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# Evaluation of the inland fisheries in Basrah Province during 2020-2021, Iraq

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**A B S T R A C T**

The purpose of the study was to provide up-to-date information on inland fisheries landings in Basrah province, Iraq. During 2020-2021, the species composition, species and total landings, and trends at six landing locations in the research region were assessed. There were seven species of cyprinids, three species of cichlids, three species of mullet, and two species of sparids and silurids. The foreign species C. carpio, tilapias species, and C. auratus dominated landings, accounting for 44.2% of the entire catch. In contrast, the highly prized native species (M. sharpeyi, L. xanthopterus, C. luteus, and A. grypus) accounted for just 12.4%. In 2020 and 2021, the total landings reached 2,427.78 t and 2,365.15 t, respectively, greater than the previous years since 2009. This is attributable to the frequency of alien species and the rise in fishing effort, as measured by the number of fishermen and fishing vessels. Improving inland fisheries requires enhancing the stocks of native species, minimizing the dissemination and impacts of some exotic species, and activating national regulations governing fishing, exploitation, and conservation of aquatic life from the fisheries management perspective.

## 1. INTRODUCTION

### *1.1. Research Background*

Typically, inland fisheries are small-scale operations that harvest for household consumption and local barter or trade [1] and exploit wild fishery resources in inland water environments such as rivers, streams, floodplains, wetlands, lakes, inland seas, canals, and reservoirs [2], especially in rural areas with higher population densities capable of exploiting these resources. FAO estimated that inland fisheries caught 11.47 million tons in 2015, accounting for 12.2% of worldwide capture fishery production. Seventeen nations, led by China, India, and Bangladesh, accounting for 80% of this 0.15-2.3 million-ton inland fishing catch [3].

FAO indicated that over 60 percent of the total inland capture of fish in Iraq in 1990 came from the southern region [4]. The southern part of Iraq represents a potentially rich supply of fish. In recent years, however, the Basrah province has experienced a decline in water quality and quantity due to anthropogenic activities such as agricultural runoff wastes, untreated wastewater, the invasion of fish species, and seawater intrusion upstream up to 100 kilometers into the Shatt Al-Arab River during dry years as a result of a drastic reduction in the flow rates of the Tigris, Euphrates, and Karun Rivers [5-9].

### *1.2. Literature Review*

Several works were published related to the inland fisheries of Basrah, such as Ref. [10] who described the species, fishing efforts, catch rates and total catch of the artisanal fisheries in the landing locations in the north of Basrah province in 2005. Ref. [11,12] defined the annual species landings in the Basrah inland fisheries during 2005-2016. Later, Ref. [13] investigated the species composition, total catch, fishing effort and landing trends in the inland waters of Basrah province during 2017-2019.

### *1.3. Research Objective*

This paper aims to introduce a fresh look at inland fisheries, including the species composition, species and total catches, and the landing fish trends in six fish landing locations throughout the inland waters of Basrah province from January 2020 to December 2021.

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## 2. METHODS

### 2.1. Study area

The Basrah province is located in the southernmost part of the Mesopotamian Plain and is rich in water resources. It is northern bordered by the great Tigris and Euphrates Rivers and the water masses of the marshlands. It is southern and is limited by the northwest corner of the Arabian Gulf. Two more main water bodies, including the Shatt Al-Arab River, run through Basrah City to the Arabian Gulf—the Shatt Al-Basrah Canal connecting to the Arabian Gulf through Khor Al-Zubair.

Basic fishing activities in several fish landing sites throughout the inland waters of Basrah province (Fig. 1) were investigated from January 2020 to December 2021, while March and April were the closed times for fishing. Official data from the Ministry of Agriculture, Basrah Agriculture Directorate, was used to analyze the inland fisheries of Basrah. This data included the total monthly catch of each species, the number of fishers, and the specifications of fishing gears in the following landing sites; Al-Qurna, Al-Midaina, Al-Dair, Al-Hartha, Abu-Al-Kaseeb, and Al-Seeba.

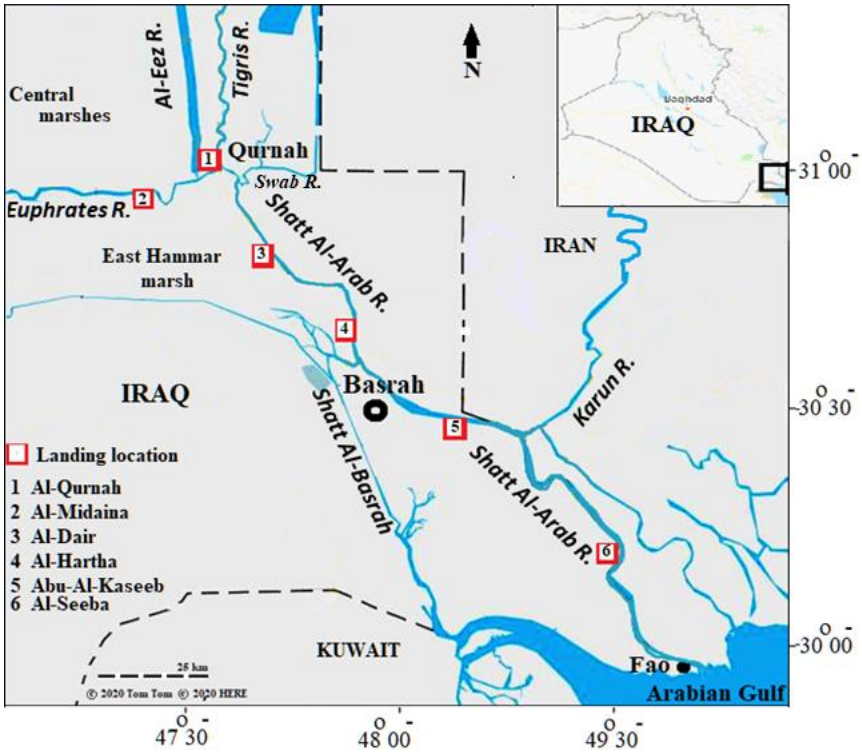


**Fig. 1.** Location of the landing sites of data collection in the Basrah inland fisheries.

### 2.2. Data analysis

These raw data were computerized, analyzed through descriptive statistics, and included in numerical and graphic results. The monthly relative abundance (% RA) of each species from the total catch was calculated for the two years according to the formula of Ref. [14]:

$$\%RA = C_i/TC * 100$$

Where, $C_i$ is the catch of $i^{th}$ species, and TC is the total catch.

The similarity between the catches for the two years, according to the weight per cent of each species estimated using the Morisita index [15]:

$$C\lambda\% = 2\Sigma X_i Y_i / \Sigma X^2_i + \Sigma Y^2_i,$$

where $C\lambda$ is the similarity level, $X_i$ and $Y_i$ the weight percent of $i^{th}$ species in each year of catch.

The monthly biomass diversity index (Hb) was calculated for each year by the following formula by Ref. [16]:

$$H_b = - \sum P_i \log_e P_i$$

Where $P_i$ is the proportion of $i^{th}$ species as the weight of each species for each month, the monthly variations in the weight of each species between the two years were tested using Student's t-Test to inspect the difference between the years. The trend line technique was used to illustrate the general direction and describe the pattern of each species' catch. All computations and analyses were carried out using Microsoft Excel 2010 program.

## 3. RESULT AND DISCUSSION

### 3.1. Catch composition

The fishermen caught 15 fish species belonging to 5 families in the Basrah inland fisheries during 2020-2021 (Table 1). Species comprised seven cyprinids, three cichlids, three mullet species, and two sparids and silurids. In terms of original, seven native fish species were observed during the study, including *Leuciscus vorax*, *Carasobarbus luteus*, *Mesopotamichthys sharpeyi*, *Luciobarbus xanthopterus*, *Arabibarbus grypus*, *Planiliza abu* and *Silurus triostegus*, five aliened species involved *Cyprinus carpio*, *Carassius auratus*, *Oreochromis niloticus*, *O. aureus* and *Coptodon zillii*, and three marine species comprised *P. subviridis*, *P. klunzengeri* and *Acanthopagrus arabicus.*

Moreover, *O. niloticus, O. aureus* and *C. zillii* are called Tilapias and *P. subviridis*, and *P. klunzingeri* as mullets. Mixed fish is unmarketable species sold together.

The stocked fish (*C. carpio*) and the invasive fish (*O. niloticus, O. aureus, C. zillii* and *C. auratus*) dominated the landings fish species. They constituted 44.2% of the total catch in the present study (Table 2). In contrast, the highly valued native fish (*M. sharpeyi, L. xanthopterus, C. luteus* and *A. grypus*) formed only 12.4% of the total catch, where they were classified as threatened by the International Union for the Conservation of Nature. They are included on the Red List [17-19]. Ref. [10] recorded 22 fish species belonging to 12 families in the artisanal fisheries of the lower reaches of Tigris, Euphrates and Swab Rivers at Qurna town, north of Basrah in 2005, and they mentioned that the species, *M. sharpeyi, L. xanthopterus, C. luteus* and *A. grypus* formed 13.4% from the total catch and the aliened species, *C. auratus, C. carpio* and *C. idella* instituted 12.2% of the total catch during 2005 (Table 2). Ref. [12] documented fourteen freshwater fish species in the Basrah province including some species recorded in the present study in addition to *Hypophthalmiehthys molitrix* and *C. idella*, and they stated that native species like *M. sharpeyi, L. xanthopterus, C. luteus* and *A. grypus* formed 15.7% of the total catch and the aliened species, *C. carpio, C. auratus* and *C. zillii* constituted 29.5% of the total catch during 2005-2016 (Table 2). This may be due to habitat degradation, the stocking of alien species and the invasion of exotic species. The southern region of Iraq suffered from a substantial reduction in water quality and quantity due to the construction of hydropower dam projects in the headwaters of the Tigris and Euphrates Rivers and their tributaries [20]. Dams on major rivers worldwide have adversely affected fisheries, primarily by altering the seasonal floods to which many fish species and fisheries are adapted, especially in the downstream reaches [21].

**Table 1**. Fish species in the Basrah inland fisheries (2020-2021)

| Family | Scientific name | English name | Local name |
|---|---|---|---|
| Cyprinidae | *Cyprinus carpio* | Common carp | Samti |
| | *Leuciscus vorax* | Tigris asp | Shalig |
| | *Carasobarbus luteus* | Himri barble | Hemri |
| | *Mesopotamichthys sharpeyi* | Binni | Bunni |
| | *Luciobarbus xanthopterus* | Yellowfin barbell | Gattan |
| | *Arabibarbus grypus* | Shabout | Shaboot |
| | *Carassius auratus* | Crucian carp | Kaezmeh |
| Mugilidae | *Planiliza abu* | Abu mullet | Khishni |
| | *Planiliza subviridis* | Greenback mullet | Beyah |
| | *Planiliza klunzingeri* | Klunzinger's mullet | |
| Cichlidae | *Oreochromis niloticus* | Nile tilapia | Bultee (Tilapia) |
| | *Oreochromis aureus* | Blue tilapia | |
| | *Coptodon zillii* | Redbelly tilapia | |
| Sparidae | Acanthopagrus arabicus | Arabian yellowfin seabream | Shanak |
| Siluridae | *Silurus triostegus* | Tigris catfish | Jerry |

Ref. [22] stated when a non-native fish is established in the environment and then dispersed, potential negative consequences include suppression of native fish populations through competition, predation and hybridization, and disruptions to habitats and ecosystem function. Also, different species of carp have been stocked in Iraqi natural waters and continue to be stocked annually by the Ministry of Agriculture, whereas there was a deficiency in the stocking of indigenous species. In addition, several fish species invaded Iraqi waters in various ways and expanded rapidly and became one of Basrah's most dominant species in different water bodies [23]. So far, about thirteen exotic fish species have been reported in the Shatt Al-Arab River [24]. The impacts of cyprinids and cichlids introduced upon native fish and their habitats were well documented in several countries [25-28].

### *3.2. Monthly and annual catches*

The monthly variations in the inland fisheries during 2020-2021 are presented in Figure 2. The law forbids freshwater fishing in the Basrah province from the middle of February to the middle of April yearly. The total landings fluctuated from 139.07 t in May to 467.8 t in November 2020 and from 187.35 t in February to 273.67 t in December 2021. There is an indication of a positive trend in the total catch during the present study (slope (b)= 0.68). The catch of *C. carpio* varied from 40.70 t in March 2020 to 67.80 t in January 2022 and from 8.80 t in November 2022 to 79.50 t in 2022. There is a positive trend in the catch of *C. carpio* during the study period (b= 1.12). The landings of *P. abu* ranged from 22.00 t in February to 50.25 t in December 2020 and from 28.25 t in September to 47.1 t in January 2021. The landings of *P. abu* show a slightly declining trend during 2020-2021 (b= -0.30). In 2020, the landing of tilapias varied from 7.27 t during July to 39.00 t during November and from 27.50 t during February to 56.50 t during December 2021. The catch of *L. vorax* fluctuated from 17.00 t in March to 31.50 t in December 2020 and from 14.50 t in February to 25.50 t in November 2021.

**Table 2**. A comparison of species composition in the Basrah inland fisheries (1975-2021)

| Species | Ref. [29] 1975-1977 | Ref. [10] 2005 Tigris | Ref. [10] 2005 Euphrates | Ref. [12] 2005-2016 | Present study 2020-2021 |
|---|---|---|---|---|---|
| *C. carpio* | 0 | 2.4 | 3.8 | 17.6 | 26.7 |
| Tilapia species | 0 | 0 | 0 | 7.9 | 14.5 |
| *P. abu* | 5.7 | 6.3 | 8.1 | 16.4 | 14.5 |
| *L. vorax* | 2.2 | 1.1 | 2.1 | 9.6 | 14.1 |
| Mullets | 3.2 | 0.5 | 0.9 | 7.2 | 5.4 |
| *C. luteus* | 12.6 | 1.3 | 2.8 | 11.5 | 5.1 |
| *M. sharpeyi* | 24.8 | 0.3 | 0.7 | 3.2 | 3.9 |
| *C. auratus* | 0 | 11.0 | 10.2 | 4.0 | 3.0 |
| *A. grypus* | 0.16* | 0.2 | 0.04 | 0.2 | 2.2 |
| *L. xanthopterus* | 24.1 | 0.7 | 0.4 | 1.0 | 1.6 |
| *A. latus* | 1.1 | | | 0.6 | 1.1 |
| *Silurus triostegus* | - | 70 | 53 | 20.7 | - |

* Fishing was banned for this species in the marshes to allow a maximum of fish to breed and flourish.

The landing of mixed fish ranged from 7.27 t in March to 19.75 t in December 2020 and from 14.81 t in January to 23.95 t in September 2021. There are positive trends in the catches of tilapias and mixed fish (b= 0.74 and 0.59, respectively), while is a negative trend in the catch of L. vorax (b= -0.18).

Figure 3 illustrates the monthly fluctuations in the landings of M. sharpeyi, C. luteus, mullets, C. auratus, L. xanthopterus, A. grypus and A. latus from 2020 to 2021. The harvest of M. sharpeyi varied from 1.45 t in August to 8.00 t in June 2020 and


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from 8.63 t in August to 16.95 t in May 2021. The catch of M. sharpeyi shows a clear increasing trend during 2020-2021 (b= 0.45). The landing of C. luteus ranged from 5.15 t in February to 18.95 t in December 2020 and from 9.30 t in February to 14.3 t in November 2021, while the landing of mullets fluctuated from 5.00 t in May to 22.26 t in November 2020 and from 1.65 t in January to 12.00 t in September 2021. The landings of C. luteus and mullets demonstrate clear declining trends during 2020-2021 (b= -0.40 and -0.06, respectively), however, the declining trend of C. luteus was sharper during the study period. The catch of C. ).

auratus fluctuated from 0.67 t in February to 17.55 t in November 2020 and from 2.7 t in January to 7.00 t in July 2021. The landing of C. auratus shows a clear decreasing trend during 2020-2021 (b= -0.22). The harvest of L. xanthopterus varied from 0.05 t in August to 7.73 t in December 2021 and from 2.85 t in October to 7.30 t in January 2021, whereas A. grypus landing changed from 1.22 t in November to 4.10 t in May 2020 and 2.07 t in December to 5.51 t in January 2021. There are positive trends in the landings of L. xanthopterus, A. grypus and A. latus (b= 0.06, 0.03 and 0.06, respectively) along the investigated period.

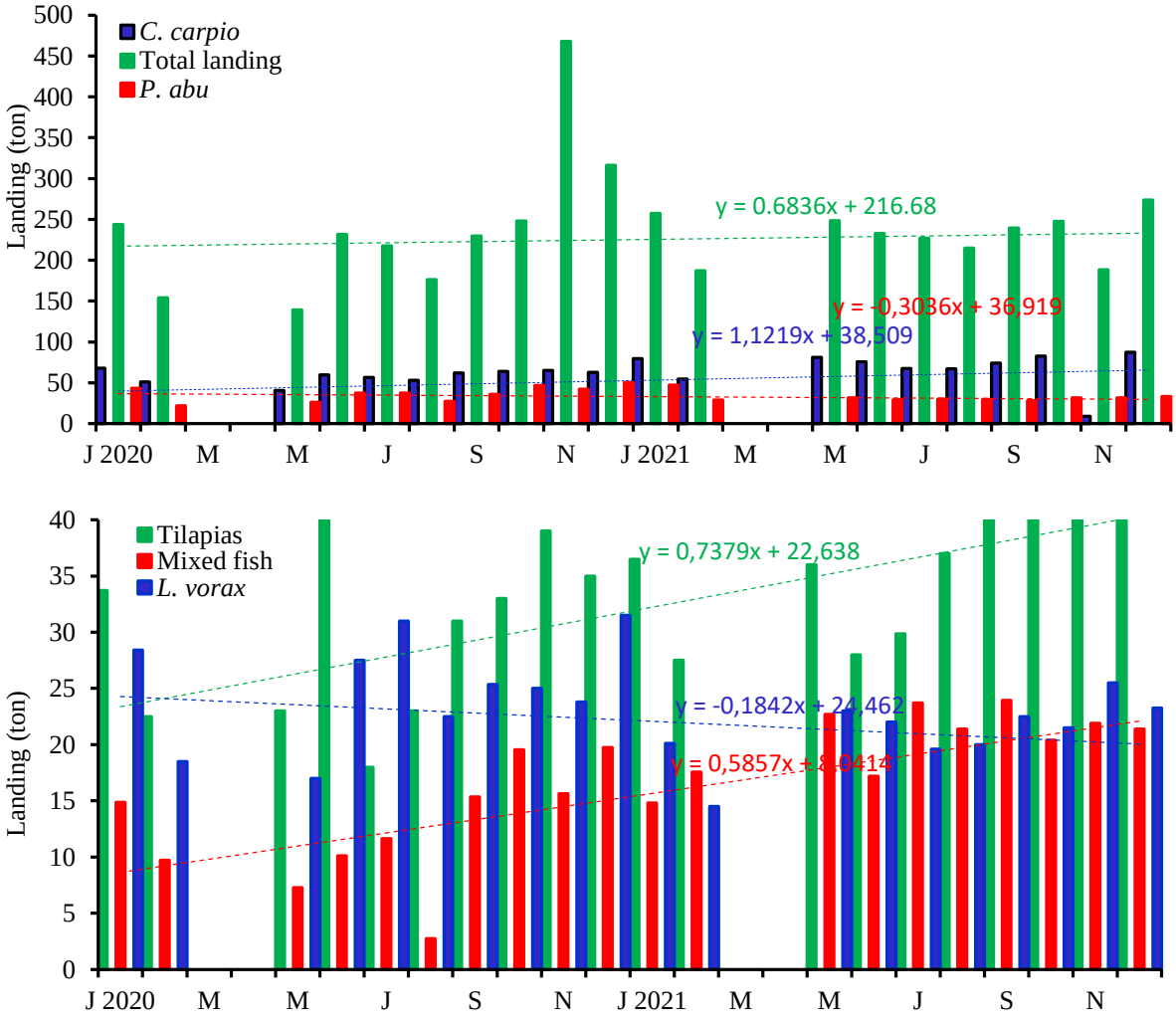


**Fig. 2.** The monthly fluctuations in the total landings, *C. carpio, P. abu, tilapias, L. vorax* and mixed fish.

The monthly value of the biomass diversity "Hb" for each species in each year of the catch is illustrated in Figure 4. The diversity ranged from 1.94 in August to 2.16 in June 2020 and from 2.03 in January to 2.25 in February 2018. The overall values of the biomass diversity index of each species were 2.07 in 2020 and 2.12 in 2021. Ref. [23] found that the overall values of biomass diversity of each species ranged from 2.10 in 2017 to 2.11 in 2019.

The total landings of various fish species and their contributions to the inland fisheries during 2020 and 2021 are presented in Table 3. The total landing in 2020 was 2,427.78 t, whereas 2,365.15 t in 2021, and no significant difference was found between the total landing in the two years (t= 1.02, P> 0.05) at the level of 0.05. Also, the similarity between the weight per cent of each species in 2020 and 2021, according to the Morisita index was a very high (Cλ= 93.8).

Four species were the mainstay of the inland fisheries in 2020 and 2021, involved C. carpio, L. vorax, tilapias species and P. liza. C. carpio dominated the overall catch, and its landing ranged from 582.83 t (24.0%) in 2020 and 693.95 t (29.34%) in 2021 (Table 3). The harvest of L. vorax fluctuated from 465.26 t (19.2%) in 2020 to 214.45 t (14.1%) in 2021, followed by tilapias species varied from 298.20 t (12.3%) in 2020 to 394.85 t (16.7%) in 2021. The catch of P. abu ranged from 369.10 t (15.2%) in 2020 to 326.30 t (13.8%) in 2021. These species comprised 69.8% of the total landings in 2020-2021. The contributions of historically important economic species such as C. luteus, A. grypus, M. sharpeyi, and L. xanthopterus were 5.5, 3.0, 2.5 and 1.2%,

respectively in 2020, while in 2021 constituted 4.8, 1.4, 5.3 and 2.0%, respectively in 2021 (Table 3). These four species instituted 12.8% of total landings in 2020-2021. Moreover, mixed fish composed 5.4% of the total landing in 2020 and 9.2% in 2021.

Ref. [12] stated that the total catch of the Basrah inland fisheries during 2005-2016 varied between 256.290 t in 2009 and 1978.395 t in 2015, with an overall catch of 11,094.940 t, including S. triostegus with 1740.2 t (20.7%), C. carpio with 1508.7 t (17.6%), P. abu with 1400.8 t (16.4%), C. luteus with 978.2 t (11.5%) and tilapia 817.7 t (7.9%), and these five species constituted 74.1% of the total catch. The increase in fish landing during the period 2020-2021 was about eightfold when compared to the period 2009-2010. However, the total landings from this fisheries during 2017-2019 ranged from 1,740.7 t in 2017 to 2,061.6 t in 2019 with an overall landing of 5,610.4 t, consisting of C. carpio with 1639.5 t (29.2%), *P. abu* with 906.7 t (16.2%) and tilapia with 964.7 t (15.4%), and these three species comprised 60.8% of the total catch [23].

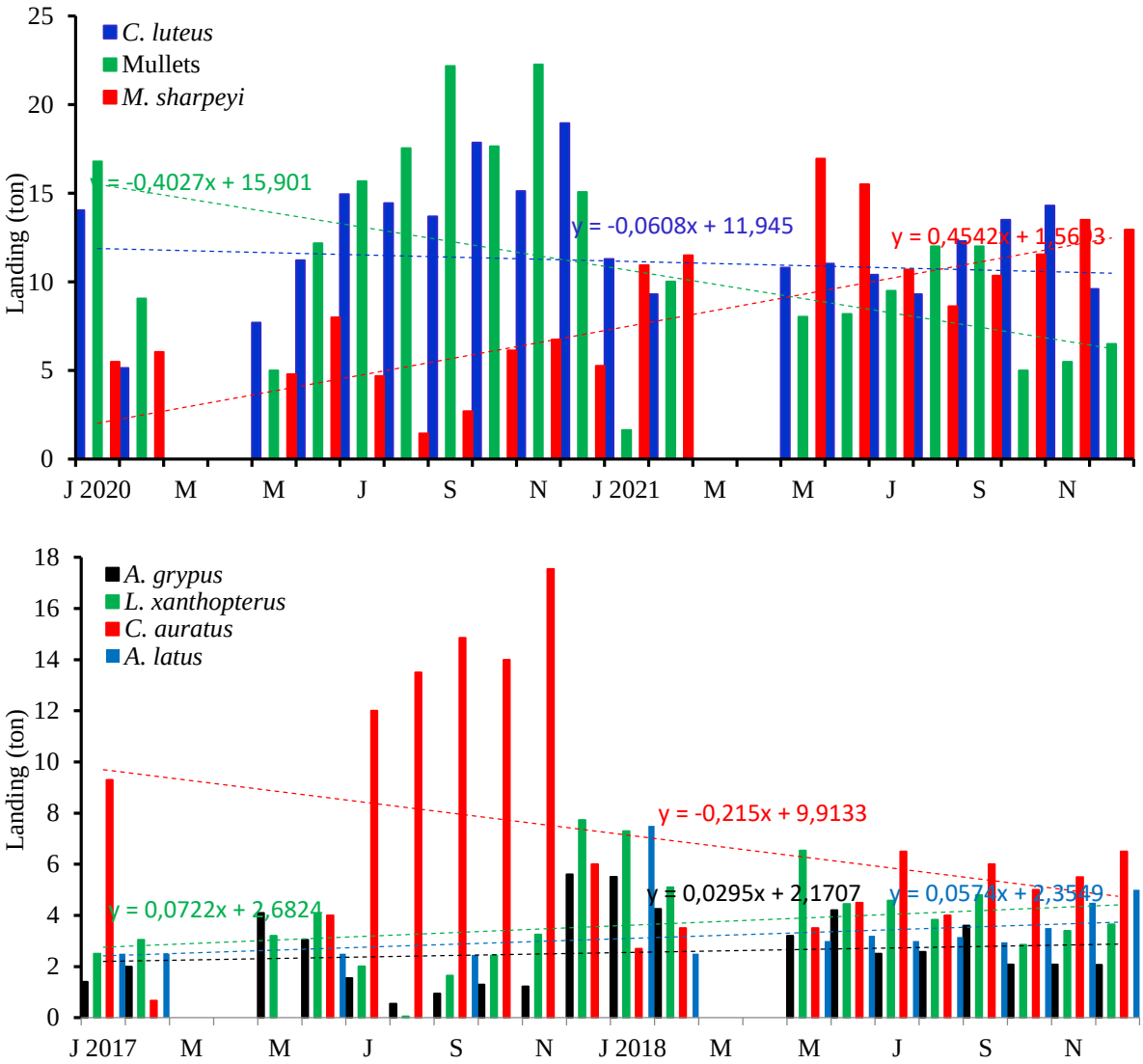


**Fig. 3.** The monthly variations in the catches of C. luteus, mullets, M. sharpeyi A. grypus, L. xanthopterus, C. auratus and A. latus.


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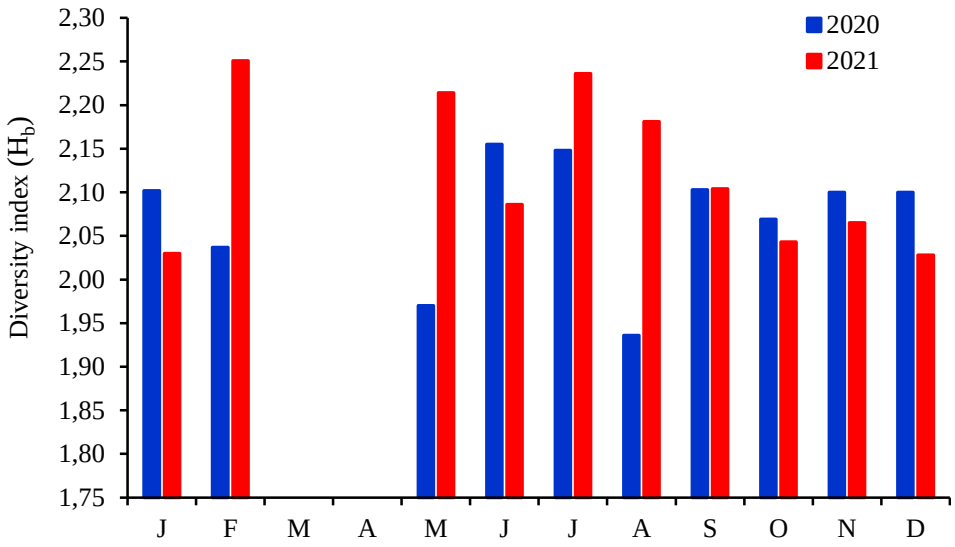


**Fig. 4.** Biomass diversity ($H_b$) values of the monthly inland fish catch during 2020-2021.

**Table 3.** Fish species landings (t) and their contributions to the Basrah inland fisheries during 2020-2021

| | 2020 | | 2021 | |
|---|---|---|---|---|
| Species | Landings | % | Landings | % |
| *C. carpio* | 582.83 | 24.01 | 693.95 | 29.34 |
| *L. vorax* | 465.26 | 19.16 | 214.45 | 9.07 |
| *P. abu* | 369.10 | 15.2 | 326.30 | 13.8 |
| *Tilapias* | 298.20 | 12.28 | 394.85 | 16.69 |
| *Mullets* | 153.43 | 6.32 | 107.09 | 4.53 |
| *C. luteus* | 133.14 | 5.48 | 113.83 | 4.81 |
| Mixed fish | 130.68 | 5.38 | 216.51 | 9.15 |
| *C. auratus* | 91.87 | 3.78 | 50.70 | 2.14 |
| *A. grypus* | 71.62 | 2.95 | 32.57 | 1.38 |
| *M. sharpeyi* | 59.60 | 2.45 | 125.58 | 5.31 |
| *S. triostegus* | 32.22 | 1.33 | 0.00 | 0.00 |
| *L. xanthopterus* | 29.90 | 1.23 | 48.02 | 2.03 |
| *A. latus* | 9.95 | 0.41 | 41.30 | 1.75 |

Some factors may have improved the total catch during the last years. Out of these, the prevalence of exotic species such as *C. carpio* and tilapia species, i.e., these species were successful in colonizing the waters of Basrah province and becoming the most abundant large freshwater fish in this region. *C. carpio* was introduced into Tharthar, Habbaniya and Hammar lakes, Iraq in 1960 [30]. Then after, Ref. [31] recorded its presence in the Shatt Al-Arab River, while tilapia species invaded Iraqi waters and first recorded in the Euphrates River near Musaib City, the middle of Iraq during 2007 [32] after that they recorded in Basrah waters during 2009 and 2015 [33]. *C. carpio* and tilapia species catch showed steady increasing trends in the last years in Basrah province [12,13]. During the last few years, the Basrah Agriculture Directorate has released large numbers of young carp from its hatcheries (Personal communication). However, several studies suggested that these species were a problem because of their perceived impacts on water quality, aquatic plants, and native fish populations through competition and lowering habitat quality [34,25].

Also, the artisanal inland fisheries have undergone a progressive change in the fishing effort. The numbers of fishermen and fishing boats may be further responsible for this improvement in the total catch of the Basrah inland fisheries. At the time of the study, there were 2140 non-motorized fishing boats (3.5-5.0 m length), with one to three fishermen employed in each boat. Also, there were 1160 motorized fishing boats (5.5-10.5 m length), which involved 573 made from fiberglass, 497 wooden, and 90 aluminum, with two to three fishermen working on each boat. While earlier studies such as [12] stated that about 1283 fishing boats operated in the Basrah inland waters during 2005-2016, most of these boats were less than 10 m long with small outboard motors with an estimated 1490 fishermen.

Generally, the main fishing gears and techniques used by fishermen in the Basrah inland fisheries during the investigated period included gill nets of various mesh sizes, seine and cast nets, and electro-fishing, which did not differ from those previously described by other authors [35,36,10].

## 4. CONCLUSION

\The study demonstrated that the annual landings by fishermen in Basrah's inland fisheries had increased over the past few years compared to the landings since 2009. This rise in catches was mainly attributable to the occurrence of foreign species, while the contributions of the highly valued native fish (M. sharpeyi, L. xanthopterus, C. luteus, and A. grypus) were below historical levels. Therefore, proper fisheries management is required to improve inland fisheries, such as enhancing the stocks of native species, minimizing the dispersal and impacts of some exotic species, and activating the national regulating fishing, exploitation, and protection of aquatic organisms, No. 48 for 1976.

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