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# Biological assessment of fish assemblage environment in Garmat Ali River using Integrated Biological Index (IBI) during 2003 -2016

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**Abstract -** To provide a complete picture of the fish assemblage environment in this region, the present study used the Integrated Biological Index (IBI) to analyze the biological evaluation of the fish assemblage environment in the Garmat Ali River from 2003 to 2016. From the following primary groupings, seventeen units were used to construct the IBI (species richness, fish species composition, and trophic guilds). Forty-eight species were found overall, with 28 species found in the first period August 2003 to July 2004, 26 species discovered in the second period from November 2007 to October 2008, and 34 species found in the third period November 2015 - October 2016. The number of native species for each of the three time periods 14, 11, and 8, as well as the number of foreign species 5, 6, and 8, and marine migratory species 9, 9 ,and 18 for each of the three times. The percentage of native species for each of the three time periods was 60.5, 51.1, and 2.4%; the percentage of foreign species was 12.2, 34.5, and 69.7%; and the percentage of marine species for each of the three time periods was 27.5, 14.4, and 27.9%. For the three periods, the percentage of omnivore species individuals was 30.9, 31.08, and 80.6%, while the percentage of detrivore species individuals was 67.7, 45.6, and 2.2, For the three time periods, the percentage of individual carnivores was 1.4, 23.2, and 12.9%, whereas the percentage of individual herbivores was 0.2, 0 and 4.3%. The first period's IBI value (61.8) was included under the Marginally impaired (60-80) category, and the second, and third periods' values 59.3, and 53.9 respectively, were included under the Impaired category (below 60).

## التقييم الحياتي لبيئة تجمع اسماك نهر كرمة علي باستخدام دليل التكامل الحياتي ( IBI) خلال ٢٠٠٣-٢٠١٦

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**المستخلص** – تناولت الدراسة الحالية دراسة التقييم الحياتي لبيئة تجمع اسماك نهر كرمة علي باستخدام دليل التكامل الحياتي (IBI) للمدة 2003 – 2016 لإعطاء صورة دقيقة عن بيئة تجمع اسماك هذه المنطقة. تم انتخاب سبعة عشرة وحدة قياس لحساب دليل التكامل الحياتي من المجموعات الرئيسة الاتية (غنى الانواع، تركيبة المجتمع السمكي وتركيبة التغذية). بلغ عدد الانواع الكلي (48) وبتواجد 28 نوع في المدة الاولى (اب 2003 – تموز 2004) و26 نوع في المدة الثانية (تشرين الثاني 2007 – تشرين الاول 2008) و34 في المدة الثالثة (تشرين الثاني 2015- تشرين الاول 2016). بلغ عدد الانواع المستوطنة للمدد الثلاث على التوالي 14، 11، 8 في حين بلغ عدد الانواع الغريبة 5، 6، 8 على التوالي وعدد الانواع البحرية المهاجرة 9، 9، 18 نوع للمدد الثلاث على التوالي. بلغت النسبة المئوية لأفراد الانواع المستوطنة للمدد الزمنية الثلاثة على التوالي 60.5، 51.1، 2.4 % وبلغت النسبة المئوية لأفراد الانواع الغريبة 12.2، 34.2، 69.7 % على التوالي في حين بلغت النسبة المئوية لأفراد الانواع البحرية

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المهاجرة للمدد الثلاثة على التوالي 27.5، 14.4، 27.9%. بلغت النسبة المئوية لأفراد الانواع مختلطة التغذية للمدد الزمنية الثلاثة على التوالي 30.9، 31.08، 80.6% والنسبة المئوية للأفراد فتاتية التغذية 67.7 ، 45.6 ، 2.2% وللأفراد لحمية التغذية 1.4، 23.2، 12.9% والنسبة المئوية للأفراد نباتية التغذية 0.2، 0، 4.3% للمدد الزمنية الثلاث على التوالي. ادرجت قيم دليل التكامل الحياتي للمدة الزمنية الاولى 61.8 تحت تقييم حافة الضعيف (60-80) Marginally impaired وللمدتين الزمنيتين الثانية والثالثة 59.3 و 53.9 تواليا تحت تقييم ضعيف Impaired أدنى من 60.

**الكلمات المفتاحية:** المدة، دليل التكامل الحياتي، اكلة اللحوم، اكله الأعشاب، القوارت، نهر كرمة علي

## Introduction

Climate change, human-caused harms such as dam construction, littering, and a shortage of water discharges, as well as oil contamination, have substantially impacted the makeup of fish populations and the quality of water in rivers, which are continually subject to extreme changes (Parks *et al.*, 2014). Life evaluation approaches focused on calculating individual cases have been replaced with an environmental assessment based on fundamental ecological variables, such as population change, nutritional levels, health, and status of the fish community, which has proven more efficient and reliable. A single-life assessment procedure is more suited. The Index of Biotic Integrity (IBI), one of these techniques, was first proposed by Dr. James Karr and used to assess small warm-water rivers in the United States (Plafkin *et al.,* 1989; Karr, 1991). The Index of Biotic Integrity (IBI), created and first used by Dr. James Karr, was used to assess tiny warm-water rivers in Illinois and Indiana in the American Midwest (Karr, 1981). The fish community has been regarded as one of a freshwater ecosystem's most delicate and easily recognizable components. They have many characteristics that are advantageous for the integration of life and the health of the ecosystem because of how they react to changes in both biological and non-biological factors, such as water quality (Scott 1987; Berkman and Rabeni 1986; Steedman1988; Simon 1990).

This guide has been used in many countries worldwide, including the United States (Bowen *et al*., 2006; Vile and Henning 2018), Mexico (Mecado-Silva *et al.*, 2002), Canada (Lumb *et al.*, 2006), and Brazil (Casatti, *et al.* 2009). USA (Simon *et al.* 2015), Abhijna and Kumar (2017) used an integrated biological index (F-IBI) in Veli-Akkulam Lake, India, with seven candidate fish metrics, including native species richness, native family richness, benthic species richness, water column species richness, percent non-native individuals, percent tolerant individuals, and percent herbivores, in addition to five original metrics, such as native species richness, native family richness, benthic species richness, water column species richness, % non-native individuals, % tolerant individuals and % herbivores, in addition to five original metrics such as intolerant species richness, % omnivores individuals, % top carnivore individuals, a total number of individuals and % individuals with anomalies. Among the studies on the Shatt al-Arab is Hussein's (1995) study on the gathering of juvenile fish.

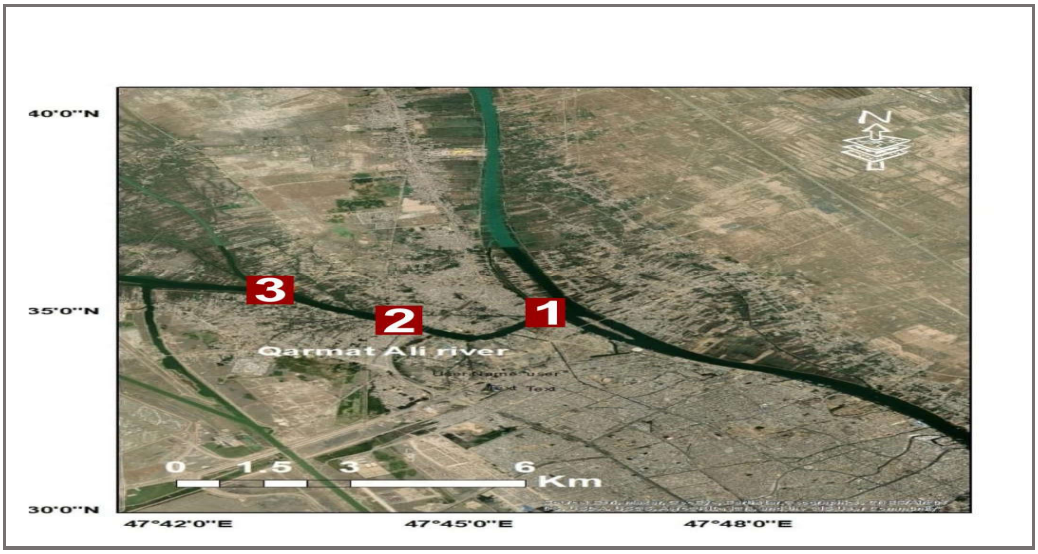
Antique et al., (2019) also examined the biotic integrity of 149 distinct research sites in the streams and rivers of the Geum River basin in South Korea and its application to evaluating waterbodies in the Marshes of Al-Chibayish, Al-Hammar, and Al-Hawizeh (Abd 2010; Mohamed *et al.*, 2015; Al-Thahaibawi 2019).

The present study uses the IBI to assess the Garmat Ali River in southern Iraq from 2003 to 2016.

## Description of the Study Area

Due to its connections to the Shatt Al-Arab River in the south, north of Sindbad Island, and the East Al-Hammar marsh in the north, both of which are impacted by the tidal phenomena, the Garmat Ali River is essential to the survival of fish in southern Iraq **(**Hussein *et al*.,1991**).** The river has an average length of 6 kilometers, width of 280 meters, and depth of 9 meters. The River Karmat Ali branches off into a number of side rivers, including the plant with Khartrad River and Al-Asafia. *Phragmites australis, Typha domingensis, Ceratophyllum demersum,*

*Vallisneria australis, Schoenoplectus litoralis, Paspalum paspaloides, Najas arundinaceae*, *Paspalum paspaloides, Potamogeton pectinatus, Najas armata* **(**Al-Essa 2005**),** and numerous species of waterfowl, such as Larus genei, Areda cinerea, Nycticorax nycticorax and Areda cinerea **(**Salim *et al.*, 2006**).** (fig.1).




(Figure 1) Garmat Ali River, where (3) represents the beginning of the river and (1) the end of the river

**Materials and Methods**

The data obtained from the study of Younis (2005) from August 2003 to July 2004 and Lazem (2009) from November 2007 to October 2008, and (Hameed 2017) from November 2015 to October 2016 were combined to assess the fish community of the River Garmat Ali for the period from 2003-2016.

**Integrated Biological Index (IBI)**

Seventeen metrics were selected for measurement (IBI) from the following major groups to assess the environment of Garmat Ali River They are as follows:

**(A) Species richness group which includes:**

1- Total number of species
2- The number of native species
3- The number of alien species
4- The number of migratory marine species

**B -The composition fish community Group includes the units:**

5- The percentage of the native individuals' species
6- The percentage of the sensitive native individuals' species
7- The percentage of the alien individuals' species
8- The percentage of the migratory marine individuals' species
9- The percentage of the *Planiliza abu* individual species
10- The percentage of the *Carassius auratus* individual species
11-The percentage of the *Poecilia latipinna* individual species

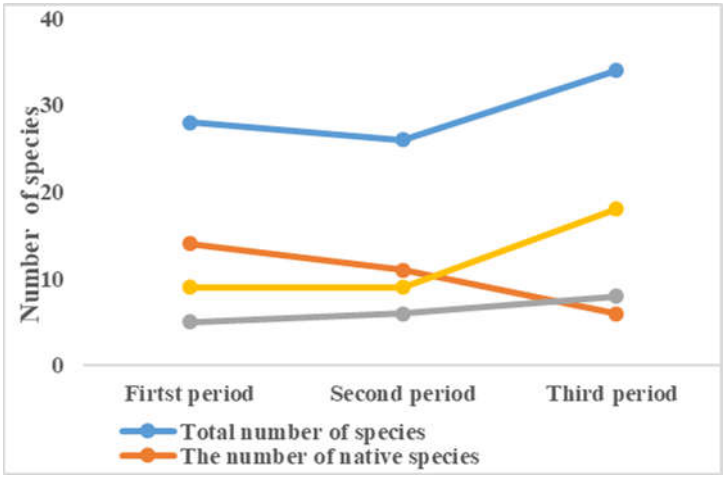
12-The percentage of the individuals Tilapia family
13-The percentage of the *Tenualosa ilisha* individual species

**C-Combination Nutrition Group includes the units:**
14-The percentage of the herbivore individual species
15-The percentage of the carnivore individual species
16- The Percentage of the detrivores individual species
17- The percentage of omnivore individual species
The IBI was calculated using the method defined by (Minss *et al*.1994), with unit values ranging from (0-10) and IBI values ranging from (0-100).

**Results:**

**A- The Richness of Species Group**

With a total of 47 species in the first period (August 2003–July 2004), 26 species in the second period (November 2007–October 2008), and 34 species in the third period, this group was made up of the first, second, third, and fourth units (November 2007 - October 2008) from October 2016 until November 2015. In comparison, the number of alien species reached ten, with the presence of (5, 6, and 8) species for the three periods, and the number of migratory marine species (22), with the presence of (9, 9, and 18) species for the three periods, respectively. The number of native species reached (15), with the presence of (8, 11, and 14) species for three consecutive periods (Figure -2).




(Figure 2) Total number of species, native, alien, and marine species for the three periods

**B -Composition Fish Assemblage Group**

Eight units comprised this group, including the fifth, sixth, seventh, and eighth. For three consecutive periods, the percentages of native species reached (60.5, 51.1, and 2.4) %, the percentage of alien species was (12.2, 34.5, and 69.7) %, and the percentage of marine migratory species reached (27.5, 14.4, and 27.9) %. The three periods ' low percentages of native-sensitive species were a defining characteristic, with percentages for each time reaching (1.0, 4.9, and 0.04) %, respectively (Figure 3). (Table .1).

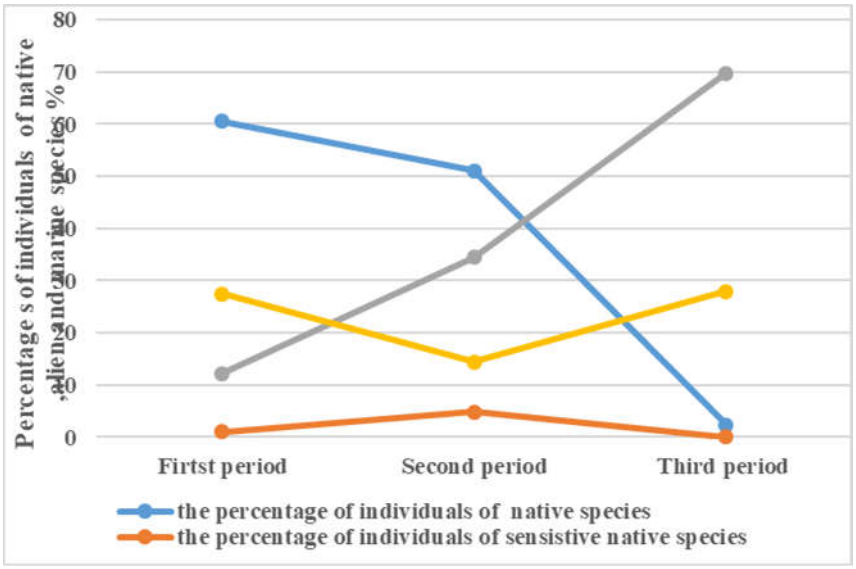
The tenth unit included the percentage of the *C. auratus* species, where (16298) fish were collected from this species at a percentage (11.7, 21.2, and 7.6) % for the three periods,

respectively. The ninth unit measured the percentage of P. abu individuals that belonged to one of the widespread native species, where (26970 fish were collected from this species at a rate (59.0, 39.3, and 2.02) % for the three consecutive periods.

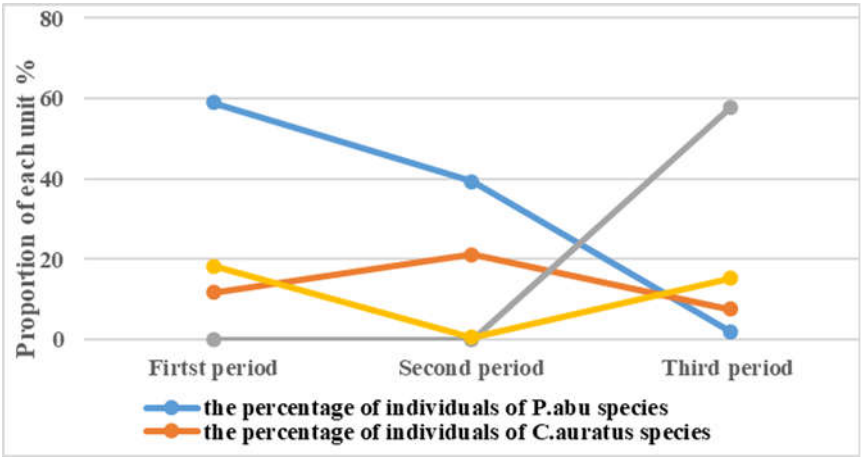
The eleventh and twelfth units contained the percentages of *P. latipinna* and the tilapia family, which were recorded in the third period, with 81548 fish representing the first species at a percentage of 57.7% and 6025 fish representing the tilapia family at a percentage of 4.3 percent. The twelfth unit, where 28534 fish were collected at rates of 18.29, 0.52, and 15.3% for the three time periods, respectively, represented the migratory sea fish *T. ilisha* (Figure 4).

(Table 1) Geographic origin and trophic groups for fish captured of the units included within the Integrated Biological Index (IBI) in Garmat Ali River

| The metrics | Species |
|---|---|
| **Native species** | *Acanthobrama marmid, Leuciscus vorax Alburnus mossulensis, , Luciobarbus grypus, Luciobarbus kersin, Carasobarbus luteus, Mesopotamichthys sharpeyi, Luciobarbus xanthopterus, Garra rufa, Planiliza abu, Aphanius dispar, Mystus pelusius, Mastacembelus mastacembelus, silurus triostegus, Aphanius mento.* |
| **Alien species** | *Carassius auratus, Cyprinus carpio, Gambusia holbrooki, Poecillius sphenops, Heteropneutus fossilis, Oreochromis aureus, Oreochromis niloticus, Coptodon zillii, Poeclilia latipinna, Hemiculter leucisculus.* |
| **Migratory marine species** | *Planiliza carinata, Planiliza subviridis, Bathygobius fuscus, Periophthalmus waltoni, Tenualosa ilisha, Acanthopagrus arabicus, Thryssa hamiltoni, Photopectoralis bindus, Brachirus orientalis, Scatophagus argus, Sillago sihama, Planliza klunzingeri, Thryssa mystax, Thryssa malabarica, Thryssa dussumierii, Thryssa vitirostris, Thryssa witeheadi, Sillago attenuate, Sillago Arabica, Nematolosa nasus, Boleophthalmus dussumierii, Hyperhamphus limbatus.* |
| **Native sensitive species** | *L. grypus, L. kersin, C. luteus, M.sharpeyi, L.xanthopterus, G. rufa, M. pelusius, M. mastacembelus, S. triostegus.* |
| **Herbivores species** | *M.sharpeyi, O.aureus, O. niloticus, C. zillii* |
| **Carnivores species** | *A. marmid, L. vorax A. mossulensis, L. kersin, A. dispar, B. fuscus, P.waltoni, P. waltoni, G. holbrooki, A. arabicus, T. hamiltoni, P. bindus, B. orientalis, S. argus, S. sihama, T. mystax, T.malabarica, T. dussumierii, T. vitirostris, T. witeheadi, S. attenuate, S. Arabica, H.limbatus, A. mento,H.leucisculus* |
| **Detrivores species** | *P. abu, P.carinata, P.subviridis, P. klunzinger.* |
| **Omnivores species** | *L. grypus, L. xanthopterus, G.rufa, C. luteus, C.auratus, C. carpio, , P. sphenops, H. fossilis, P. latipinna. T. ilisha.* |



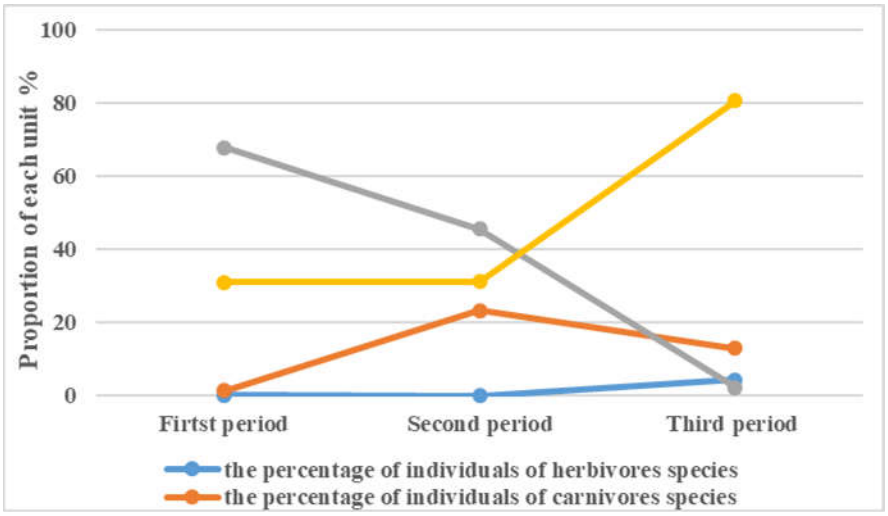

(Figure3) Percentages of the individuals of native, alien, marine and native sensitive species to three periods




(Figure 4) The percentages of *P.abu, C.auratus, P. latipinna,* and *T. illisha* species

**C-Combination Trophic Group**

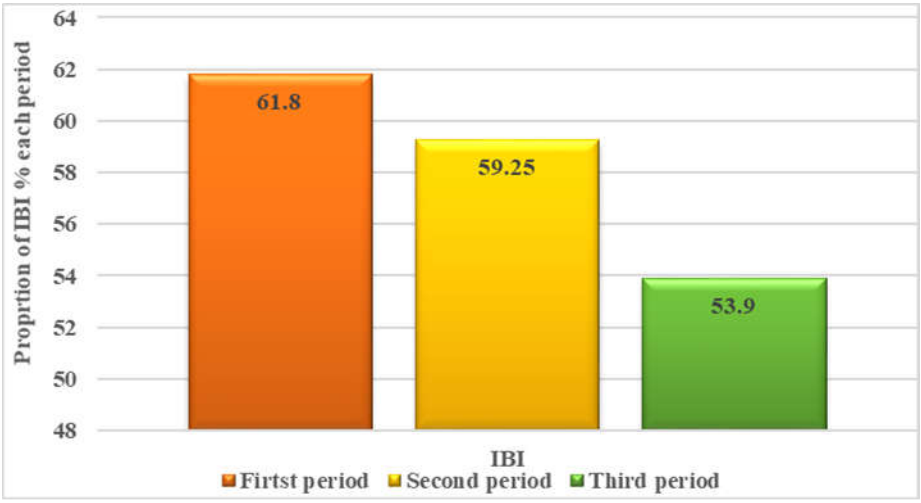
Four units comprised this group, while the fourteenth unit represented the proportion of herbivorous fish species that occurred in the first and third Periods eras at low percentages (0.2 and 4.3%) and vanished in the second period. The proportion of fish individuals for carnivores was included in the fifteenth unit. This percentage achieved its highest level in the second period (23.2%) and its lowest level in the first period (1.4%). The rate of detrivore species individuals was included in the sixteenth unit, and it was (67.7, 45.6, and 2.2) % for three consecutive periods. The seventeenth and final unit had the percentage of omnivore fish, which showed up at an almost high rate during the three periods, especially in the third period, when it reached (80.6) of the total fish captured (Figure 5).




(Figure 5) Percentage of individuals of the herbivores, carnivores, detrivores, and omnivores species for three periods of time

**Integrated Biological Index (IBI)**

The values of the IBI are included for the first period (61.8) under the assessment of the Marginally impaired (60-80), and the second and third periods (59.3 and 53.9) respectively, under the evaluation of the Impaired (below 60). Figure (6) shows the improvements in the values of the Integrated Biological Index over three time periods.




(Figure 6) The values of the overall IBI of the Garmat Ali River for the time of three periods

**Discussion**

An excellent technique to evaluate the influence of living and non-living processes that affect the disturbance of the freshwater ecosystem is to determine the ecosystem's health and integrity. The cumulative effect of these activities is typically complex to calculate and quantify (Simon and Lyons 1995).

When compared to the fifteen native species obtained in the study (Hussain *et al.*, 1989) on the Shatt al-Arab River during the period (1982-1983), the number of native species found in the

Garmat Ali River decreased, reaching its lowest level in the third period, comparing (8) species. This reflected the life disorder experienced by the Qarmat Ali River and was also reflected in the percentage of individuals of these species, especially the sensitive ones, to reach (0.04) in the third period. It led to a decrease in the proportion of endemic species and is due to several factors, including: Change in water quality, as these species are very sensitive species that leave the area when any change occurs increasing the introduction of exotic species, starting with carp ending with tilapia fish, but in the third span, the number of alien species rose to eight. The proportion of those people rose to (69.7%), which is in line with Hughes and Whitter's (2005) assertion that native species are the basis of the fish community and a crucial part of diversity, while alien species are a sign of biological pollution and a risk to the environment, mainly when they make up a significant portion of the fish community. The number of migratory marine species in the Garmat River increased, particularly in the third period, when the number of marine species reached (18 ''in several studies (Townsend and Crowl 1991; Whitter *et al.*, 1997)**,** and this is supported by the survey Ross (1991), who indicated that the decline in the number of native sensitive species, which appeared at a low rate during the three time periods and amounted to (1.0, 4.9, and 0.04)% of the total number of fish caught respectively, is associated with these factors. Ross (1991)'s study, which found that the alien species led to a 77% decline in native sensitive species, supports this. Mebane *et al.,* (2003) found that the number of the most indigenously sensitive species decreased when human activities disturbed the aquatic ecosystem, and this finding was supported by Mohamed *et al*., (2017)**.** However, the third period of the current investigation revealed a high percentage of individuals from the omnivore and detrivore species and a drop in the percentages of individuals from the herbivore and carnivore species. This is consistent with Younis *et al*., (2001). This matches what Karr and Chu discovered (1997), who predicted that the proportion of carnivorous fish in turbulent rivers would rise to 40%. This was corroborated by McCormick *et al*., (2001), who noted that the decline in carnivorous fish was inversely connected with increased turbidity and agricultural disturbance and coincided with increased environmental disruption. Guitterez (1994) discussed how sensitive fish are to physical and chemical changes that reduce plant populations or alter the framework of plant growth. The quantity of fish they provided accordingly is reduced with increased disturbance, and other investigations have supported this finding in Iraqi seas (Mohamed *et al*., 2015; 2017, and Al-Thahaibawi 2019).

## Conclusion

We conclude from the present study that the final assessment of the river is under weak and requires an increase in water releases from towards Basra in order to supplement the fish population and reduce pollution in the river.

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