19       | 2 | 10.53    | 17       | 14 | 81.35   | 3 |
| II  | 22       | 22 | 100      | 0        | 0 | 19       | 19 |
| III | 12       | 12 | 100      | 0        | 0 | 8        | 8 |
| IV  | 8        | 8 | 100      | 0        | 0 | 6        | 6 |

These results were unharmonious with [17] where confirm that gonado-somatic index (GSI) between males and females' common carp in Euphrates river / Middle Iraq was 1: 3.1, perhaps this is due to the contrast in fishing methods. In a related context, these results are consistent with the results of [18] in Al Hammar marsh southern Iraq. The present study indicated that males and females began to mature in the first year of its life and this is consistent with what he referred to [19], Where indicated that in tropical climates the species of common carp mature at 3–6 months of its life, as well as the males, usually reach maturity before females. Gonado-somatic-index (GSI) of the species gives idea about the degree of maturation applying the relation between the weight of gonad and the total or gutted bodyweight of the fish. The higher values of GSI appeared in this. study in March and February for the females and males respectively with a sharp fall in the GSI values between July and August for both sexes, this indicates that gonads in *Cyprinus carpio* species remained active throughout the year with the major peak for the spawning season in the spring season. these results were consistent with showed by [20], which indicated that no rest for common carp gonads AL-Gharraf Canal southern Iraq. Several environmental factors could be responsible for this high breeding activity for *C. carpio* through the spring season, including the changes in temperature and the length of the lighting. Where changes lead in temperature and the length of the period of lighting to the spawning of many tropical fish species [21, 22, 23, 24]. These results are consistent with the results of [18] in Al Hammar marsh southern Iraq.
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