A risk of the effluents of Diyala River on some ecological and physiological for Qattan Barbus xanthopterus at Tigris River middle of Iraq

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Abstract

The effect of the confluence of the Diyala River and the Tigris river on the life of the Barbus xanthopterus was studied. Two sites were selected for the study, water and fish samples were collected monthly for the period from July 2017 to January 2018. Some of the physical and chemical properties of the water were measured, water temperature ranged between 8.6 ° C to 31.3 ° C, dissolved oxygen between 2.3 to 10.2 mg / liter, the pH between 6.9 to 5.5 to 7.6, the salinity of the water ranged between 0.3 to 1 g / liter and turbidity was 18.9 to 57.3 brownish naphthalene units. The oxygen biological requirement for water was between 0.6 to 15.2 mg / liter. Forty two specimens of Qattan Barbus xanthopterus were cached, with total length from 22.63 to 40.46 cm and total weight from 117.8 to 1070.3 g. The average age was from 1 to 7 years old. The blood characteristics were measured, and the range of the red blood cells RBC ranged between 1.3 to 5.8 cells x 10⁶/ mm³ and for white blood cells WBC between 7.7 to 16.2 cells x 10³ / mm³ and the PCV ranged between 17.4 to 29.8% and the Hb blood hemoglobin was between 6 to 9.9 g/dL. Some liver enzymes were also measured in the blood, and their concentration of GOT (AST), GPT (ALT) alkaline phosphatase (ALP) and lactate dehydrogenase (LDH) ranged 38.0 to 875.9 U / L, 1.6 to 26.4 U/L, 9.4 To 83.7 U / L and 1051.8 U / L respectively.

The current results conclude that there are clear influences of the Diyala estuary at the Tigris River in the second site, and consequently, tangible effects have appeared on the environment and some biological and physiological characteristics of the fish of the current study.

Key words: Freshwater, pollution, fish blood parameters, health of fish

1. Introduction

Fish is one of the most commercially traded foods in the world, and its trade has expanded over time [1]. Fish is known internationally as an important food because it improves the health of the human being, and is also considered one of the most important economic commodities in its circulation in developed countries [2]. Sixty-nine species of fish live in the internal Iraqi water environment, the most important of which are the economically important fish of: common carp: Cyprinus carpio Qattan: Barbus xanthopterus, Shaboot: Barbus grypus, Biz: Barbus esocinus, Nabash: Barbus barbulus, Shiliq: Aspius vorax, and Hamri: Barbus luteus. The fish of the Cyprinidae family are of importance and the majority in the number of freshwater fish species [3, 4]. In view of the commercial importance of the Qattan fish and carp, many local studies have been conducted on it in many environments of Iraqi waters, including rivers, lakes, reservoirs, and the Tigris and Euphrates [4, 5]. Some of them studied the Qattan spread and growth; other studied its environment, life and stock [6, 7]. Local studies also dealt with common carp, and there are those who focused on their environment and stocks [4, 5]. Water pollution is one of the most important factors and basic obstacles in reducing the production of many fish species because it impedes the internal environment of the fish and its vital activities, including nutrition and reproduction of all living organisms, which in turn affects the life of living organisms [8]. Water pollution is defined as adding pollutants, wastes, or energy by humans to the water environment that is sufficient to cause negative physical, chemical or biological changes that lead to damage to human health, living resources or ecosystems [4]. Many other studies were focused on the use of aquatic organisms in general. Fishes as particular to detect or a basic guide and indicator to know the presence of pollution to assess the health of the aquatic environment So the transmission of heavy elements through the food chain by fish and then accumulation in their bodies and in ultimately reached humans by eating fish as food [9].
Given the scarcity or lack of local and modern studies, including on the impact of pollutants, including heavy elements, on the environment and life of local, economic and commercial fish, such as Qattan and common carp in the Tigris River scattered when meeting Diyala River south of Baghdad, the present study aimed to focus on the following:

1. The effect of Diyala River on the qualitative characteristics of water when meeting Tigris River.
2. Study the blood characteristics of fishes.
3. Determination of blood enzyme activity for fishes.

2. Materials and methods

2.1. Study Area Description

The current study was conducted in two stations at the Tigris River south of Baghdad / Iraq for the period from July 2017 to January 2018, as the first site extends for a distance of 4 km and is located north of the meeting point of the Tigris River with the mouth of the Diyala River, and the second site extends 4 km south of the meeting point of the Tigris River and the mouth of the Diyala River (Figure 1). The Tigris River represents the 39th longest among the rivers of the world, with a total length of 1900 km, of which 1,350 km are within Iraqi lands [10]. Various types of aquatic plants are spread on its banks, as well as the spread of agricultural lands, factories and factories on both sides of the river and various activities are witnessed by fishermen. Various types of Iraqi freshwater fish are found and spread in it, including Barbus xanthopterus, the common carp, B. grypus, B. luteus, the brown B. sharpeyi, the Liza abu, the goldfish Carassius auratus, Acanthobrama marmid, Acanthobrama marmid, the Aspius vorax, the brown Barbus sharpeyana, and all kinds of carp [11]. The depth of the river ranges from 2 to 5 meters at the Zafaraniya area, south of Baghdad, and many aquatic plants spread on its edge, such as the reeds Phragmites australis and Cyperus papyrus, and it is noticed that there are light oily spots during the period of sample collection due to the processing plants, electrical energy and packaging that it is located on its left side [12].

2.2. Sampling collection

Water and fish samples were collected monthly from the two study sites for the period from July 2017 to January 2018. Water samples were taken in the morning from the surface layer with a depth of about 20 cm using polyethylene containers with a capacity of 2,250 liters sealed, after washing well with river water to make physical and chemical measurements of the water.

Figure 1. Tigris river study site.
Fish of Qattan were cached using two types of gill net (length of 100 meters and width of 3 meters) with the length of the rib eye of the net (2.5 and 3.5) cm, as well as the fishing net or cast net with the length of the side of the net eye (2 and 2.5) cm. Fish were cached during the early hours of the morning using a fiber-glass boat (length of 5 and a 5-horsepower motor), where the nets are set up from 10-15 times to obtain the required samples for the two sites. The fish are directly transported live by corkscrew containers containing water and transported to the laboratory and then directly run on them to laboratory tests.

2.3. Phenotypic measurements

2.3.1. Total length (TL) and weight (TW)

Fish total length (TL) is the distance from the front of the snout and the mouth closed to the end of the tail fin and its lobes touching. The total length of the fish was measured to the nearest 0.1 cm. The total length was measured using the lengths measuring plate (100) cm, and the total weight of the fish was measured to the nearest 0.1 g using a Horiba device (Italian made) two decimals.

2.3.2. Age of Fish

The scales, which are of the cycloid type, were taken from the left side below the level of the base of the dorsal fin, and a special container was placed for each fish, where they were soaked for 24 hours with (KOH) solution. After the scales were washed with water and cleaned with a cloth, then the scales were placed between two fixed glass slides with a transparent tape containing a sheet of paper on which information is attached to each fish, the fish ages were then estimated based on the annual growth rings that appear on the scales and read under a microscope [13].

2.4. Laboratory work

2.4.1. Air and water temperature

The temperature of air and water was measured in the field by using a mercury thermometer with a gradient of 0-55 °C in all study stations. Wait for the same period and then read the result in Celsius units (°C).

2.4.2. pH

A pH-meter, which is of the HANNA type, was used to measure the pH of river water in the field after treating and calibrating it with standard buffer solutions with a known pH 4, 7 and pH 9.

2.5. Measurement of salinity and solids total dissolved

Salinity was measured using a European-made Electrical Conductivity Meter (MARTINI Instruments). The dissolved solids in the field were measured directly in g/ l. The equation presented in APHA [14] was used to calculate salinity values in terms of electrical conductivity values

\[ \text{Salinity (‰)} = \frac{\text{EC (μ semins)}}{\text{(cm)}} \times 0.00064 \]

2.6. Turbidity

They were measured using a HANNA/ H1 Turbidity Meter, and the results were expressed in a Nephelometric Turbidity Unit (NTU).

2.6.1. Dissolved oxygen and vital oxygen requirement

Dissolved oxygen was measured using the Modification Azid Winkler method described by APHA [15], after field stabilization of the sample and correction with standard 0.025N sodium thiosulphate compounds. Five days, after which the vital requirement was measured in the same manner described above, and the BOD5 values were calculated through the following equation:

\[ \text{BOD}_5 = \text{Primary dissolved oxygen} - \text{final dissolved oxygen} \]
2.6.2. Blood test

Blood samples were drawn from the tail vein of the fish using a 3 ml syringe. The blood sample is divided into two parts. The first is used to measure hematological characteristics, RBC red blood cell count, WBC white blood cell count, PCV% blood volume and hemoglobin concentration Hb [16]. The second part of the blood is used and placed in a centrifuge 3000 revolutions/minute for a period of 10 minutes, after which the serum is separated and placed in special tubes and kept in freezing at (-20 °C) for the purpose of blood enzyme tests that include ALP, GOT, GPT and LDH.

2.6.3. Red blood cell count

Twenty μl of blood taken with a Saheli haemoglobinometer pipette was mixed with 0.98 ml of a solution known as Modified Dacie's fluid, and after mixing them; a 0.1 mm volume was taken and placed in a Neubauer improved hemocytometer covered with its special glass cover. Then the red blood cells were counted in four corners and in the center under the force of magnification 400 times. Then the resulting number was multiplied by 2500 to obtain the number of red blood cells per milliliter of blood.

2.6.4. White blood cell count

Twenty μl of blood that was taken with a Saheli pipette was mixed with 0.98 ml of DACI, and then 0.1 ml was taken and placed in a counting slide covered with its special glass cover. Then the white blood cells were counted in the side four squares, and the result was multiplied by 125 to obtain the number of white blood cells per milliliter of blood.

2.6.5. PCV%

A drop of blood was placed on a glass slide, and then 75 mm long microhematocrit tubes were filled with anticoagulant one end of the capillary tubes sealed with artificial clay, and the tubes (two tubes per model) were placed in a Microhematocrit centrifuge (produced by the British company Hawksley) for a period of time not exceeding five minutes at a speed of 13000 revolutions/minute, then the result was read with a Microhematocrit reader, as the reading represented the value of the packed cell volume per 100 ml of blood.

2.6.6. Hemoglobin concentration

A mount of 0.02 mL of blood was taken with a Saheli pipette and placed in a special measuring tube, then mixed with five mL of Drabkin’s reagent and left for a period of ten minutes. The depletion reading was performed by a Spectrophotometer (produced by the German company Bausch & Lamb) with a wavelength of 540 nm and then the reading was converted to the amount of hemoglobin in g/100 cm³ of blood.

2.6.7. Estimation of the activity of some blood enzymes

After performing the centrifugation of the blood, the serum is taken by a pipette and kept at -20 °C until biochemical tests for blood enzymes, including GOT, GPT, ALP and LDH, a special reagent from the Italian-made Assel Company was used for each of the required tests. Enzymes were measured according to Bransden et al., [17]. ALP was measured according to Valarmathi and Azariah [18]. The VEGASYS Chemical Analyzer from the Italian company (AMS) was used to analyze the enzymes. As samples are placed inside the device and the analysis process is read through a special computer screen of the device. The mechanism of action of the device in the analysis of enzymes depends on Absorbance photometry, as each enzyme to be measured has its own wavelength, and a detector is used for each enzyme [19].

2.7. Statistical analysis

The Statistical Analysis System -SAS was used for data analyzing. The program of Randomized Complete Block Design (RCBD) was used to show the significant differences between the different sites. Duncan Multiple Range test to find the significant differences between the different factors at a significance level of 0.05.
3. Results and Discussion

3.1. The physical and chemical properties of water

3.1.1. Air and water temperature

Tables (1 and 2) indicate the variation in water temperatures during the study period, as the highest temperature was recorded at 31.3 °C during the month of July 2017 for the second site. The lowest temperature was 8.6 °C during the month of January 2018 in the first site. It is noticed from the above results that the water temperature fluctuates and rises during the hot months and decreases during the cold months, which is certainly due to the nature of the Iraqi environment climate as it is hot, dry in summer and cold and rainy in winter. The current study agreed with what was indicated by the study of Al-Sarraj et al., [20], which attributed this to several factors, including the length of daylight hours with the sun's rays, light transmittance, the quality and quantity of suspended materials in the water environment, and the movement and levels of water. The study of Khalifa [12] showed that most environmental studies of Iraqi waters in general and the Tigris River in particular are characterized by high temperatures most of the year and low during the winter months.

3.1.2. Dissolve oxygen concentration

Tables (1 and 2) show the changes in dissolved oxygen values between the sites and months of the current study. The highest value was recorded at 10.2 mg/ liter during January 2018 for the first site, while the lowest value was 2.3 mg/ liter during July 2017 for the second site. The current results indicate that the dissolved oxygen concentration in the first site is higher than that recorded in the second site throughout the study period. The high values of oxygen concentration recorded in the first site may be due to good ventilation and continuous mixing as well as the large role of water plants present in addition to being large open areas in which the process of gas exchange is facilitated, compared to those low in the Tigris River at the second site, which is certainly due to being affected by water.

The polluted Diyala River, which carries a lot of the wastes of the Rustumia plant for wastewater treatment, and organic materials that the waste and household waste carry into the river's course and decompose it by microorganisms, which increases the demand for oxygen and thus its concentrations decrease [4]. The current results are in agreement with previous local studies that recorded high values of dissolved oxygen in water, ranging between 7.1 to 11.7 mg / liter in different locations of the Tigris River due to good ventilation [12], and low values attributed to the impact of the water of the Tigris River by waste from factories and human activities [21].

3.1.3. pH

Tables (1 and 2) indicate slight fluctuation in the pH values during the study months. It ranged with a range from 6.9 to 7.6 with a rate of 7.2 ± 1.0 in the Tigris River at the first site, and with a range between 5.5 to 6.7, at a rate of 6 ± 0.1 in the second site. The pH results showed that the water in the first site was close to moderate compared to its decrease in the second site throughout the study period. The Iraqi waters in general and the Tigris River in particular are characterized by being close and close to the moderate and sometimes tending to be alkaline [22]. The current study agreed with what was recorded by some previous local studies in different locations of the Tigris River in which the pH values ranged from 6.6 to 8.6, and the light basicity was attributed to the abundance of bicarbonate and carbonate in Iraqi waters [23].

3.1.4. Salinity

Tables (1 and 2) indicate the difference in salinity values during the sites and months of the study. As the maximum value was 1 g / liter during the month of July 2017 and it was recorded in the second site and the lowest value was 0.3 g/ liter during the month of January 2018 and it was recorded in the first site. The current results indicate that the water of the Tigris River for the two sites is within fresh water to brackish water according to Reid [24] water classification. Al-Tamimi [4] recorded the salinity of the Tigris River water ranging from 0.4 to 0.9 gm / liter south Baghdad, which is close to the current results.

The current water salinity values were high during the summer months and low during the winter months. In addition, it was higher in the water of the second site than in the first site. The high temperature during the summer months and the increase in evaporation rates, as well as the decrease in the level of water coming into the Tigris River, as well as the continuous washing of soil salts as a result of agricultural activity may lead to an increase in salinity concentrations [22].
Table 1. Some physical and chemical properties of the waters of the first site at Tigris River, south of Baghdad

| Months    | Air temperature (°C) | Water temperature (°C) | Dissolved oxygen concentration (mg/L) | pH   | Salinity (gm/L) | Turbidity (naphthalene unit) | Bio-oxygen requirement (mg/L) |
|-----------|----------------------|------------------------|---------------------------------------|------|-----------------|------------------------------|-------------------------------|
| July 2017 | 31.6                 | 29.2                   | 7.1                                   | 7.6  | 0.5             | 29.2                         | 2.5                           |
| August    | 31.0                 | 28.3                   | 7.5                                   | 7.1  | 0.5             | 36.5                         | 2.3                           |
| September | 29.8                 | 27.8                   | 9.0                                   | 7.2  | 0.5             | 25.3                         | 2.1                           |
| October   | 28.6                 | 24.5                   | 9.1                                   | 7.1  | 0.5             | 24.7                         | 2.0                           |
| November  | 22.2                 | 18.5                   | 9.2                                   | 6.9  | 0.4             | 23.6                         | 1.6                           |
| December  | 16.1                 | 12.2                   | 9.5                                   | 6.9  | 0.4             | 20.6                         | 1.6                           |
| January 2018 | 11.8               | 8.6                    | 10.2                                  | 7.1  | 0.3             | 18.9                         | 0.6                           |
| Range     | 31.6 - 11.8          | 29.2 - 8.6             | 10.2 - 7.1                            | 6.9  | 0.5 - 0.3       | 36.5 - 18.9                  | 2.5 - 0.6                     |
| Mean ± standard error | 24.5 ± 1.6       | 21.3 ± 1.7             | 8.8 ± 0.2                             | 7.2  | 0.4 ± 0.02      | 25.5 ± 1.8                   | 1.8 ± 0.1                     |

3.1.5. Turbidity

Tables (1 and 2) show the changes in the turbidity values of the Tigris water for the two current study sites during the different months. As the highest value of 57.3 units of naphthalene block during July 2017 was in the second site, compared to the lowest value of 18.9 units of naphthalene block, which was recorded during January 2018 in the first site. The current results indicate an increase in turbidity in the waters of the Tigris River in the second site compared to the first site throughout the study period, due to its encounter with the heavily polluted Diyala River and the presence of wastes resulting from the Al-Rustumiya wastewater treatment plant, pollutants and organic materials that the waste and household waste carry into the riverbed and decompose them by the living Microstructure and increased motility and confusion [25]. The high values of water turbidity in the second site during the hot months may be attributed to the increase of water currents and tidal waves and the increase in the activity of organisms and aquatic organisms [4]. This leads to mixing of the base materials at the bottom of the water, especially increased cloudiness and decreased light transmittance [26].

3.1.6. Bio-oxygen Demand

Tables 1 and 2 show that there are differences in the BOD values at the two sites in the Tigris River and during the different months. The highest value was recorded at 15.2 mg/liter during the month of August in the second site, and the lowest value was 0.6 mg/liter during the month of January 2018 in the first site. The high of this indicator in the waters of the Tigris River at the second site may be due to its meeting with the Diyala River and the organic waste, sewage and household waste that it carries into the river’s course and its decomposition by micro-organisms, which increases the demand for oxygen in addition to the presence of plants that consume oxygen. The high values of the bio-oxygen requirement during the hot months may be due to the increase in temperatures and the increased activity of micro-organisms that play a fundamental role in the process of decomposition of organic materials and the withdrawal of oxygen from the water column [27].

Table 2. Some physical and chemical properties of the waters of the second site at Tigris River, south of Baghdad.

| Months    | Air temperature (°C) | Water temperature (°C) | Dissolved oxygen concentration (mg/L) | pH   | Salinity (gm/L) | Turbidity (naphthalene unit) | Bio-oxygen requirement (mg/L) |
|-----------|----------------------|------------------------|---------------------------------------|------|-----------------|------------------------------|-------------------------------|
| July 2017 | 33.4                 | 31.3                   | 2.3                                   | 6.7  | 1.0             | 57.3                         | 14.0                          |
| August    | 32.8                 | 29.9                   | 2.5                                   | 6.3  | 0.9             | 54.0                         | 15.2                          |
| September | 31.6                 | 29.8                   | 2.7                                   | 6.3  | 0.9             | 43.7                         | 10.2                          |
| October   | 29.8                 | 26.8                   | 3.2                                   | 5.8  | 0.8             | 36.3                         | 7.5                           |
The current results witnessed an increase in the length and weight of the two species of fish caught in the warm months at Tigris River at the first location. The increase in fish individual, species, lengths and weights at most of Iraqi water bodies during warm and cold months depending on food availability, good ventilation, and the primary productivity [28]. Values of lengths and weights for same fish species at were recorded at Tigris and Euphrates Rivers ranged between 9.5 to 80 cm for length and between 7 to 7000 g for total length and weight [4, 7]. These may agree with the current results. The variation in the sizes and weights of the caught fish may be due to the fact that large fish are close to the surface and fish close to the bottom, as well as to

| Months      | Total length (cm) 1st site | Total length (cm) 2nd site | Total weight (gm) 1st site | Total weight (gm) 2nd site | Age (year) 1st site | Age (year) 2nd site |
|-------------|---------------------------|----------------------------|---------------------------|---------------------------|-------------------|-------------------|
| July 2017   | 23.7A d                   | 24.5A c                    | 209.0B d                  | 168.0A d                  | 2.0B c            | 3.7A c           |
| August      | 30.9B c                   | 22.6A d                    | 507.8B c                  | 117.8A d                  | 3.0A b            | 3.0A c           |
| September   | 29.3B c                   | 22.7A d                    | 227.0B d                  | 142.8A d                  | 1.7B d            | 2.7A d           |
| October     | 35.6B b                   | 39.2A a                    | 792.3B b                  | 675.5A a                  | 4.0B a            | 5.7A a           |
| November    | 34.8B b                   | 28.5A b                    | 450.5B c                  | 270.3A c                  | 2.7B c            | 4.6A b           |
| December    | 40.5B a                   | 31.4A b                    | 1070.3B a                 | 325.5A b                  | 4.7A a            | 4.6A b           |
| January 2018| 31.7A c                   | 29.2A b                    | 405.3B c                  | 239.4A b                  | 2.7A c            | 3.0A c           |
| Range       | 40.5-23.7                 | 39.2-22.6                  | 1070.3-209                | 675.5-117.8               | 4.7-1.7           | 5.7-2.7          |
| Mean        | 32.1 ± 1.7                | 30.7 ± 1.7                 | 666 ± 531.8               | 406 ± 277                 | 0.2 ± 0.3         | 0.3 ± 0.4        |

The different capital letters indicate significant differences within the same row at a probability level (P ≤ 0.05). The different lowercase letters indicate significant differences within a single column per month at a probability level (P ≤ 0.05). The different lowercase letters indicate significant differences within a single column per month at a probability level (P ≤ 0.05).
the continuous movement of fish for feeding or reproduction as well as the type of fishing nets, that the abundance of fish of all kinds, lengths and weights is closely related to the surrounding environment that may Is or is not suitable for fish growth, existence and subsistence [29].

3.1.8. Blood physiological characteristics

It is evident from Table (4) the significant differences (P < 0.05) variation of some physiological blood characteristics for fishes between sites and months at Tigris River. As there was a significant increase in red and white blood cells, agglutinated blood cells and hemoglobin concentration (5.8, 16.2, 29.8 and 9.9), respectively, during the month of August 2017 in the second site. While the lowest values were recorded during January 2018 for red and white blood cells, agglutinated blood cells, and hemoglobin concentration (0.7, 7.7, 17.4 and 5.8), respectively, in the first site. The current results indicate a significant increase in the blood parameters for fishes at Tigris River at the second site compared to the first site. This may be due to the impact of the polluted Diyala River on the two types of fish in the Tigris River, for the current study inhabiting the second site. The study by Bransden et al. [17] stated that increased numbers of red and white blood cells in fish are the result of water pollution, especially during the hot summer months. This results in an increase in the accumulated blood cells and hemoglobin, which may agree with the current study. Also, the decrease in the values of the four blood parameters for fishes at Tigris River at the first site, especially during the cold months, may be due to the low pollution of the water of the site itself. Sudarshan and Kulkarni [30] reported that fish growth stops during a decrease in the water temperature during the winter months, and with the advent of spring, an increase in the metabolic activities of fish begins as a result of feeding and the abundance of food, and thus there is an increase in growth until it reaches its peak during summer.

Farabi et al., [31] confirmed that there was a significant decrease in both red and white blood cells, the PCV and hemoglobin concentration during the cold months in the winter when the weather was cool due to the decrease in fish activity. The increase in the number of red blood cells is usually a response that fish take to counteract a decrease in the concentration of oxygen in the surrounding environment and to meet their needs of dissolved oxygen with an increase in their metabolic activity [32]. Martinez et al., [33] reported that lack of oxygen stimulates the fish to increase the number of red blood cells in order to adapt to the quality of that environment, while the increase in white blood cells is often the result of a reaction due to stress and disease states, as well as the two characteristics of PCV and Hb. Hemoglobin concentration is associated with increased red blood cells, enlarged red blood cell volume, or it can be explained by the high levels of salinity concentration and thus causes an increase in the number of red blood cells in order to meet the need for the increased demand for the consumption of oxygen required in its use to expend additional energies for the activities of the body, including the osmotic regulation.

| Table 4. Blood parameters for Qattan cached at Tigris River, south of Baghdad. |
|-------------------------------|----------------|----------------|----------------|----------------|----------------|
| Months | RBC (10^6 cell/ml) | WBC (10^3 cell/ml) | PCV% | Hb (gm/dL) |
| 1st site | 2nd site | 1st site | 2nd site | 1st site | 2nd site | 1st site | 2nd site |
| July 2017 | 1.3B c | 2.8A c | 8.2 B b | 11.5A c | 21.8 B b | 28.7 A b | 5.8B c | 9.4A b |
| August | 2.0B a | 5.8A a | 8.7B a | 16.2A a | 17.9B b | 29.8 A a | 6.2B b | 9.9A a |
| September | 2.0B a | 4.7A b | 8.6B a | 12.3A b | 18.5B b | 29.0 A a | 6.8B b | 9.1A b |
| October | 1.8A b | 2.2A d | 8.2B a | 11.3A c | 21.0A a | 29.5 A a | 7.2B a | 9.2A b |
| November | 1.7A b | 2.1A d | 8.1B a | 10.9A c | 21.7A b | 27.3 A b | 7.3B a | 9.1A b |
| December | 1.5B b | 2.2A d | 8.0B a | 10.8A c | 21.9B a | 28.3 A c | 7.2B a | 9.4A c |
| January 2018 | 0.7B b | 2.0A d | 7.7A a | 7.7A d | 17.4B a | 23.7 A a | 6.0B a | 7.9A b |
| Range | 2.0-0.7 | 5.8-2.0 | 8.6-7.7 | 16.2-7.7 | 21.9-17.4 | 29.8-23.3 | 7.3-6.0 | 9.9-7.9 |
| Mean | 1.6±0.5 | 3.1±0.9 | 8.2±0.1 | 12.1±0.6 | 20.1±0.5 | 28.1±0.5 | 6.7±0.2 | 9.2±0.2 |
| standard error | 1.6±0.5 | 3.1±0.9 | 8.2±0.1 | 12.1±0.6 | 20.1±0.5 | 28.1±0.5 | 6.7±0.2 | 9.2±0.2 |

The different capital letters indicate significant differences within the same row at a probability level (P ≤ 0.05). The different lowercase letters indicate significant differences within a single column per month at a probability level (P ≤ 0.05).
3.1.9. The activity of some liver enzymes in the blood

Table (5) shows that there are significant differences (P ≤ 0.05) in the blood enzymes values of the Qattan caught from the Tigris River at the sites and months of the current study. As the highest concentration of GOT, GPT, ALP and LDH enzymes was recorded with values of 875.9, 26.4, 83.7 and 1051.8, respectively, during the month of July 2017 in the second site. While the lowest values for the same enzymes were recorded at 38.0, 1.6, 9.4 and 104.3, respectively, during January 2018 in the first site. The results of the same table indicate a remarkable increase of GOT, GPT, ALP and LDH enzymes in the blood for fishes, which coincided with the increase in temperatures during the summer months in the second site and vice versa with regard to the first site during the winter months. The concentrations of the four enzymes in the blood of the same fish in the second site were higher than in the first site. This increase in the four enzymes measured in the Qttan at the second site in the waters of the Tigris River may be due to the Tigris River being affected by the polluted Diyala River’s water and the organic and inorganic wastes it carries, which causes the fish to be stressed and contracted with cancerous diseases. Some previous local studies indicated increased pollution of the Diyala River with heavy elements as a result of the outputs of factories, hospitals, generators, and civil activities that are ultimately thrown into the Diyala River [27].

Table 5. Values of some blood enzymes for Qattan cached at Tigris River south of Baghdad.

| Months         | Aspartate Amino Transaminase (AST/GOT) U/L | Alanine Transaminase (ALT/GPT) U/L | Alkaline Phosphatase (ALP) U/L | Lactate Dehydrogenase (LDH) U/L |
|----------------|------------------------------------------|-----------------------------------|-------------------------------|---------------------------------|
|                | 1st site                                 | 2nd site                          | 1st site                      | 2nd site                        |
| July 2017      | 376.9Ba                                  | 875.9Aa                           | 25.3Aa                        | 40.6Ba                          |
| August         | 205.3Bb                                  | 525.1A b                          | 21.8B b                       | 35.6B b                         |
| September      | 199.6Bb                                  | 315.5A c                          | 20.2A c                       | 39.8B a                         |
| October        | 137.9Bb                                  | 311.3A c                          | 19.8A c                       | 34.6B a                         |
| November       | 125.3Bb                                  | 200.7A d                          | 12.7B d                       | 34.2B d                         |
| December       | 75.7Bc                                   | 195.5A d                          | 9.5B e                        | 11.3B c                         |
| January 2018   | 38.0Bd                                   | 149.5A d                          | 1.6B f                        | 9.4B d                          |
| Range          | 38.0-376.9                               | 149.5-875.9                       | 25.3-1.6                      | -4.926.4                       |
| Mean ± standard error | 165.5 ±23.0 | 367.6 ±1.8 | 16.0 ±1.7 | 29.3 ±2.7 | 283.4 ±15.5 | 651.6 ±62.9 |

The different capital letters indicate significant differences within the same row at a probability level (P ≤ 0.05). The different lowercase letters indicate significant differences within a single column per month at a probability level (P ≤ 0.05).

The study of Coppo et al. [34] indicated that GOT, GPT, ALP, and LDH enzymes are released from the liver and their concentrations increase in the blood when exposed to sudden or long-term stress situations such as high-water temperature, environmental pollution, and exposure to heavy toxic elements, causing acute liver disorders. Many previous studies indicated that heavy elements and pesticides in water cause an increase or decrease in the levels and concentrations of protein in the blood and enzymes depending on the type of pollutant, the toxic substance, the type of fish exposed to the pollutant, the water quality and the duration of exposure. The study of Valarmathi and Azariah [18] stated that toxic substances lead to many changes in the physiological state of the animal because they ultimately cause internal defects in the cell organelles that could result in an increase or inhibition in the activity of various enzymes. These enzymes control the metabolism of an organism, and thus any slight difference in their activities would affect the organism through its effect on disrupting the metabolism process [35]. These enzymes are important protein catalysts for the vital life reactions of fish and a good indicator of the activity and effectivenes of the liver, and thus they are a main method and source for detecting pollution levels and environmental and pathological changes in which these fish live [33].
3.1.10. Fish hepatic index

Table (6) indicates that there is a significant difference (P ≤ 0.05) in the hepatic index values for cached fishes at Tigris River between the sites and months of the current study. The values of the hepatic index were increased for fishes, the highest was recorded (3.0) during July 2017 in the second site. While the lowest values were recorded at 0.7 during the month of January 2018 in the first site. It is noticed from The current results recorded increasing in the values of hepatic index for fishes at the second site, with the same time of increasing in the water temperatures during the summer months comparing with the winter months. In addition, the present values of HIS for fishes were higher at the second site than same fishes at the first site.

Table 6. The hepatic index values for Qaatan cached at Tigris River near Baghdad.

| Months     | 1st site | 2nd site |
|------------|----------|----------|
| July 2017  | 1.7 B a  | 3.0 A a  |
| August     | 1.5 B a  | 2.4 A b  |
| September  | 1.3 B a  | 2.1 A b  |
| October    | 1.2 B a  | 1.8 A c  |
| November   | 1.1 A a  | 1.7 A c  |
| December   | 0.9 B b  | 1.5 A c  |
| January 2018 | 0.7 B b | 1.2 A c |
| Range      | 0.7-1.7  | 1.2-3.0  |
| Mean ± standard error | 1.2 ±0.1 | 1.9 ±0.1 |

The different capital letters indicate significant differences within the same row at a probability level (P ≤ 0.05). The different lowercase letters indicate significant differences within a single column per month at a probability level (P ≤ 0.05).

The study of Sindhe and Kulkarni [32], indicated that the gradual increase or decrease in the level of hepatic index values results from exposure to toxic metal contamination to which fish are exposed and lead to liver damage and changes to it. Some previous studies also showed that it is possible for pollutants in general, including heavy elements to be transported in the water environment through food chains by eating food by fish, and the accumulation of these elements and pollutants increases in rates sufficient to cause damage to fish tissues, including the liver, which is the center of the chief detoxification. Some previous studies of different environments and fish species mentioned that the increase in the values of hepatic index may be due to good nutrition that contains carbohydrates, especially glycogen, while the opposite happens when good nutrition is decreased, and the reason for this decrease in the values of the hepatic index of HSI is due to the use of energy stored in the liver for the development of the ovaries, and the decrease in the HSI values of the two fishes gives an indication of a decrease in the weight of the liver, and this indicates that the fish is in a state of growth or reproduction or stress and an external influence [30].

Conclusion

The conclusion from the present results, that clearly influences and changes in some of the ecology, biology and physiology for Qattan B. xanthopterus. Fishes were clearly affected at the second site comparing with same fish species at the first site when Dayala and Tigris Rivers were meeting.

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