Archives of Agriculture and Environmental Science 9(3): 508-513 (2024)
https://doi.org/10.26832/24566632.2024.0903014

e-ISSN: 2456-6632

This content is available online at AESA

Archives of Agriculture and Environmental Science

Journal homepage: journals.aesacademy.org/index.php/aaes

ORIGINAL RESEARCH ARTICLE

Evaluating the characteristics, trends and challenges of marine fisheries in Iraq

Abdul-Razak M. Mohamed[1*] and Abdullah N. Abood[2]

[1]Department of Fisheries and Marine Resources, College of Agriculture, University of Basrah, Iraq
[2]Basrah Agriculture Directorate, Ministry of Agriculture, Iraq
[*]Corresponding author's E-mail: abdul19532001@yahoo.com

ARTICLE HISTORY

Received: 03 July 2024
Revised received: 08 September 2024
Accepted: 15 September 2024

Keywords

Arabian Gulf
Fishery management
Iraq
Marine fishery
Shared species

ABSTRACT

The characteristics, trends and challenges of the marine fisheries of Basrah province, Iraq were studied in this study. Information on fish landings was gathered from the main landing site of the marine fisheries at Al-Fao port from January 2023 to December 2023. The total landing of marine fisheries was 29,446 tons for 28 fish species and two shrimp species. Threadfin bream constituted 10.87% of the landing, followed by Mullets (9.72%) and Emperor (9.39%). Shrimp formed about 13.87% of the total catches. The landings of Threadfin bream and Emperor, as well as shrimp, significantly increased in 2023, while the contribution of historically more important species such as the landing of river shad has decreased to the lowest level. Therefore, from a fisheries management perspective, it is crucial to manage the stock of various species, especially River shad by ensuring the right amount of water is obtained from the upper Tigris and Euphrates Rivers to marine waters through the Shatt Al-Arab River, implementing national fishing regulations to deter illegal fishing methods and safeguard the fish during their migration, reproduction, and in their nursery habitats in inland waters.

Citation of this article: Mohamed, A. R. M., & Abood, A. N. (2024). Evaluating the characteristics, trends and challenges of marine fisheries in Iraq. *Archives of Agriculture and Environmental Science*, 9(3), 508-513, https://dx.doi.org/10.26832/24566632.2024.0903014

INTRODUCTION

The Basrah province is situated in the southernmost part of the Mesopotamian Plain and is abundant in water resources. It is bordered by the Tigris and Euphrates Rivers besides the water masses of the marshlands to the north and the Arabian Gulf to the south. There are two main water bodies: the Shatt Al-Arab River, which flows through Basrah City to the Arabian Gulf, and the Shatt Al-Basrah Canal, which connects to the Arabian Gulf through Khor Al-Zubair. The Shatt Al-Arab River receives freshwater from the Tigris and Euphrates Rivers, and the Karkheh and the Karun Rivers from Iran (UN-ESCWA & BGR, 2013). In the province, two distinct groups of fish are caught: marine fish species from the northwest region of the Arabian Gulf (marine fishery) and freshwater fish from the main rivers and the marshlands (inland fishery). All the fisheries are generally artisanal, with no large-scale industrial fisheries undertaken in Iraqi marine waters since 1990 (Ali *et al*., 1998). The marine waters support a wide variety of fish species, with 214 species belonging to 75 families, including 16 cartilaginous and 198 bony fish species listed in the Iraqi marine waters (Al-Faisal & Mutlak, 2018; Salman & Jazaa, 2023). In the latter part of the century, the Basrah province experienced a decline in the quality and quantity of water. This was caused by the construction of hydropower projects in the headwaters of the Tigris and Euphrates Rivers and their tributaries, the diversion of the Karun and Karkha Rivers into Iranian territory, and seawater intrusion upstream, reaching up to 100 km into the Shatt Al-Arab River during dry years. These factors led to the deterioration of the aquatic systems of the province (Hameed & Aljorany, 2011; Abdullah *et al*., 2016; Al-Asadi *et al*., 2022). Several studies have been carried out on the marine fishery of Basrah (Ali *et al*., 1998; Morgan, 2006; Al-Dubakel, 2011; Mohamed & Qasim, 2014; Mohamed, 2018; Mohamed & Abood, 2020; Mohamed & Jawad, 2020; Mohamed & Abood, 2023). These studies focused on the species composition, fishing efforts, total and species landings, and fish

marketing conditions. It's crucial to keep track of the status of different fish species due to substantial changes in the natural flow of rivers. These changes impact habitat quality and the behavior of marine species. Therefore, our study aims to assess the landing of various species and their trends from January 2023 to December 2023 and compare it with historical data. This will help in the planning and management of the fisheries sector in Iraq.

MATERIALS AND METHODS

Study area

The Basrah province is situated in the south of Iraq and has a diverse range of water resources, including rivers, channels, marshes and marine waters that characterize the province. The Shatt Al-Arab River flows through the Basrah governorate to the Gulf, along with the Shatt Al-Basrah Canal leading to the Gulf through Khor Al-Zubair and Khor Abdullah (Figure 1). Marine fishing primarily operates in the Shatt Al-Arab estuary, Khor Abdulla, and Khor Al-Amaya regions, and the main center for landing and auctioning is the Al-Fao port, which is located in the northwest corner of the Arabian Gulf (Mohamed *et al*., 2005). The main marine fishery landing site at Al-Fao port (Figure 1) was monitored from January to December 2023.

Data analysis

The official data about the monthly catch of each species, the number of fishermen, and the specifications of fishing gear were gathered by the staff of the Directorate of Basrah Agriculture of the Iraqi Ministry of Agriculture from the landing site and documented in the directorate. The data was computerized, analyzed using descriptive statistics, and presented in numerical and graphical formats for each species. The relative abundance (%R) of each species was calculated according to the formula of Krebs (1972):

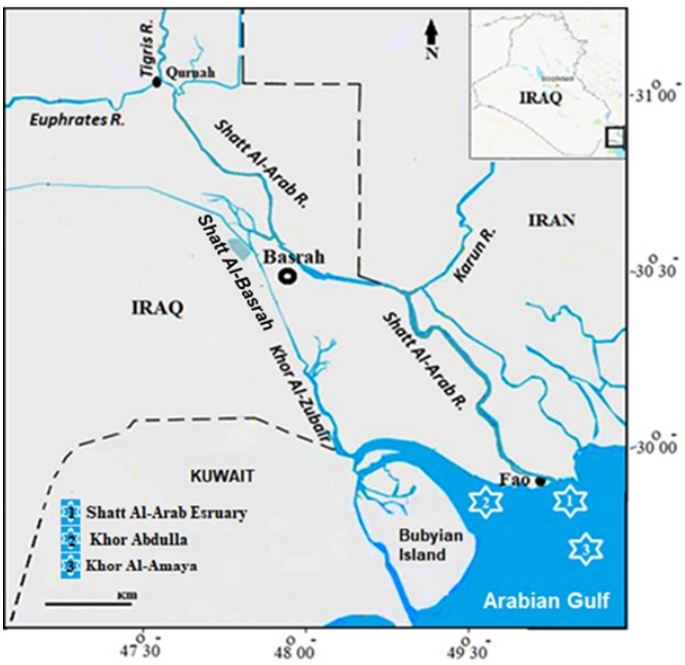

Figure 1. *Fishing areas in Iraqi marine waters, northwest Arabian Gulf.*

$$R\ (\%) = C_i/TC \times 100$$

Where,

C_i is the landing of i^{th} 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 analyze the difference between months using the SPSS software (version 16, 2007) statistical package. The Microsoft Excel 2010 program was used to determine the trend line (technical analysis) indicating the general direction and patterns of fish species' landing and to perform all computations and analyses.

RESULTS AND DISCUSSION

Catches species

The fish species and their scientific, common, and local names caught by marine fishery during 2023 are given in Table 1. A total of 28 species from sixteen families were identified in the marine catches. Additionally, two shrimp species from the Penaeidae family were found. Moreover, small, unidentified fish species and unmarketable fish from various species were grouped as mixed fish. Sparidae and Sciaenidae are each represented by four species, Mugilidae by three species, Chirocentridae, Platycephalidae, Epinephildae, Carangidae, Haemulidae and Penaeidae by two species each, and other families by one species each.

Total and species landings

Figure 2 illustrates the monthly total landing of marine fishery in 2023. The lowest landing was 1,802 tons in February, and the highest was 3,450 tons in December, with an overall landing of 29,446 tons. The marine waters of the Basrah province are home to numerous fish and shrimp species. Fishing is a major economic activity in the region, with Basrah being the primary supplier of marine resources to domestic markets in Iraq. Several published works on marine fishery since 2009, including Al-Dubakel (2011), Mohamed & Qasim (2014), Mohamed (2018), and Mohamed & Abood (2023), were reviewed to show the annual total landings and the landings of the main species in this fishery from 2009 to 2023. There has been a significant increase in marine fishery landings over the years. In 2010, the landing was 3,029 tons (Mohamed & Qasim, 2014), which then rose to 3,183 tons in 2015 (Mohamed, 2018), increased further to 19,877 tons in 2020 (Mohamed & Abood, 2023), and finally reached 29,446 tons in 2023, according to the present study. The consistent rise in landings is associated with increased catches across most fish groups due to advancements in infrastructure, upgrades in navigation technology, and the greater mechanized power of fishing boats. In 2023, 1612 licensed fishing boats were operating in the marine fishery, including 1,337 fiberglass boats powered by 65-250 hp using mainly drift gill nets and 275 steel-hulled dhows powered by 120-950 hp using

Table 1. Landing composition of the marine fishery during 2023.

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

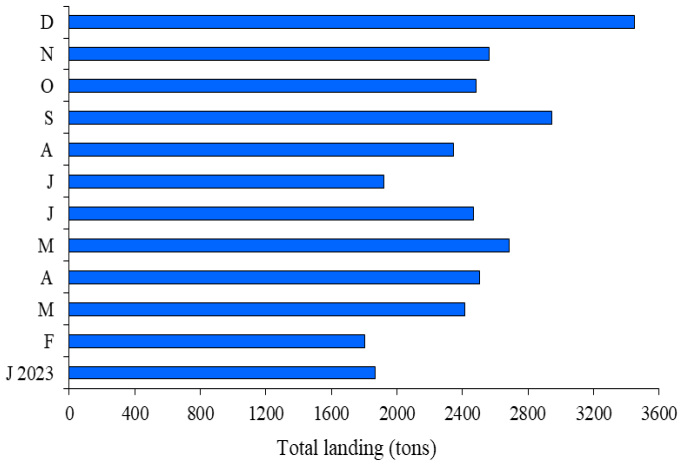

Figure 2. *The monthly total landing of the marine fishery during 2023.*

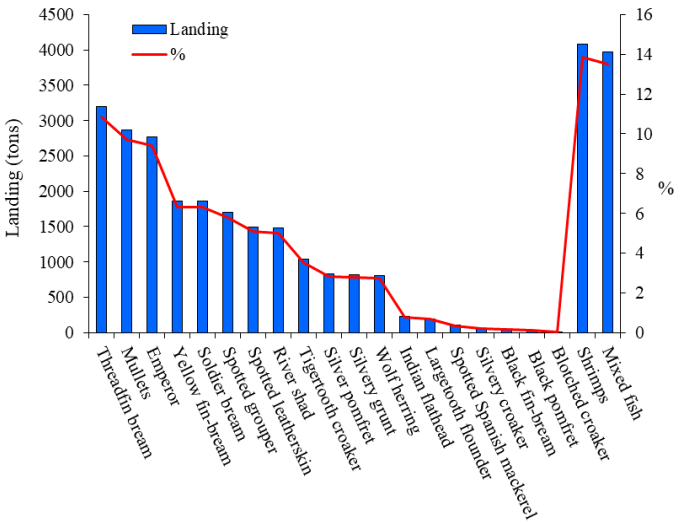

Figure 3. *The total landing and relative abundance for each species caught by marine fisheries during 2023.*

drift gill nets, traps (gargoor), stake nets (hadra), hand lines, and small trawl nets to catch demersal and pelagic fish species as well as shrimp. In 2011, 940 licensed fishing boats were operating in the marine fisheries of Iraq, comprised of 538 fiberglass speed boats and 403 wooden and steel-hulled dhows (Mohamed & Qasim, 2014). Figure 3 shows the total species landings by marine fishery during 2023. Three species constituted the bulk of marine landing (8,828 tons) including Threadfin bream (3,200 tons), Mullets (2,863 tons) and Emperor (2765 tons). Additionally, shrimp and mixed fish landings during 2023 were 4,084 and 3,975 tons, respectively, whereas other species ranged from 10 tons for Blotched croaker to 1,864 tons for yellow fin-bream. The Shad River landing, a dominant fish species in Iraqi marine fishery for decades, was only 1480 tons.

Relative abundances of species

Figure 3 shows the relative abundances of different species caught by marine fishery during 2023. Threadfin bream was the dominant species, accounting for 10.87% of the total catch, followed by Mullets (9.72%) and Emperor (9.39%). Other species varied from 0.03% for Blotched croaker to 6.33% for yellow fin-bream. Shrimp and mixed fish comprised 13.87% and 13.50% of the total marine catch, respectively. The study revealed a shift in the dominant fish species in the marine fishery over time. The main species were Mullets and River shad for a long time (Mohamed, 2018). However, by 2017, the annual marine fishing landing was mainly composed of River shad, Threadfin bream, and Mullets (Mohamed & Abood, 2020). Subsequently, in 2023, the landing trend shifted towards Threadfin bream, Mullets, and Emperor.

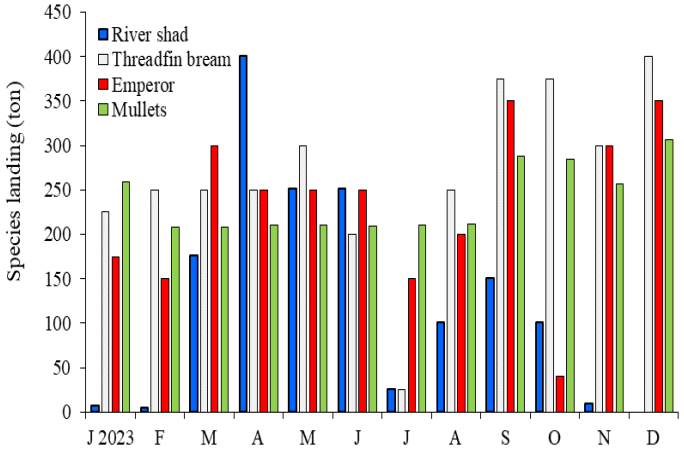

Figure 4. *The monthly fluctuations in the landings of the threadfin bream, mullets, river shad and emperor during 2023.*

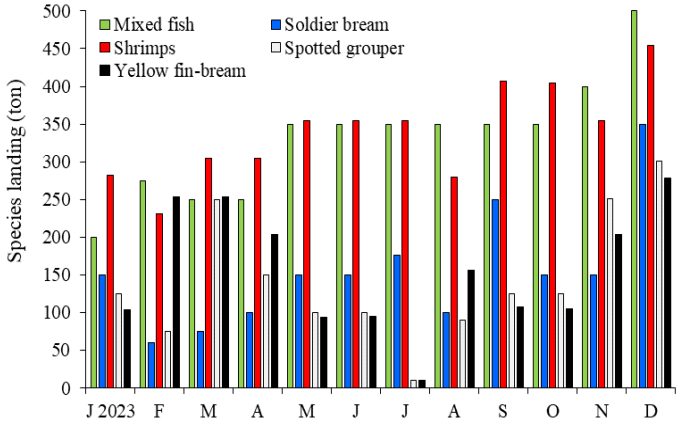

Figure 5. *The monthly fluctuations in the landings of soldier bream, spotted grouper, yellow fin-bream, shrimp and mixed fish during 2023.*

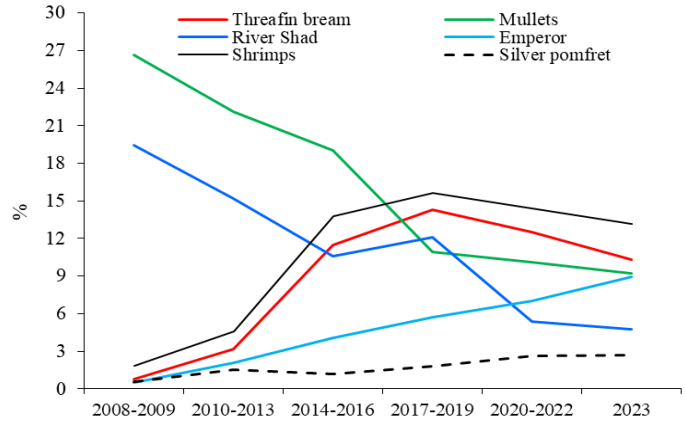

Figure 6. *The landing proportions of threadfin bream, mullets, river shad, emperor, silver pomfret and shrimp in the marine fishery (2008-2023).*

Species monthly landings

The monthly fluctuations in the landings of Threadfin bream, Mullets, River shad and Emperor in marine fishery during 2023 are illustrated in Figure 4. The Threadfin bream catch ranged from 25 tons in July to 400 tons in December, while the Mullets varied from 208 tons in March to 307 tons in December. The river shad catch changed from zero tons in December to 401 tons in April, and the emperor catch ranged from 40 tons in October to 360 tons in December. Figure 5 demonstrates the monthly variations in the yellow fin-bream, Soldier bream, spotted grouper, shrimps and mixed fish by marine fishery during 2023. The landing of yellow fin-bream fluctuated from 10 tons in July to 279 tons in December. The lowest catch of Soldier bream was 60 tons in February, while the highest catch was 350 tons in December. The catch of spotted grouper varied from 10 tons in July to 301 tons in December. The shrimp catch changed from 231 tons in February to 454 tons in December, and the mixed fish catch ranged from 200 tons in January to 500 tons in December. During the study, Threadfin bream occupied the first position with the highest rate at 10.87% of the total landing. However, it was only 0.77% of the landings in 2008, but its catches increased steadily over the years, reaching a maximum peak at 14.3% in 2018 (Figure 6). Mullets ranked second in the marine fishery during the present study, comprising four species (*Planliza subviridis*, *P. klunzengeri*, *P. carinata* and *Osteomugil speigleri*), locally known as Beyah (Mohamed *et al*., 2016). The contribution of Mullets decreased significantly from 37.16% in 2009 (Mohamed & Qasim, 2014) to 9.72% in the present study. The involvement of the emperor increased from 0.19% in 2010 (Mohamed & Qasim, 2014) to 9.39% in the current study. The proportion of shrimp landings saw a sharp increase from 1.19% in 2010 (Mohamed & Qasim, 2014) to a peak of 19.07% in 2017 (Mohamed & Abood, 2020), before decreasing with some fluctuations to 13.87% in the current study (Figure 6). The river shad is an anadromous fish that migrates from marine waters to the upper reaches of the Shatt Al-Arab River for spawning and nursery (Mohamed *et al*., 2012). It is considered the most commercially important fish species that dominated the Iraqi marine fishery from 1965 to 2002 (Mohamed & Qasim, 2014). However, the contribution of the river shad has significantly declined from 24.27% in 2008 (Mohamed & Qasim, 2014) to 5.02% in the present study (Figure 6). As a result of the reduction of river shad stock in Iraqi waters, fishermen have tended to catch other marine species to cover the cost of fishing trips and to keep their lives, for this reason, the landings of other species increased during the last decades.

Certain fish 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 (Mohamed *et al*. 2008; Mohamed *et al*. 2012; Almukhtar *et al*., 2016) and the Mullets for feeding (Hussain *et al*., 2009; Mohamed & Hussain, 2012). However, the landings of these species decreased in recent years due to various factors. These include the significant reduction in the discharge rates of the Shatt Al-Arab River, overfishing of the species, and the absence of regulations to protect and manage marine resources. The Shatt Al-Arab River is the primary source of freshwater, nutrients, and fluvial inputs into the marine waters of Iraq. In the past few decades, the river has been degraded due to the diminished flow of the Tigris and Euphrates Rivers. This is due to the construction of multiple hydropower dam projects in the headwaters of these rivers and their tributaries (Al-Ansari, 2016; Haghighi *et al*., 2020; Montazeri *et al*., 2023). This has led to substantial reduction in water quality and quantity, and the absence of flood pulses. Also, the flow of the Karun River has been diverted into Iranian terrain (Hameed & Aljorany, 2011). The annual migration and breeding patterns of fish will likely be disturbed due to changes

in the downstream river flow caused by dam construction. This will lead to the loss of migration incentives, pathways, and spawning grounds, reduced survival rates of eggs and young fish, and decreased food production (Larinier, 2001; van Puijenbroek *et al*., 2019). According to Scudder & Connelly (1985), the construction of major dam projects on rivers has had a detrimental impact on fisheries by altering the natural flood patterns that many fish species and fisheries rely on, especially in downstream areas.

It has been documented in the available literature that the stocks of important and shared fish in the northern Arabian Gulf, spanning Iraq, Kuwait, and Iran, have been heavily exploited beyond the optimal level. This exploitation has been reported in Iraq (Ali *et al*., 2000; Mohamed *et al*., 2001; Mohamed & Qasim, 2014; Mohamed *et al*., 2016; Mohamed & Abood, 2020), Kuwait (Al-Sabbagh and Dashti, 2009; Al-Husaini *et al*., 2015; Alqattan & Gray, 2021), and Iran (Parsa *et al*., 2017; Kazemi *et al*., 2022). The abundance of river shad has declined to the extent that it has been classified as threatened by the International Union for the Conservation of Nature and included on the Red List (Freyhof, 2014). Moreover, mature river shad migrate to the upper reaches of the Shatt Al-Arab River to breed, while young shad move downriver to the Gulf. Unfortunately, these migration routes are unprotected because of insufficient fishing regulations, resulting in excessive and unselective harvesting.

Conclusion

The study showed that the overall catch of marine species has increased in recent years. This increase has been attributed to the growing number and mechanized power of fishing boats, which has led to the prevalence of certain fish species like Threadfin bream and Emperor, and shrimps in the fisheries. However, economically important species such as river shad and Mullets have contributed less than in the past due to environmental degradation and mismanagement. Consequently, to ensure the sustainability of aquatic ecosystems in the south of Iraq, it is necessary to implement the following management measures: regional cooperation among neighboring countries to secure adequate water flow from the upper Tigris and Euphrates Rivers and their tributaries through the Shatt Al-Arab River to preserve the ecosystem of the northwest Arabian Gulf; and issue item No. 9 of Regulation No. 48 of 1976 for the Regulation of Fishing and Aquatic Exploitation and Protection, which aims to regulate marine fishing and protect River shad during their migration, reproduction, and in their nursery habitats.

DECLARATIONS

Authors contribution: Conceptualization: A.R.M. and A.N.A.; Methodology: A.R.M.; Software and validation: A.R.M.; Formal analysis and investigation: ARM; Resources: A.R.M.; Data curation: A.R.M.; Writing—original draft preparation: A.R.M.; Writing—review and editing: A.R.M. and A.N.A.; Visualization: A.R.M.; Supervision: A.R.M.; Project administration: A.R.M. All authors have read and agreed to the published version of the manuscript.

Conflicts of interest: The authors declare no conflict of interest.

Ethics approval: This study did not involve any animal or human participant and thus ethical approval was not applicable.

Consent for publication: All co-authors gave their consent to publish this paper in AAES.

Data availability: The data that support the findings of this study are available on request from the corresponding author.

Supplementary data: Not available.

Funding statement: Not available.

Additional information: No additional information is available for this paper.

ACKNOWLEDGEMENTS

The authors thank the Department of Fisheries and Marine Resources/ College of Agriculture/ University of Basrah for providing the essential research facilities required for this study. They also expand thanks to the Basrah Agriculture Directorate, Ministry of Agriculture for providing the raw fisheries data and other valuable information.

REFERENCES

Abdullah, A. D., Gisen, J. I. A., van der Zaag, P., Savenije, H. H. G., Karim, U. F. A., Masih, I. & Ioana Popescu, I. (2016). Predicting the salt water intrusion in the Shatt al-Arab estuary using an analytical approach. *Hydrology Earth System Sciences*, *20*, 4031-4042. https://doi.org/10.5194/hess-20-4031-2016

Al-Ansari, N.A. (2016). Hydro-politics of the Tigris and Euphrates basins. *Engineering*, *8*(3), 140-172. https://doi.org/10.4236/ENG.2016.83015

Al-Asadi, S. A. R., Alhello, A. A., Ghalib, H. B., Muttashar, W. R. & Al-Eydawi, H. T. (2022). Seawater intrusion into Shatt Al-Arab River, Northwest Arabian. *Journal of Applied Water Engineering and Research*, *11*(2), 289-302. https://doi.org/10.1080/23249676. 2022.2113460

Al-Dubakel, A. Y. (2011). Commercial Fishing and Marketing of Hilsa River shad *Tenualosa ilisha* (Hamilton-Buchanan, 1822) in Basrah-Southern IRAQ. *Emirates Journal of Food and Agriculture*, *23*, 178-186. https://doi.org/10.9755/EJFA.V23I2.6455

Al-Faisal, A. J. & Mutlak, F. M. (2018). Survey of the marine fishes in Iraq. *Bulletin of the Iraq Natural History Museum*, *15*(2), 163-177. https://doi.org/10.26842/BINHM.7.2018.15.2.0163

Al-Husaini, M., Bishop, J.M. Al-Foudari, H.M. & Al-Baz, A.F. (2015). A review of the status and development of Kuwait's fisheries. *Marine Pollution Bulletin*, *100* (2), 597-606. https://doi.org/10.1016/j.marpolbul.2015.07.053

Ali, T. S., Mohamed, A. R. M. & Hussain, N. A. (2000). Growth, Mortality and Stock Assessment of Silver pomfret, *Pampus argenteus* in the Northwest Arabian Gulf, Iraq. *Marina Mesopotamica*, *15*(2), 373-387.

Ali, T. S., Mohamed, A. R. M. & Hussain, N. A. (1998). The Status of Iraqi Marine Fisheries during 1990-1994. *Marina Mesopotamica*, *13*, 129-147.

Almukhtar, M. A., Jasim, J. & Mutlak, F. (2016). Reproductive Biology of Hilsa Shad Tenualosa ilisha (Teleostei: Clupeidae) During Spawning Migration in the Shatt Al Arab River and Southern Al Hammar Marsh, Basra, Iraq. *Journal of Fisheries and Aquatic Science*, *11*(1), 1-13. https://doi.org/10.3923/jfas.2016.43.55

Alqattan, M. E. A. & Gray, T. S. (2021). Marine pollution in Kuwait and its impacts on fish-stock decline in Kuwaiti Waters: Reviewing the Kuwaiti Government's Policies and Practices. *Frontiers in Sustainability*, *2*, 1-17. https://doi.org/10.3389/frsus.2021.667822

Al-Sabbagh, T. & Dashti, J. (2009). Post-invasion status of Kuwait's finfish and shrimp fisheries (1991-1992). *World Journal of Fish and Marine Sciences*, *1*(2), 94-96.

Freyhof, J. (2014). *Tenualosa ilisha*. The IUCN Red List of Threatened Species 2014: e.T166442A1132697. https://doi.org/10.2305/IUCN.UK.2014-1.RLTS.T166442A1132697.en.

Haghighi, A.T., Sadegh, M., Bhattacharjee, J., Sönmez, M. E., Noury, M., Yilmaz, N., Noori, R., & Kløve, B. (2020). The impact of river regulation in the Tigris and Euphrates on the Arvandroud Estuary. *Progress in Physical Geography: Earth and Environment*, *44* (6), 948-970. https://doi.org/10.1177/0309133320938676

Hameed, A. H. & Aljorany, Y. S. (2011). Investigation on nutrient behavior along Shatt Al-Arab River River, Basrah, Iraq. *Journal of Applied Sciences Research*, 7 (8), 1340-1345.

Hussain N. A, Mohamed A. R. M., Al Noor S. S, Mutlak F. M, Abed, I. M., & Coad B. W. (2009). Structure and ecological indices of fish assemblages in the recently restored Al-Hammar Marsh, southern Iraq. *BioRisk*, *3*, 173-186. https://doi.org/10.3897/BIORISK.3.11

Kazemi, J, Koshafar A. & Roomiani L. (2022). Investigation of population growth pattern of *Pampus argenteus* based on length frequency distribution analysis in the north of the Arabian Gulf. *Journal of Oceanography*, *13*(49), 57-70. https://doi.org/10.52547/ joc.13.49.57

Krebs, C. J. (1972). Ecology. The Experimental Analysis of Distribution and Abundance. Harper and Row, New York, 694 p.

Larinier, M. (2001). Environmental issues, dams and fish migration, in: Marmulla, G. (Ed.), Dams, fish and fisheries: Opportunities, challenges and conflict resolution. FAO Fisheries Technical Paper, 419. Rome.

Mohamed, A. R. M. (2018). Assessment and management of Iraqi marine artisanal fisheries, northwest of the Arabian Gulf. *Journal of Agriculture and Veterinary Science*, *11*(9), 85-92.

Mohamed, A. R. M. & Qasim, A. M. H. (2014). Trend of the artisanal fishery in Iraqi Marine Waters, Arabian Gulf (1965-2011). *Asian Journal of Applied Sciences*, *2* (2), 209-217.

Mohamed, A. R. M. & Abood, A. N. (2023). Characterization of Iraqi artisanal marine fisheries, northwest of the Arabian Gulf. *Asian Journal of Fisheries and Aquatic Research*, *21*(2), 22-33.

Mohamed, A.R.M., Ahmed, S.M. & Al-Okailee, M.T. (2012). Variations in occurrence, abundance and diet of hilsa, *Tenualosa ilisha* larvae in the north of Shatt Al-Arab River, Iraq. *Basrah Journal of Agriculture Sciences*, *25*(2), 40-52.

Mohamed, A.R.M. & Hussain, N.A. (2012). Trophic strains and diet shift of the fish assemblage in the recently restored Al-Hammar marsh, southern Iraq. *Journal of University of Duhok*, *15*(1), 119-127.

Mohamed, A. R. M. & Abood, A. N. (2020). Current status of Iraqi artisanal marine fisheries in northwest of the Arabian Gulf of Iraq. *Archives of Agriculture and Environmental Science*, *5*(4), 457-464. https://doi.org/10.26832/24566632.2020.050404

Mohamed, A. R. M., Ali, T. S. & Hussain, N. A. (2005). The physical oceanography and fisheries of the Iraqi marine waters, northwest Arabian Gulf. Proceedings of the Regional Seminar on Utilization of Marine Resource, 20-22 December 2002, Pakistan, pp. 47-56.

Mohamed, A. M., Hussain, N. A, A-Noor, S. S. & Mutlak, F. M. (2008). Occurrence, abundance, growth food habits of sbour *Tenualosa ilisha* juveniles in three restored marshes southern Iraq. *Basrah Journal of Agriculture Sciences, 21, 89-99.*

Mohamed, A. R. M., Hussain, N. A. & Ali, T. S. (2001). Estuarine components of the ichthyofauna of the Arabian Gulf. *Marina Mesopotamica, 16(2): 209-224.*

Mohamed, A. R. M., Hussein, S. A. & Abood, A. N. (2016). Occurrence of the Speigleri's Mullet, *Osteomugil speigleri* (Bleeker, 1858) in the Iraqi Marine Waters, Northwest Arabian Gulf. *Asian Journal of Applied Sciences*, *4*(4), 824-832.

Mohamed, A. R. M. & Jawad, L. A. (2020). Marine Artisanal Fisheries of Iraq, in: Jawad, L.A. (Ed.), The Arabian Seas: Biodiversity, Environmental Challenges and Conservation Measures. Springer, Switzerland, pp. 917-948. https://doi.org/ 10.1007/978-3-030-51506-5

Montazeri, A., Mazaheri, M., Saeed Morid, S. & Mosaddeghi, M. R. (2023). Effects of upstream activities of Tigris-Euphrates River Basin on water and soil resources of Shatt Al-Arab Border River. *Science of the Total Environment*, *858*(1), 1-15. https://doi.org/ 10.1016/j.scitotenv.2022.159751

Morgan, G. (2006). Country review: Iraq, in: Young, C. De. (Ed.), Review of the state of world marine capture fisheries management: Indian Ocean. FAO Fisheries Technical Paper, 488, 458p.

Parsa, M., Khoshdarehgi, M. M., Nekuro A. & Pouladi A. (2017). Population dynamics parameters of Silver Pomfret *Pampus argenteus* in Iranian waters of the northern Persian Gulf and Oman Sea. *Biodiversitas*, *18*(2), 244-249. https://doi.org/ 10.13057/ biodiv/d180226

Salman, H.H. & Jazaa, H.S. (2023). Shatt Al-Arab River and the seawater intrusion: causes and solutions. *Al-Bahir Journal for Engineering and Pure Sciences*, *2*(1), 39-51. https://doi.org/10.55810/2313-0083.1018

Scudder, T. & Connelly, T. (1985). Management Systems for Riverine Fisheries. FAO Fisheries Technical Paper 263. 85pp.

UN-ESCWA & BGR (United Nations Economic and Social Commission for Western Asia; Bundesanstalt für Geowissenschaften und Rohstoffe). (2013). Inventory of Shared Water Resources in Western Asia. Beirut, Chapter 5- Shatt Al-Arab, Karkheh and Karun Rivers, 147-167.

van Puijenbroek, P. J. T. M., Buijse, A. D., Kraak M. H. S. & Verdonschot, P. F. M. (2019). Species and river specific effects of river fragmentation on European anadromous fish species. *River Research and Applications*, *35*, 68-77. https://doi.org/10.1002/rra.3386