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The Current Status and Recent Trends of Iraqi Marine Fisheries in The Northwest Arabian Gulf

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Abstract: This study describes the artisanal marine fisheries in Iraq. Historical data from 2008 to 2021 and monthly monitoring results from January to December 2022 were used to document the current state of knowledge and identify potential gaps. The study aims to recommend more effective measures for managing marine fisheries in Iraq. According to the study, there has been a significant increase in total fish landings in recent years. The lowest landing recorded was 2,587 tons in 2008, while the highest was 19,877 tons in 2020. The study also found a shift in the dominant fish species over time, with a decline in the contribution of main fish species such as river shad and mullets, and an increase in low economic species, particularly threadfin bream, which became the predominant species in the landings. The fishing effort (number of registered fishing boats) in the present study was higher than that recorded since 2008. From a fisheries management viewpoint, it is essential to emphasize the need for participatory crisis mitigation strategies between upstream and downstream riparian countries to preserve the ecosystems of the marine waters of Iraq, updating the law on fishing and protection of aquatic organisms and the regional cooperation in managing the shared species stocks.

Keywords: *Artisanal marine fisheries, Shared species, Fisheries management, Arabian Gulf, Iraq.*

INTRODUCTION

The artisanal fishery, also called small-scale fishing, is a traditional method of catching fish and selling it in domestic and international markets. This type of fishing involves using multiple gears and strategies that vary throughout the year. The fishery is characterized by using simple fishing technologies, which results in a lower amount of fishing compared to semi-industrial and industrial fisheries that operate in coastal waters. The artisanal fishery targets a broad species of invertebrates, demersal and pelagic fish. (FAO, 2013; Purcell *et al.*, 2018).

The marine coast of Iraqi is 105 km with a continental shelf of 1034 km2 northwest of the Arabian Gulf (Earth Trends, 2003) and includes many open creeks such as Khor Al-Khafga, Khor Al-Umaya, Khor Al-Rocka, and Khor Abdullah (Albadran *et al.*, 2016). The region is dominated by the large river delta of the Euphrates, Tigris and Karun, merging into the Shatt Al-Arab, representing the primary outflow in the Arabian Gulf (Pohl *et al.*, 2014). Therefore, the coast is dynamic and highly productive and considerable numbers of marine species coexist and thrive here due to receiving massive amounts of fluvial input via the Shatt Al-Arab River, which historically plays an important role in providing the northwestern Arabian Gulf with nutrient-rich fresh (FAO 2011; Al-Yamani, 2021), and serves as a significant nursery, feeding and reproduction grounds for several economic shares between countries, such as river shad fish, pomfret, mullet, shrimp, and other species (FAO, 2014). Al-Faisal and Mutlak (2018) stated that 214 species and 75 families, including 16 cartilaginous and 198 bony fish species, have been registered in Iraqi marine waters.

The marine waters of Iraq have a long-standing tradition of artisanal fishing. This fishery involves catching multiple species of fish and shrimp using various gears. It has been the primary source of marine fish supply to the local markets since 1986. A socio-economic study on fish resources in Iraq was conducted by Khayat (1978). It documented the marine artisanal and industrial landings from 1965 to 1973. Since then, several works have been published to describe Iraq's artisanal marine fisheries, including those by Ali *et al.* (1998), Morgan (2006), Al-Dubakel (2011), Mohamed and Qasim (2014), Mohamed (2018), Mohamed and Abood (2020), Mohamed and Jawad (2021), and Mohamed and Abood (2023).

In recent decades, several studies have designated that the discharge of the Shatt Al-Arab River has sharply declined to the Arabian Gulf due to the many hydrological projects constructed on the Tigris and Euphrates basins in boarding countries and the conversion of the Karkheh and Karun Rivers into Iranian territory (Al-Yamani, 2008, 2021; Brandimarte *et al.*, 2015; Al-Ansari, 2016; Yaseen *et al.*, 2016; Montazeri *et al.*, 2023).

It is essential to monitor the landings of various species and analyze artisanal marine fisheries statistics to

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ensure responsible fisheries management in Iraq. Therefore, this study aims to designate the landing of different species of artisanal marine fisheries and evaluate their landing trends in Iraq during 2022 to provide appropriate management for these fishery resources.

MATERIALS AND METHODS

Study Region

A study was conducted on the Iraqi artisanal marine fisheries from January to December 2022. These fisheries primarily operate in the Shatt Al-Arab estuary, Khor Abdulla, and Khor Al-Amaya regions (Fig. 1). The main center for landing and auctioning of

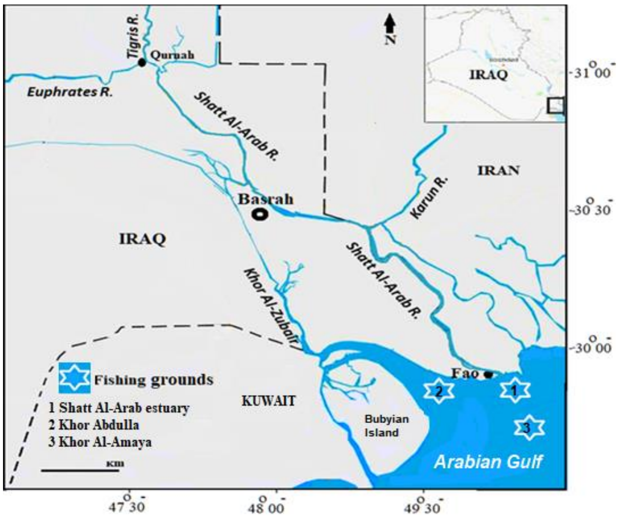

Fig. 1: Fishing grounds in Iraqi marine waters, northwest Arabian Gulf.

Marine fisheries is the Al-Fao port, which is located in the northwest corner of the Arabian Gulf (Mohamed, *et al*., 2002). The Shatt Al-Arab estuary basin is rectangular in shape, with a shallow depth of no more than 4 m. It is an extension of the tidal flats and is crossed by the course of the Shatt Al-Arab, which reaches a depth of 8 m. The length of Khor Abdullah is 60 km and it extends from Um Qasr Port to Khor Al-Amaya, representing tidal flats and an open coastal lake. The deepest water, over 10 m, is towards Bubyian Island. Khor Amaya is composed of several deep valleys that exceed 26 m in depth, and the substratum is mainly of sandy-clay texture (Mohamed *et al*., 2001). The surface water temperature ranged from 12.4°C in January to 37.2°C in June, and salinity ranged from 28.1‰ in November to 47.3‰ in July (Al-Shamary *et al*., 2020).

Data Analysis

To describe the marine fisheries of Iraq in this study, the official prime data were dependent to include the monthly total catch of each species, the number of fishermen and the specifications of fishing gear collected by staff of the Ministry of Agriculture, Basrah Agriculture Directorate from the main center of landings and auction of marine fisheries at Al-Fao port as documented in the Directorate. These prime data were computerized, analyzed through descriptive statistics and included in each species' numerical and graphic results.

The relative abundance by biomass (%R) was used to identify the percentage of each species according to the formula of Krebs (1972):

$$\%R = Ci/TC * 100$$

where Ci is the landing of ith species and TC is the total landings.

The monthly variations between monthly landings were tested using one-way analysis of variance (ANOVA), and the least significant differences were used to analyses the difference between months using SPSS software (version 16, 2007) statistical package. A trend line (technical analysis) was used to show the general direction and describe patterns of fish species landings using the TREND function in Microsoft Excel 2010. The biomass diversity index (Hb) was calculated for each month by Morisita's index (Morisita, 1959):

$$Hb = - \sum Pi \log_e Pi$$

where Pi is the proportion of ith species as the weight of each species for each month.

RESULTS

Landings Composition

In 2022, the marine capture fisheries recorded the landings of different species listed in Table 1 along with their scientific, English, and local names. Thirty-one fish species from sixteen families were identified in this fishery. Additionally, two species of shrimp from the Penaeidae family were also recorded. Four species from the Sciaenidae and Sparidae families and three species each from Mugilidae and Pristigasteridae families were identified. The remaining families were represented by either one or two species. Other species that are not commercially desirable are often sold as mixed fish.

Monthly landings

Figure 2 displays the total landing of each species caught by marine fisheries during the year 2022. A combined landing of 16,971 tonnes was landed from 22 different species or species groups of fish and shrimp. The three most landed species were threadfin bream, mullets, and emperor which weighed approximately 2,200 t, 1,732 t, and 1,385 t, respectively. The other species caught ranged from 5 t for the barred spanish mackerel to 1,145 t for the river shad. Additionally, mixed fish and shrimp landings during 2022 were 2,123 t and 1,961 t, respectively.

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Table (1): Landing composition of the artisanal marine fisheries during 2022.

Family	Scientific name	English name	Local name
Nemipteridae	*Nemipterus japonicas*	Threadfin bream	Bassi
Mugilidae	*Planliza subviridis, P. carinata & P. klunzingeri*	Mullets	Beyah
Lethrinidae	*Lethrinus nebulosus*	Emperor	Sheiry
Clupeidae	*Tenualosa ilisha*	River shad	Sboor
Sparidae	*Acanthopagrus arabicus, A. berda, Sparidientex hasta & Argyrops spinifer*	Yellow fin-bream, black fin-bream & soldier bream (Sea bream)	Shaem (Shanag) & Andag
Epinephildae	*Epinephelus tauvina & E. areolatus*	Spotted grouper	Hamoor
Carangidae	*Scomberoides commersonianus & Parastromateus niger*	Carangids (Spotted leatherskin & Black pomfret)	Dhal'a & Halwayah
Sciaenidae	*Otolithes ruber, Johnius maculates, Johnius sina & Johnieops belangerii*	Tigertooth croaker, Blotched croaker, Silvery croaker	Newaiby, Shmahy, Tataoo
Stromateidae	*Pampus argenteus*	Silver pomfret	Zobaidy
Chirocentridae	*Chirocentrus dorab & C. nudus*	Wolf herring	Hiff
Pomadasyidae	*Scolopsis phaeops, Plectorhinchus schotaf & Pomadasys argenteus*	Silvery grunt	Nagroor
Bothidae, Soleidae and Cynoglossidae	*Bothus pantherinus , Euryglossus orientalis & Cynoglossus arel*	Largetooth flounder, Tongue sole & Black sole	Khofaah (Mezlag) & Lessan
Platycephalidae	*Platycephalus indicus & Gramolites scaber*	Indian flathead	Wahra
Scombridae	*Scomberomorus guttatus & Scomberomorus commerson*	Spotted Spanish mackerel & Barred Spanish mackerel	Khobat & Chanaad
Penaeidae	*Penaeus semisulcatus & Metapenaeus affinis*	Green tiger prawn & Penaeid shrimp	Robian

The relative abundance of the species or species groups of fish and shrimp in the marine fisheries during 2022 is demonstrated in Figure 3. The threadfin bream was the most significant landing species, forming 12.96% of the total marine landings followed by the mullets at 10.21% and the emperor at 8.16%. Shrimp comprised 11.56% of the total landings, while mixed fish contributed 12.51%. The historical species, river shad consisted of only 6.75% of the total landings during 2022. Other species that contributed ≥5.0% of the total landings, soldier bream and spotted grouper constituted 5.89 and 5.24% of the total landings, respectively.

Monthly Changes in Species Landings

The monthly changes of the species or species groups of fish and shrimp in the marine fisheries during 2022 contributing ≥5.0% of the total fish landings are illustrated in Figures 4-5. The lowest total landings were 986 t in February for marine fisheries and 105 t in April, while the highest landings were 1727 t in August for marine capture fisheries (Fig. 4). The analysis of variance between the species' landings throughout the year showed high significant differences between the months ($F= 14.215$, $P> 0.05$).

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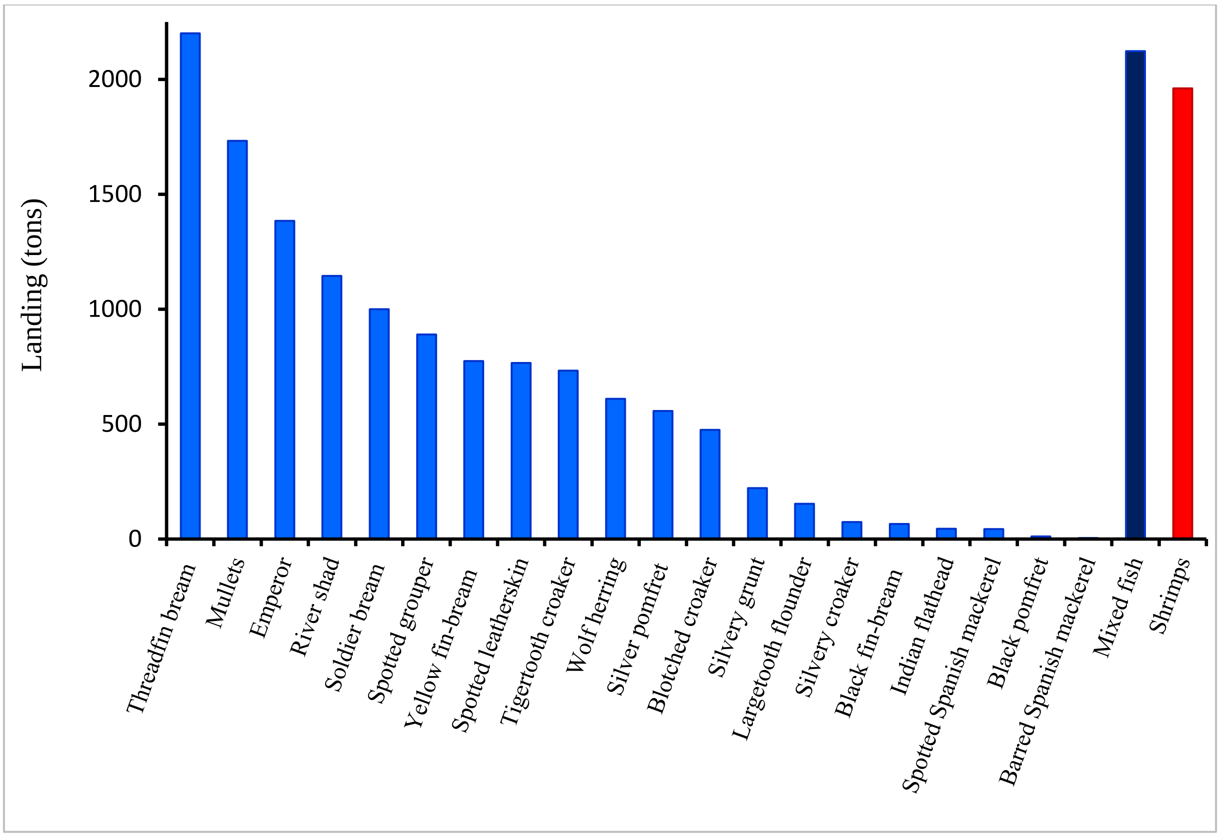

Fig. 2: The total landing for each species caught by marine fisheries in 2022.

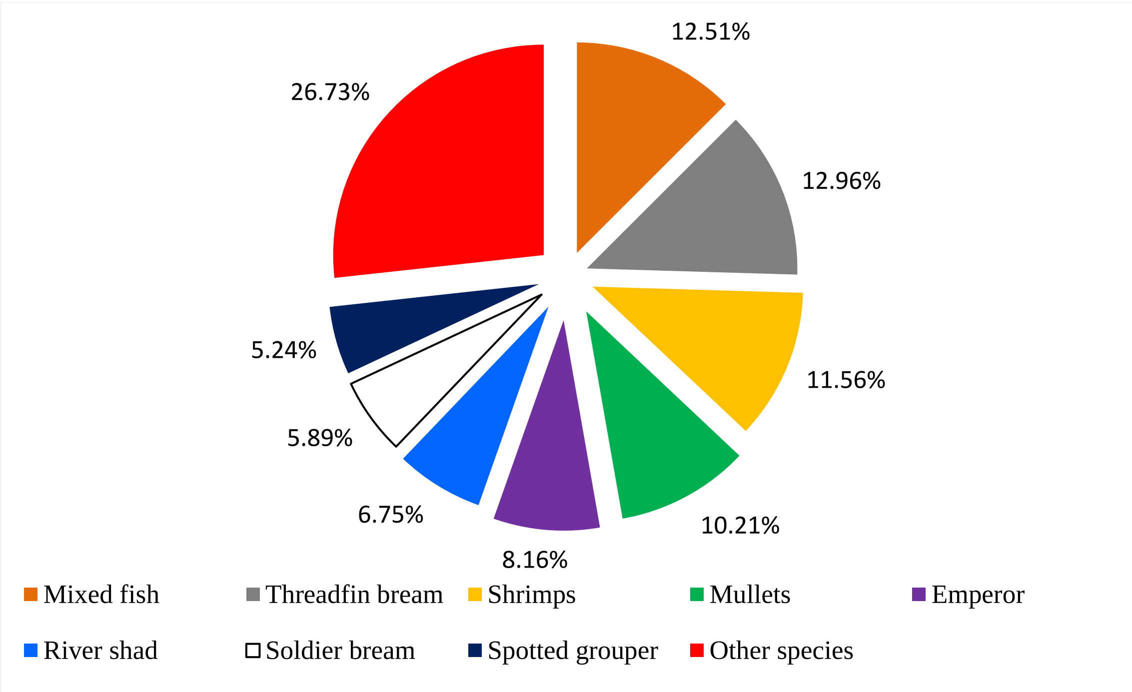

Fig. 3: The relative abundance of the most common fish species of marine fisheries in 2022.

The threadfin bream was the main species that landed during the study period and was caught throughout the year. The landing of the species extended from 125 t in April to 250 t during January and November (Fig. 4). The second most landed species was the mullets, which landed throughout the year, and their landings fluctuated from 36 t in March to 263 t in August. River shad has been considered the commercially most important migratory marine fish in Iraq for many decades, and the landing of this species exhibits a clear seasonal pattern related to the reproduction cycle, its landings fluctuated from 1 t in February to 406 t in May (Fig. 4). The emperor landed throughout the year and the lowest landing was 10 t in February, while the highest landing was 200 t in April (Fig. 4).

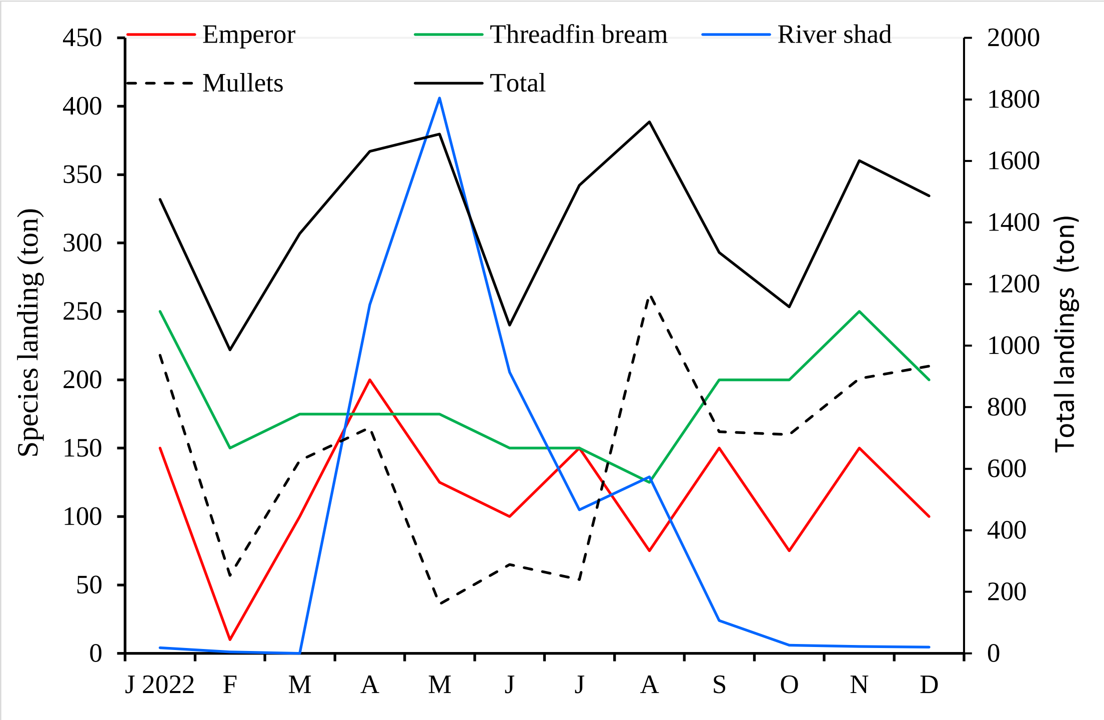

Fig. 4: The monthly fluctuations in the landings of the total, threadfin bream, mullets, river shad and emperor in 2022

Figure 5 illustrates the monthly differences in the landings of the soldier bream, spotted grouper, shrimp and mixed fish during 2022. All these species or species groups were landed throughout the year. The landing of the soldier bream varied from 10 t in May to 250 t in February, while the spotted grouper from 15 t in June to 120 t in January. The landing of shrimp fluctuated from 36 t in June to 260 t in July, and the mixed fish landing changed from 100 t in June to 250 t in November.

Fig. 5: The monthly fluctuations in the landings of soldier bream, spotted grouper, shrimp and mixed fish in 2022.

The biomass diversity "H_b" for the species or species groups of fish and shrimp in the marine fisheries during 2022 is explained in Figure 6. The diversity of the species in marine fisheries varied from 1.889 in May to 2.415 in June, and the overall value was 2.308.

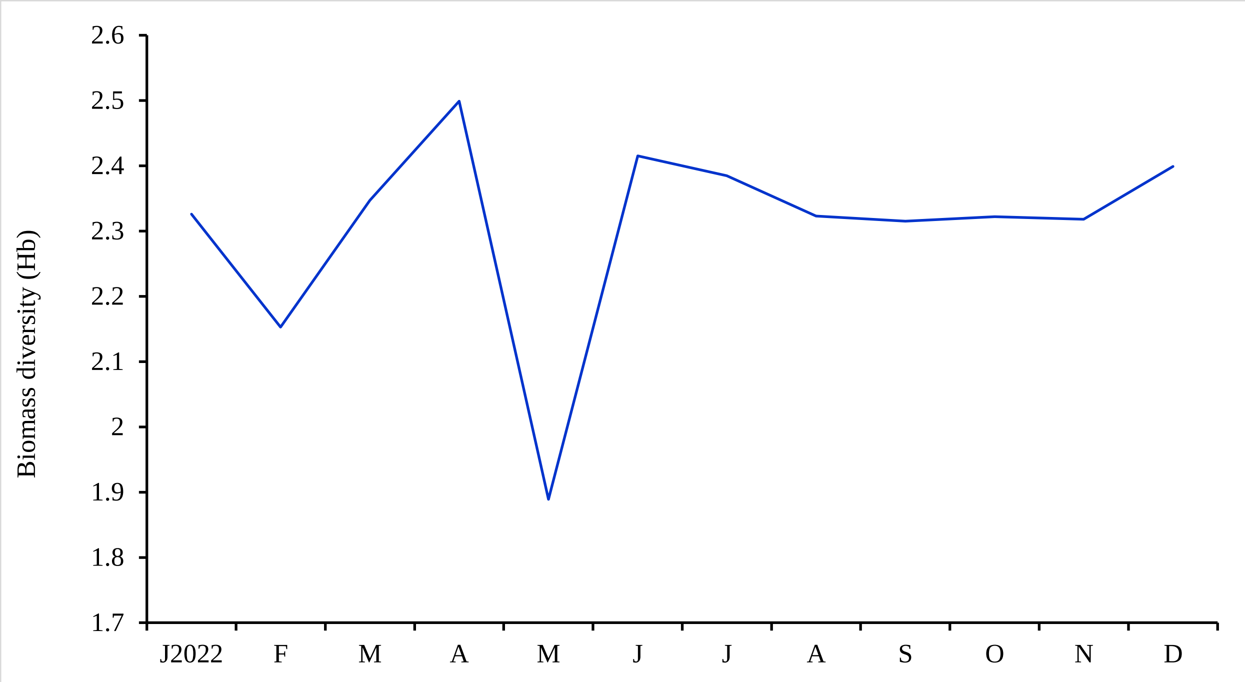

Fig. 6: Monthly variation in biomass diversity (H_b) values for marine fisheries during 2022.

Fishing efforts

The number of licensed fishing boats employed in the marine waters of Iraq during 2022 was 1612 powered boats. They comprised 1,337 fiberglass powered by 65-250 hp using mainly drift gill nets for fished target species (river shad and silver pomfret) and 275 steel-hulled dhows powered by 120-950 hp using drift gill nets, traps (gargoor), stake nets (hadra), hand lines and small trawl nets to take demersal and pelagic fish species as well as shrimp.

DISCUSSION

In the present study, the multi-species nature of the marine fisheries is confirmed here by the high diversity of species landed and directed towards various demersal, pelagic fish species and shrimp. A total weight of 16,971 t from 22 species or species groups of fish and shrimp were landed. Despite this diversity of species caught, the number of species that exceeds 500 t each annually was eleven, in addition to shrimp and mixed fish. The most major landing species were the threadfin bream followed by the mullets and the emperor. Moreover, the study exhibited a development in the total landings of fish and shrimp, but towards the dominance of some species that are considered as secondary species, and the decline of the highly economically important species (river shad and mullets) that had absolute dominance and gave distinctive characteristics to the marine fisheries of Iraq for several decades. These characteristics of the marine fisheries in the present study have been compared with the relevant literature on the artisanal marine fisheries of Iraq from 2008 to 2021 (Mohamed and Qasim, 2014; Mohamed, 2018; Mohamed and Abood, 2020; Mohamed and Abood, 2023), in addition to the results of 2022 using the trending technique, and illustrated in Figures 7 and 8.

It is clear from Figure 7 that the total landings increased obviously from 2,587 t in 2008, reached a peak of 19,877 t in 2020, and hence continued a long-term upward trend, revealing a positive trend in the total catches (b= 1189.6). This heightening in the total landings of the species from Iraqi marine waters may be attributed to the development of infrastructure, the improvement of navigation technology and the increasing mechanized power of fishing boats. The number of licensed motorized fishing boats working in this study grew to 1612 powered boats resulting in tremendous fishing pressure and then an increase in the total landings. Mohamed and Qasim (2014) stated that the total landing of the marine fisheries was 3,029 t and the overall numbers of fiberglass boats and steel-hulled dhows operated in this fishery were 538 and 403, respectively. In general, the fishing gear used by

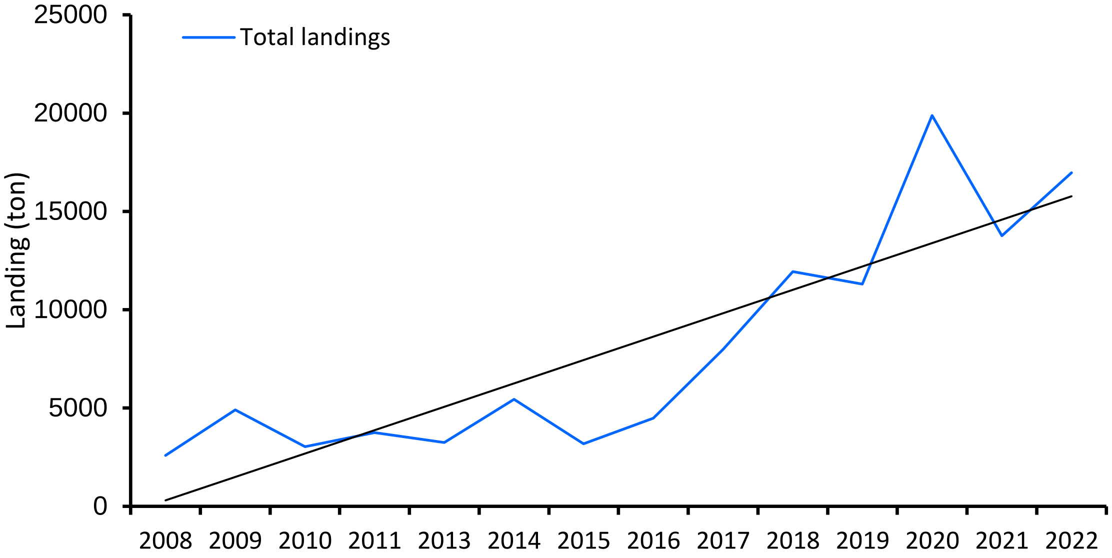

Fig. 7: The general trend of the total landings of the marine fisheries from 2008 to 2022.

fishers in the marine fisheries of Iraq during the investigated period did not differ from those previously described by other authors (Jawad, 2006; Mohamed and Qasim, 2014; Mohamed and Abood, 2023).

Figure 8 shows the landing trends of the most dominant species in the marine fisheries from 2008 to 2022 to provide a comprehensive overview of the direction development of the fishery. The mullet landings changed from 2,068 t in 2010-2013 to 5,133 1 t in 2020-2022, but there was a clear declining trend in the percentage of this species from the total landings from 26.7% in 2008-2009 to 10.1% in 2020- 2022 (b= -4.44). Also, the landings of river shad ranged from 1,344 t in 2008-2009 to 3,452 t in 2017-2019, and the proportion of this species exhibits a clear declining trend from 19.4% in 2008-2009 to 5.4% in 2020-2022 (b= -3.12). The landings of threadfin bream increased hugely from 56.3 t in 2008-2009 to 6,225 t in 2020-2022, offering a positive growth trend to 2022 (b= 3.46). Also, the landings of the emperor enlarged from 37.7 t in 2008-2009 to 3,569 t in 2020-2022 and offer a clear increasing trend (b= 1.66). The landings of silver pomfret increased from 40.2 t in 2008-2009 to 1,376 t in 2020-2022, offering a positive growth trend to 2022 (b= 0.44). The landings of shrimp inflated from 123.4 t in 2008-2009 to 7,288 t in 2020-2022 and displayed a clear increasing trend toward 2022 (b= 3.61).

Historically, the marine fisheries of Iraq mainly depend on the river shad, mullets, pomfret and shrimp. These stocks are shared with the neighboring countries of Kuwait and Iran, and hence any increased exploitation of these stocks by any country may impact the landings in these countries (Munro, 2003; Morgan, 2006). Some of these essential species have upstream migration to the upper reaches of the Shatt Al-Arab River and the East Hammar marsh for spawning, nursery and feeding like river shad (Hussain *et al.*, 1994; Al-Hassan, 1999; Mohamed *et al.* 2008; Mohamed *et al.* 2012; Almukhtar *et al.*, 2016), the mullets (*P. subviridis* and *P. klunzingeri*) and shrimp (*M. penaeus*) for nursery and feeding (Salman *et al.*, 1990; Hussain *et al.*, 2009; Mohamed and Hussain, 2012; Al-Maliky, 2022), while the principal spawning and nursery ground for silver pomfret occurs in the Khor Abdullah (Mohamed and Ali, 1993).

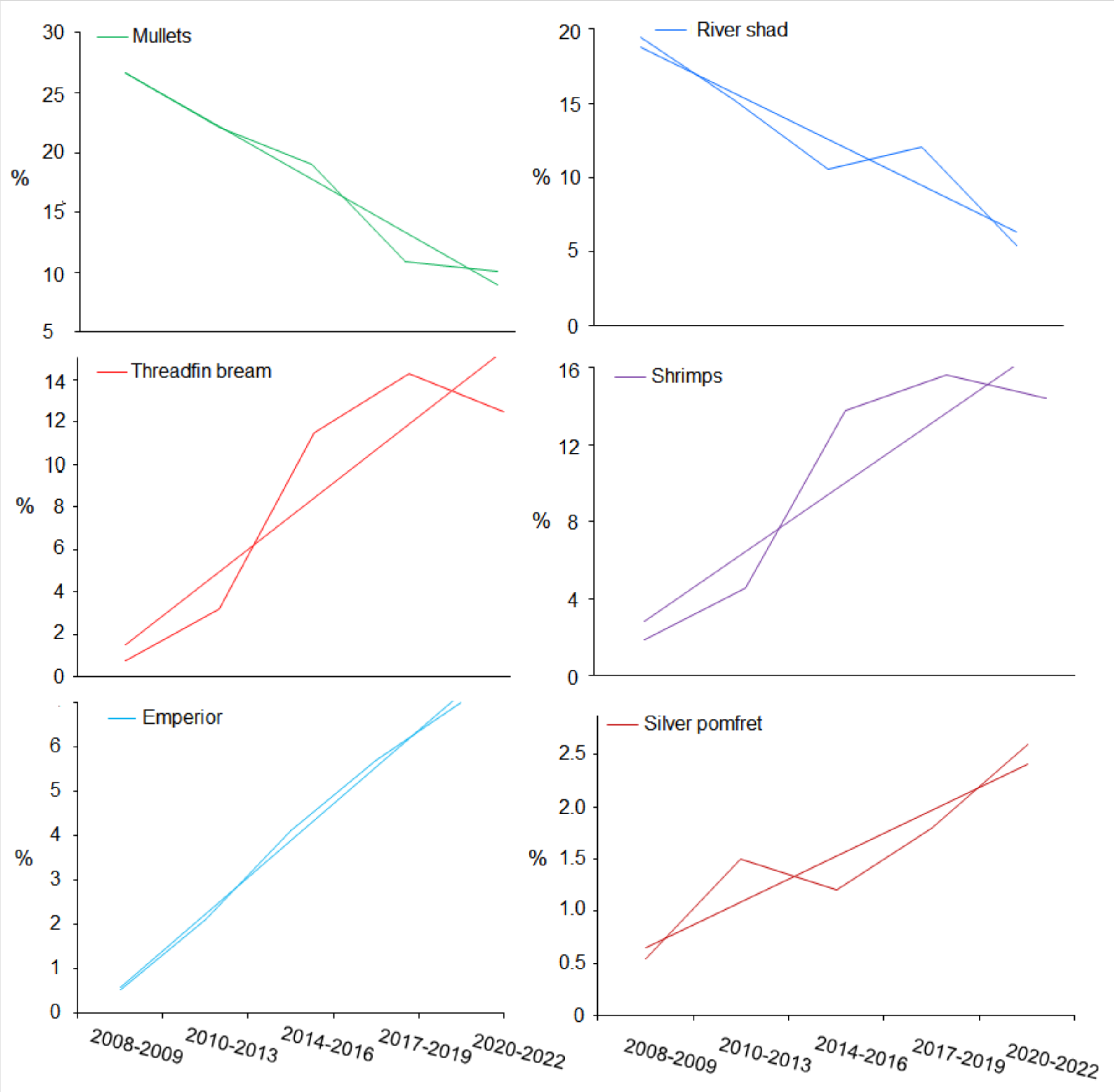

Fig. 8: The trends of the main species contributions in the marine fisheries (2008-2022).

Formerly, the river shad made up most of the catch by the Iraqi marine fisheries for a long time and was responsible for determining the general trend of this fishery from 1965 to 2006. It has been reported that the species constituted 90.2% of total landings during 1965-1973 (Khayat, 1978), 52.9% during 1990-1994 (Ali *et al*., 1998), 51.0% during 1995-1999 (Mohamed *et al*., 2002), and 30.7% during 2000-2006 (Al-Dubakel, 2011). However, this contribution has dropped drastically to lower levels over recent years to about 5.4% in 2020-2022. Moreover, the contribution of mullets has been increased from 12.3% of the total landings in Iraqi marine fisheries during 1990-1994 (Ali *et al*. 1998) to 22.3% during 2007-2011 (Mohamed and Qasim, 2014), then to 26.6% during 2008-2009 after that declined to 10.1% in 2020-2022. Sivasubramaniam (1981) stated that mullets comprised a percentage (30%) of pelagic fish production in the northwest Arabian Gulf. Whereas the contributions of river shad and mullet dropped drastically to lower levels over recent years, the contributions of other low-value species have improved considerably because the fishermen have tended to catch these species to cover the cost of fishing trips and to keep their lives (Al-Dubakel, 2011), so landings of other species have improved considerably, and a shift in the domination of these species over landings over time.

Several factors are behind the decline of the catches of the riverine migratory species over recent years, mainly the significant changes that have occurred in the region's ecosystem as a result of the deterioration of the quantities of river water flowing from the Shatt Al-Arab River due to the construction of a large number of irrigation projects, dams, and reservoirs in the upper Tigris and Euphrates rivers and their tributaries coupled with diverted discharge of Karun river inside the Iranian boundary have allowed saltwater to move further upstream on the Shatt Al-Arab River (Al-Mudaffar and

Mahdi, 2014; Issa *et al*., 2014; Al-Asadi, 2017; Haghighi *et al*., 2020; Montazeri *et al*., 2023). The region receives massive amounts of fluvial input via the Shatt Al-Arab River, which historically plays an important role in providing the northwestern Arabian Gulf with nutrient-rich freshwater, and alteration of river discharge may have significant effects on hydrodynamics, water quality, sediments, nutrients and bottom topography, then on the fish and shrimp ecosystems in the effects northwest Arabian Gulf (Al-Yamani, 2021; Al-Yamani, *et al*., 2017; Salman and Jazaa, 2023). It is almost confident that annual fish migration and breeding will be disrupted due to the modification of the downstream river flow regime by an impoundment through the loss of stimuli for migration, loss of migration routes and spawning grounds, decreased survival of eggs and juveniles, finfish recruitment and diminished food production (Larinier, 2001; Al-Husaini, 2003; Ben-Hasan *et al*., 2018; van Puijenbroek *et al*., 2019).

The other issues behind the decline in the catches of some species stocks over the current years include overfishing and indiscriminate harvesting of adults in migration routes. Published literature reported that the stocks of prime, valuable and shared fish stock in the northern Arabian Gulf between Iraq, Kuwait and Iran suffered from heavy exploitation that exceeded the optimal level of exploitation rate (Gulland, 1971), such as in Iraq (Jaber, 1995; Mohamed *et al*., 1998; Ali *et al*., 2000; Mohamed *et al*., 2001; Mohamed and Qasim, 2014; Mohamed *et al*., 2016; Mohamed and Abood, 2020; Mohamed, 2022), in Kuwait (Al-Baz and Grove, 1995; Al-Sabbagh and Dashti, 2009; Al-Husaini, *et al*., 2015) and in Iran (Hashimi *et al*., 2010; Narges, *et al*., 2011; Roomiani and Jamili, 2011; Hashimi *et al*., 2012; Parsa *et al*., 2017; Kazemi *et al*., 2022). The abundance of river shad has fallen to the point where it was classified as threatened by the International Union for the Conservation of Nature and included on the Red List (Freyhof, 2014). Alqattan *et al*. (2020) and Alqattan and Gray (2021) stated that the majer causes of declining especially in two primary stocks (river shad and silver pomfret) in Kuwaiti waters were overfishing, mainly by trawlers and gillnets. The second reason for the decline was pollution from factories and the discharge of sewage directly into the sea, in addition to high levels of salinity caused by the dams in Turkey since 2010 and the water dams built on the Karun River by Iran in 2005, which together have intensely reduced the amount of freshwater pouring into the Arabian Gulf through Shat Al-Arab River.

Moreover, there was no particular system to regulate the fishing of the marine resources and the riverine migratory species, especially the river shad, through their reproductive migration to the upper reaches of the Shatt Al-Arab River, as heavy fishing occurs on the adults before they breed, as well as on young ones (<20.0 cm) when moving downriver to the Gulf.

CONCLUSION

According to the results of the study, the study suggests the following management actions should be required to maintain sustainable stocks in the marine and wetland ecosystems in southern Iraq involve regional cooperation between Iraq, Turkey, Syria and Iran to secure the appropriate quantities of water from the upper Tigris and Euphrates Rivers and their tributaries for Iraq, following the historical principles in this regard. This emphasizes the need for participatory crisis mitigation strategies between the upstream and downstream countries to preserve the ecosystems of the northwest Arabian Gulf. The management measures should include updating the Act of Regulating Fishing and Aquatic Exploitation and Protection No. 48 for 1976 has been allocated Article No. 9 of the Act to regulate marine fishing since this article has not yet been legislated for maintaining sustainable exploitation of the marine stocks, control gear selectivity, application of closed season and development the fisheries infrastructure, such as ports, markets, landing sites…etc. Finally, the regional cooperation between Iraq, Kuwait and Iran is essential in managing the shared species stocks.

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