IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 11, Issue 9 Ver. I (September 2018), PP 85-92
www.iosrjournals.org

Assessment and Management of Iraqi Marine Artisanal Fisheries, Northwest of the Arabian Gulf

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Abstract: *The trends of Iraqi marine artisanal fisheries, northwest Arabian Gulf from 2008 to 2016 and from 1965 to 2016 were evaluated with emphasis on the management of river shad fishery. The data for total and species landings were collected from the landings site in Al-Fao port, Iraq during 2008- 2016, and compared with historical fishing information for the period 1965-2016. The results showed that despite the decline in the trend of the river shad landings, which was responsible for determining the general trend of Iraqi marine artisanal fisheries from 1965 to 2005, the general trend of total landing has been gradually increasing and this is due to the contribution of other species landings that have had the least contribution to Iraqi marine artisanal fisheries over decades compared to the river shad. The study suggests a number of management points to preserve the river shad stock in Iraqi waters.*

Key words*: Marine artisanal fisheries, River shad fishery, Fishery management, Iraq*

Date of Submission: 02-09-2018 Date of acceptance: 17-09-2018

I. Introduction

Iraqi marine waters occupy the north-western part of the Arabian Gulf (Fig. 1), which represents the estuarine part of the Gulf. Iraq possesses a small coastal area on the gulf separating the Arabian Peninsula and Iran. Despite the small length of the Iraqi coastline of 105 km and the continental shelf of 1034 km² and its territorial waters 716 km² (EarthTrends, 2003), Iraqi marine waters are the most productive area in the Gulf due to the flow of the Shatt A-Arab River (Bibik *et al.* 1971) and are considered a significant nursery, nurturing and reproduction area for local and migratory species (Hussain and Ahmed, 1995). A total of 125 fish species belonging to 60 families including 16 chondricthyes and 109 osteichthyes species have been recorded in Iraqi marine waters (Mohamed *et al.* 2001).

The high primary productivity in Iraqi marine waters corresponds with the freshwater discharge of Shatt Al-Arab River, which provides the region with important nutrients to support the primary productivity (FAO, 2011). This discharge covers the northwestern edges of Kuwait Bay (Polikarpov et. al. 2009) and its influence extends southerly to Saudi Arabia coastline as stated by Sharaf El-Din (1988). Previous estimates of the annual mean discharge of the river varied from 35-45km³yr-1 (Saad, 1978; Reynolds, 1993), but recent studies have indicated that the discharge of the Shatt Al-Arab River was sharply declined due to the many hydrological projects constructed on Tigris and Euphrates basins in neighboring countries and the conversion of the Karun River into Iranian territory (Al-Yamani, 2008; Brandimarte *et al.* 2015; Yaseen *et al.* 2016). This reduction in freshwater inflow and thus nutrients should affect the biological productivity of the northwest Arabian Gulf (FAO, 2011).

The marine artisanal fishery sector has a longstanding tradition in Iraq and includes a multi-species, multi-gear fishery that is directed towards various demersal, pelagic fish species and shrimps. Also, this sector is the main suppliers of marine fish to the domestic markets in Iraq since 1986. The Iraqi marine fisheries resources are in the fishing grounds of three fishing areas, Fig. 1 (Mohamed *et al*. 2005). These are the Shatt Al-Arab estuary, Khor Abdulla and Khor Al-Amaya (include the deeper waters in the open Gulf). Al-Fao port, southern Basrah city is the main centre of landings and auction of marine fish, then transported to the fish markets in Basrah city and other parts of the country by several marketing agencies.

Several works have been published on the state of Iraqi marine artisanal fisheries. Khayat (1978) documented the marine artisanal and industrial landings for the period 1965 to 1973. Salman (1983) described the fish landings and marketing from Iraqi marine waters during the period from 1976 to 1980. Ali *et al.* (1998) analyzed the monthly landings, fishing effort and marketing of fish by the different artisanal and industrial fishing fleets for the period 1990 to 1994. Morgan (2006) reviewed the status of marine capture fisheries in Iraq during the period 1991-2004. Al-Dubakel (2011) updated information about the fishing methods, landings and marketing of river shad *Tenualosa ilisha* at the Al-Fao fish landing site. Mohamed and Qasim (2014) analyzed

the data for the total and species landings and fishing effort of the Iraqi marine artisanal fishery from 2007 to 2011.

The present study aims to describe the trends of Iraqi marine artisanal fisheries, northwest Arabian Gulf from 2008 to 2016 and evaluate the trend of fish landings from 1965 to 2016 with emphasis on the management of river shad fishery.

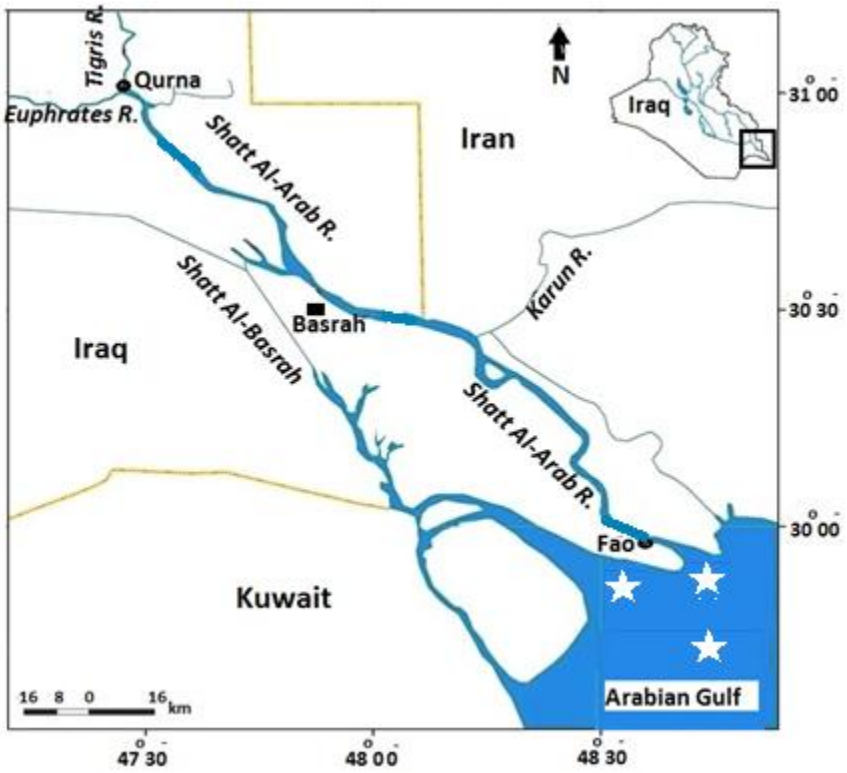

Fig. 1. Iraqi marine waters, northwest Arabian Gulf.

II. Materials and Methods

The data dealt with this paper are based on the daily raw data of the total and species landings collected from the landing site in Al-Fao port, south of Basrah, Iraq by employees of the Al-Fao Fisherman's Co-operative, as documented by the Basrah Agriculture Directorate, which covered the period from January 2008 to December 2016. The data were arranged by species on monthly and yearly bases, and the collected data were processed and analyzed using Microsoft Excel 2007.

The relative abundance (% by biomass) of each species was calculated according to the formula of Krebs (1972). The similarity level between the landings years (according to the weight percent of each species) has been estimated using Morisita's index (Morisita, 1959):

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

where $C\lambda$ is the similarity level, X_i and Y_i the weight percent of ith species in each year of landing.

The monthly variations between landing years were tested using analysis of variance (ANOVA). All statistical computations were made 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 TREND function in Microsoft Excel. The historical information about the annual landings and fishing efforts of the artisanal fishery provided in this work was derived essentially from reviews of literatures (Khayat, 1978; Ali *et al.* 1998; Al-Dubakel, 2011; Mohamed and Qasim, 2014).

III. Results

Landings composition

Fish belonging to each family in the artisanal marine fishery over the period from 2008 to 2016 were classified by species together with their scientific, common and local names are shown in Table 1. The catches were comprised of 31 commercial species belonging to 15 families, namely Clupeidae, Mugilidae, Stromateidae, Sciaenidae, Scombridae, Pristigasteridae, Sparidae, Carangidae, Platycephalidae, Serranidae,

Chirocentridae, Nemipteridae, Pomadasyidae, Bothidae and Lethrinidae. In addition, two species of shrimps belonged to family of Penaeidae were present. Mixed fish referred to small sizes of different fish species.

Annually landings

The annual total, mixed fish and shrimps landings of the Iraqi marine artisanal fishery from 2008 to 2016 are explained in Figure 2. The highest peak of total landing was recorded in 2014 and reached 5449.00 tons, representing 18.1% of the total landings, while the second peak 4907.95 tons which formed 16.3% was

Table 1. Landing composition of the artisanal marine fisheries (2008-2016)

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

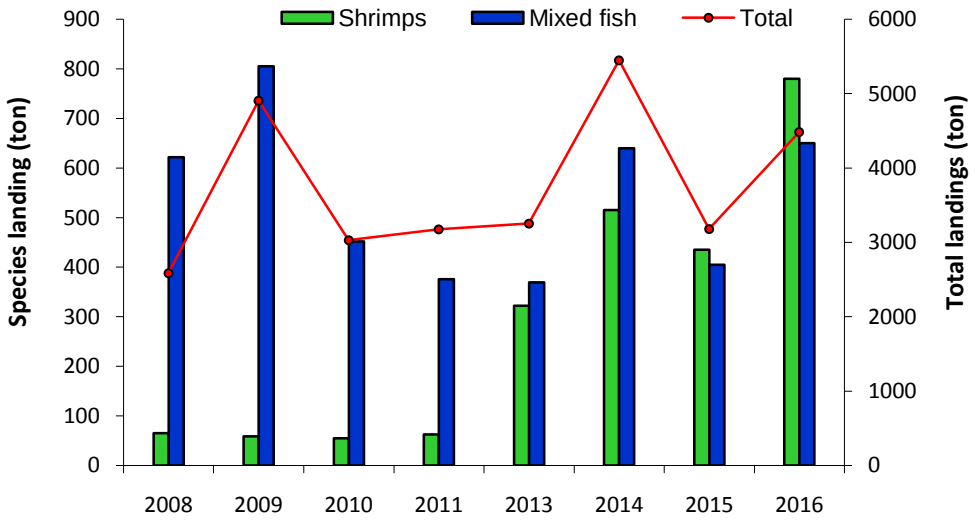

Figure 2: The annual shrimps, mixed fish and total landings from 2008-20016.

obtained in 2009. The third peak (4483 tons) take place in 2016 was less pronounced constituting 14.9% of the total landings. However, the lowest landing 2587.05 tons which formed 8.6% was recorded in 2008, whereas the total landings during the years 2010, 2011, 2013 and 2015 were maintained around 3,000 tons. The analysis of variance between the monthly landings over the eight years showed significant differences between these years ($F= 2.987$, $P> 0.05$). However, the similarity level between the weight percent of each species in the landing years according to Morisita's index indicated very high similarity level ($C\lambda= 98.6$) between 2009 and 2010, and the lowest value ($C\lambda= 65.5$) between 2008 and 2015.

The total mixed fish landings attained 4,319 tons during 2008 to 2016, and constituted 14.4% from the total landings. The annual landing of mixed fish ranged from 369 tons in 2013 to 805 tons in 2009 and its contribution from the total landing ranged from 114% in 2013 to 15.14% in 2016. The total landing of shrimps during 2008 to 2016 was 2,293 tons consisting 7.6% from the total landings. There are gradually increase in the landing of shrimps from 54.7 tons in 2010 to 780.0 tons in 2016 and their contribution from the total landing varied from 1.2% in 2009 to 18.2% in 2016.

The annual variations in the species landings of the Iraqi marine artisanal fisheries from 2008 to 2016 are illustrated in Figure 3. There are obvious fluctuations in the landings of all species in the Iraqi marine artisanal fisheries during the period from 2008 to 2016. The highest annual landings of mullets (1824.0 tons), wolf herring (558.3 tons) and carangids (409.5 tons) were recorded during 2009, whereas other species like river shad (872.0 tons), emperor (221.0 tons), grunt (158.0 tons), sea breams (150.0 tons), Indian flathead (110.0 tons) and silver pomfret (96.0 tons) were happened during 2014. The maximum annual landing of croakers (544.9 tons) was found during 2011. The highest annual landings of flounder (198.0 tons), mackerel (113.0 tons) and grouper (90.0 tons) were recorded during 2013. However, the highest annual landings of threadfin bream (841.0 tons) and mackerel (113.0 tons) were documented during 2016 and 2010, respectively.

In general, the three most abundant species in the Iraqi marine artisanal fisheries during 2008 to 2016 were mullets, river shad and carangids constituted 22.1%, 14.2% and 11.8%, respectively, whereas mixed fish and shrimps constituted 14.4% and 7.6% of the total landing, respectively during 2008-2016.

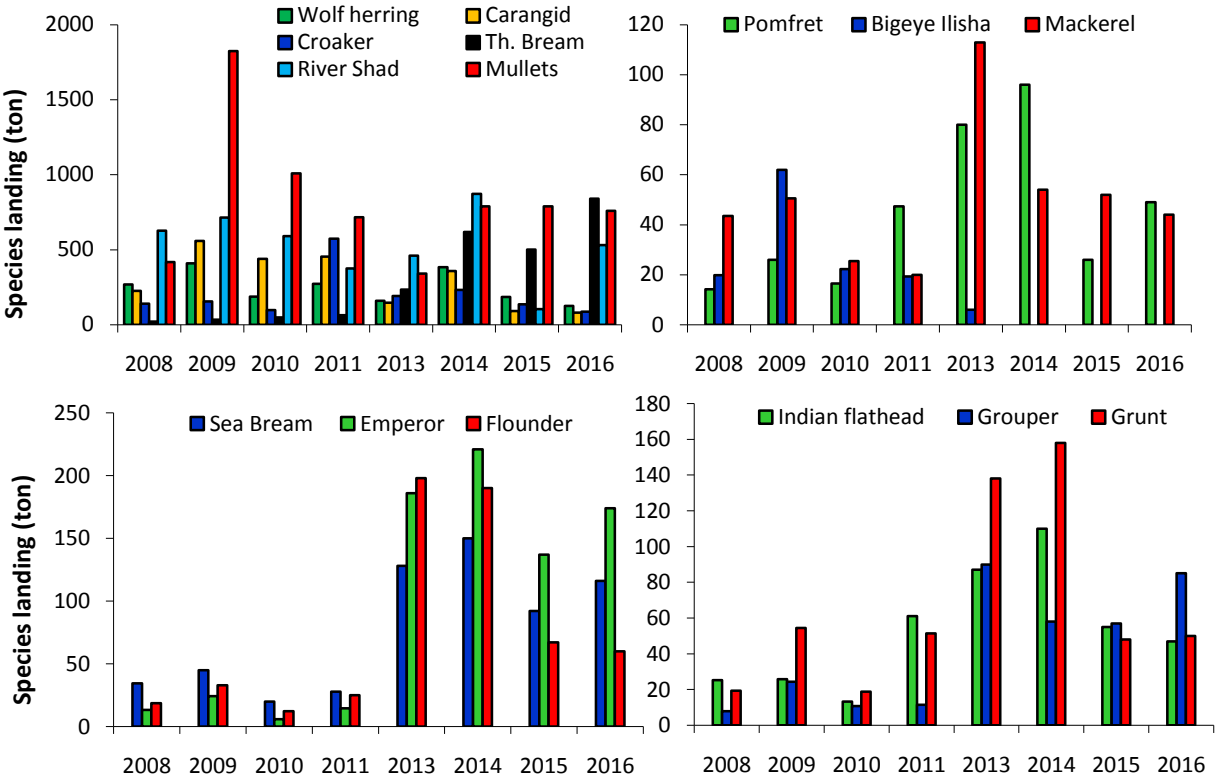

Figure 3: The annual variations in the species landings of the Iraqi marine artisanal fisheries from 2008 to 2016

Monthly landings

The monthly variations in the total landings of the Iraqi marine artisanal fisheries during 2008 to 2016 are presented in Figures 4. Generally, the affluent period of landings extended from April to November each year, while the lowest was during cold months of December-February. The level of peaks for the total landings showed clear fluctuations between months and years; the highest landings were 329.1, 846.5, 616.1, 739.5,

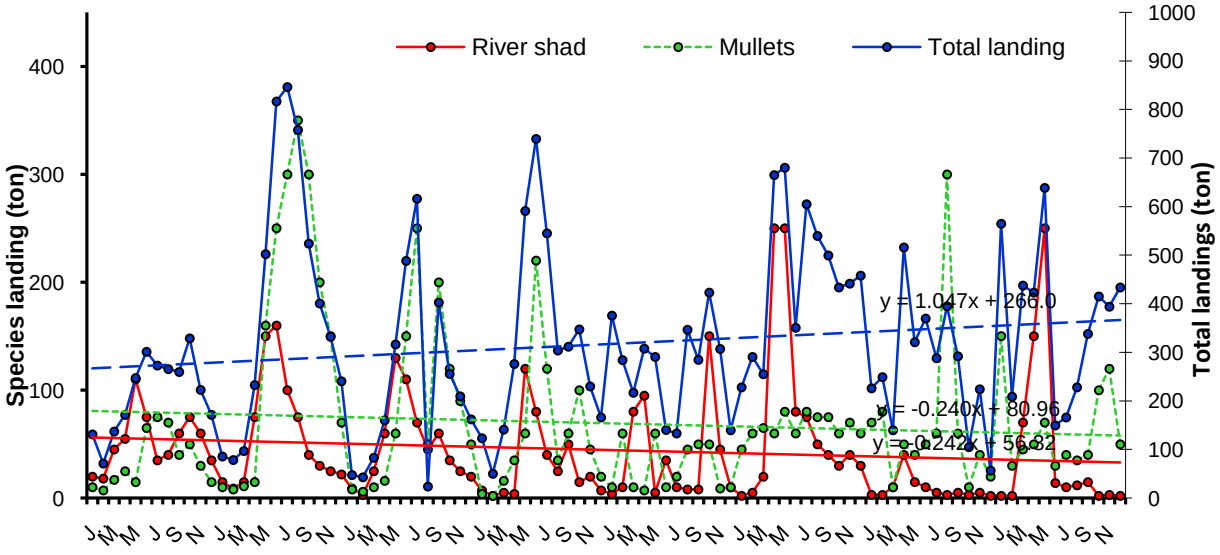

Figure 4. The monthly variations in landings of river shad, mullets and total species (2008- 2016)

423.0, 680.0, 516.0 and 639.0 tons in October 2008, July 2009, July 2009, July 2010, June 2011, October 2013, May 2014, 2016, respectively (Fig. 4). The general trend of the total landings of artisanal fisheries in Iraqi marine waters during 2008 to 2016 showed gradually increased (slop of trend line (b)= 1.029) along the investigated period.

Mullets occupied the first position in the total landings of fish in Iraqi marine artisanal fisheries during the period from 2008 to 2016. The total landing of mullets was amounted to be 6651 tons, consisted of 22.1% from the total landings. The annual contribution of mullets from the annual landing varied from 10.5% (341 tons) in 2013 to 37.2% (1824 tons) in 2009.

The highest landings of mullets were 75, 350, 250, 220, 60, 80, 300 and 150 tons in July 2008, August 2009, July 2010, June 2011, May 2013, May 2014, August 2015 and January 2016, respectively (Fig. 4). The general trend of mullets landings in Iraqi marine waters during 2008 to 2016 showed gradual declined (b= -0.240) along the investigated period (Fig. 4).

The overall landing of river shad during the period 2008 to 2016 was amounted to be 4279 tons, constituted 14.2% from the total landings. The annual landing of river shad changed from 104 tons in 2015 to 872 tons in 2014 and their contribution from the annual landing varied from 3.3% in 2015 to 24.3% in 2008. River shad was landed throughout the year, but landings increased to maximum during April-June. The highest harvests of river shad were 110, 160, 130, 120, 150, 250, 40 and 150 tons in May 2008, June 2009, May 2010, May 2011, October 2013, May 2014, April 2015 and May 2016, respectively (Fig. 4). The general trend of river shad landings in Iraqi marine waters during 2008 to 2016 showed gradual declined (b= - 0.242) along the investigated period (Fig. 4).

The other commercial fish refer to other important fish species such as silver pomfrets, sea breams, emperors, croakers, groupers, threadfin breams, flounders, grunts, big-eye shads, India flatheads and mackerels. The total landing of other commercial fish, shrimps and mixed fish are given in figure 5. The total landing of other commercial fish from 2008 to 2016 was amounted to be 13110.2 tons consisting 43.9% from the total landings. The annual landing of these fish ranged from 853.1 tons in 2008 to 2632.0 tons in 2014 and its contribution from the annual landing ranged from 30.4% in 2010 to 70.1% in 2011.

The highest landings of other commercial fish were 106.5, 344.5, 235.0,381.7, 286.0, 350.0, 296.0 and 344.0 tons in August 2008, July 2009, July 2010, June 2011, December 2013, July 2014, April 2015 and December 2016, respectively (Fig. 5). The general trend of other commercial fish landings from Iraqi marine waters during 2008 to 2016 showed gradual increased (b= 0.900) along the investigated period (Fig. 5).

The highest landings of shrimps were 15, 8, 10, 10, 13, 55, 65 and 200 tons in October 2008, May 2009, September 2010, June 2011, September 2013, September 2014, May 2015 and May 2016, respectively(Fig. 5). The general trend of shrimps landings in Iraqi marine waters during 2008 to 2016 showed gradual increased (b= 0.690) along the investigated period (Fig. 5).

The maximum landings of mixed fish were 90, 120, 70,70, 50, 80, 70 and 120 tons in October 2008, August 2009, September 2010, May 2011, February and May 2013, November and December 2014, April 2015, and October 2016, respectively (Fig. 5). The general trend of mixed fish landings from Iraqi marine waters during 2008 to 2016 showed gradual declined (b=- 0.057) along the investigated period (Fig. 5).

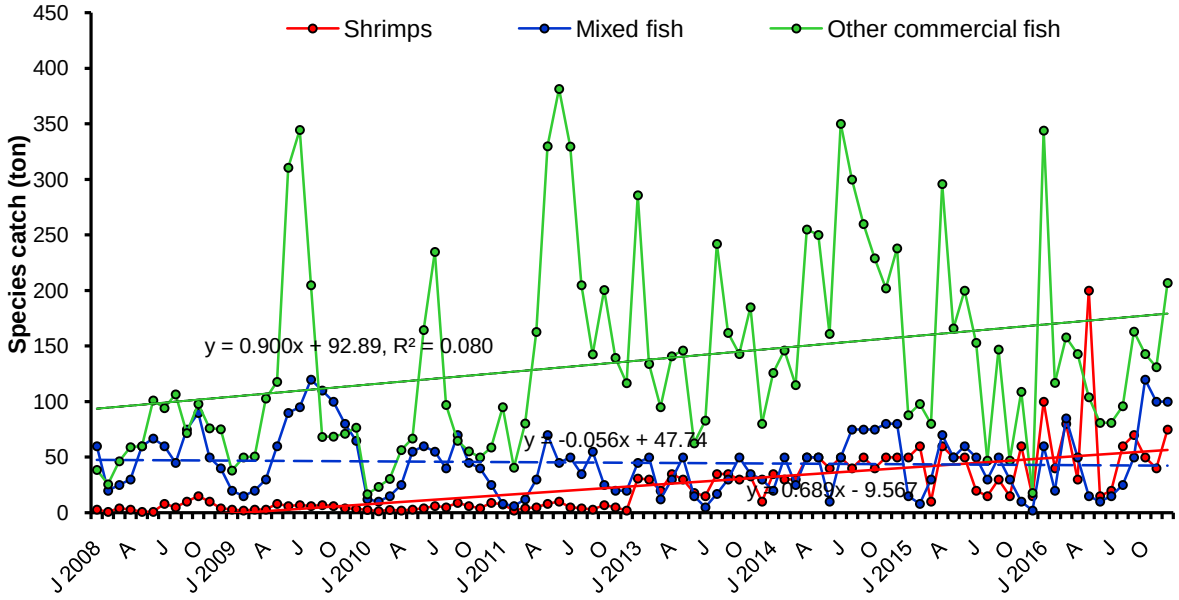

Figure 5. The monthly variations in landings of shrimps, mixed fish and other commercial fish (2008-2016)

IV. Discussion

The results showed that despite the decline in the trend of the river shad landings, which was responsible for determining the general trend of Iraqi marine artisanal fishery from 1965 to 2005, Fig. 6 (Mohamed and Qasim, 2014), the general trend of total landing has been gradually increasing and this is due to the contribution of other species landings that have had the least contribution to Iraqi marine artisanal fishery over decades compared to the river shad. Shad constituted 90% (8000.0 tons) of total fish landings during the period 1965-1973 (Khayat, 1978) and dropped to 52.9% (9308.3 tons) during 1990-1994 (Ali *et al*., 1998), then to 30.7% during 2000-2006 (Al-Dubakel, 2011), to 16.9% (3634.0 tons) during 2007-2011(Mohamed and Qasim, 2014)and to 14.2% (4279.0 tons) in the current study, and occupied the second rank of most dominated species. River shad ascend to the upper reaches of Shatt Al-Arab River for spawning (Al-Noor, 1998; Al-Hassan, 1999; Mohamed *et al.* 2012). The fishing area of the species in Iraqi marine waters is restricted around Shatt Al-Arab estuary through along the period extended from March to November with distinct peak in April-May (Fig. 6). Most of the catches of this species are made by dhow boats and speedboats using drifting gill nets. The river shad stock in the north Arabian Gulf is certainly shared among Iraq, Iran and Kuwait (Morgan, 2006). Therefore any actions on this stock by any country fleet may affect the landings in other countries (Munro, 2003). The river shad stock from all countries is being exploited at a higher level than the optimum. The river shad stock in Iraqi marine waters suffer from heavy exploitation, E= 0.67 (Mohamed and Qasim, 2014). Also, information about status of the species in Iranian waters indicated that the stock is overexploited, as E= 0.70-0.72 (Hashimi *et al.* 2010; Roomiani and Jamili, 2011). Also, the river shad stock in Kuwaiti waters suffer from heavy exploitation, E= 0.67 (Al-Baz and Grove, 1995; Al-Sabbagh and Dashti, 2009). Moreover, the river shad landings in Kuwaiti waters decreased from 1197 tons in 1995 to 154 tons in 2005 and to 137 tons in 2013, and their contributions from the total landings were declined from 17.05% in 1995 to 4.39% in 2013 (Al-Husaini *et al.* 2015).

Mullets consisted of 22.1% from the total landings and occupied the first rank in the Iraqi marine artisanal fisheries during the study period. Mullets consist of four species in Iraqi marine waters (*Planliza subviridis, P. carinata, P. klunzingeri* and *Osteomugil speigleri*), locally known as Beyah (Mohamed *et al.* 2016). Mullets have worldwide distribution and inhabit coastal waters and estuaries of the tropical and subtropical zones of world seas; a few spend their lives in freshwater (Carpenter *et al.* 1997). Mullets constituted a very significant contribution (30%) to the production of pelagic fish in the northwest Arabian Gulf (Sivasubramaniam, 1981). The intertidal zone of Khor Abdullah and Shatt Al-Arab estuary are the main fishing

areas throughout the year with clear peak during June-October, and mainly caught by drift gill nets (Ali *et al.* 1998). The contribution of mullets increased from 12.3% (2239.6 tons) during 1990-1994 (Ali *et al*. 1998) to 22.3% (4806 tons) during 2007-2011 (Mohamed and Qasim, 2014), then to 22.1% (6651.0 tons) from the total landings in the present study. However, the yearly pattern showed noticeable increase during 2009 followed by sharply decrease during the following years, i.e. the general trend of mullets landings in Iraqi marine waters showed gradual slightly declined during 2008-2016.

The contributions of other commercial species landings that have had the least contribution to Iraqi marine artisanal fishery over decades have been increased. The amount of these species increased from 2904.6 tons (16.0%) during 1990-1994 [16] to 9402.4 (43.6%) during 2007-2011 (Mohamed and Qasim, 2014), then to 12333.0 tons (41.0%) from the total landings in the present study. It is clear from the general trend of these species landings from Iraqi marine waters showed gradual increased along the investigated period.

Also, the amounts of shrimps landings increased from 178.2 tons (0.98%) during 1990-1994 (Ali *et al.* 1998) to 618.6 tons (2.9%) during 2007-2011 (Mohamed and Qasim, 2014), then to 2292.6 tons (7.6%) from the total landings in the present study. The shrimp catch represents 25 to 45% of the total fishery landings in Kuwaiti waters (Chen *et al.* 2013).

As a result of the reduction of river shad stock in Iraqi marine waters, fishermen have tended to catch other fish 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 decade. There are several possible reasons that may have contributed to the decline in the river shad landings over recent years, such as the large reduction in the discharge rates of the Shatt Al-Arab River, the overfishing of the species and the lack of the regulations to protect and manage the marine resources.

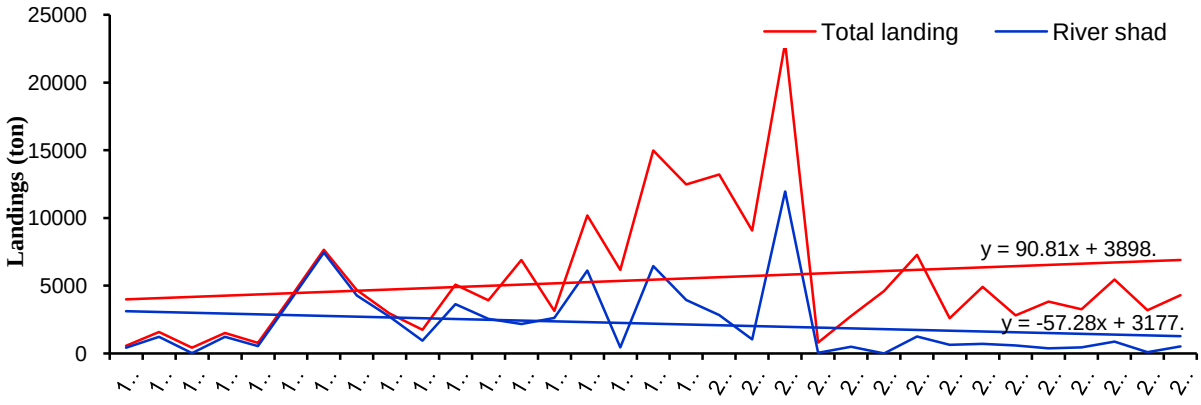

Figure 6: General trends of the river shad and total landings in the Iraqi marine artisanal fishery (1965-2016)

Therefore, have to focus on the management of river shad stock in the areas of migration reproductive as well as in nursery areas in the Shatt Al-Arab River, its branches and east Hammar marsh. The study suggest the following administrative points to preserve the river shad stock at least in Iraqi waters:

- Establishment of closed areas to protect spawning as well as recruitment of river shad, these areas are Shatt Al-Arab River and East Hammar marsh during breeding by imposed a 30-day ban during May to protect spawning biomass.
- Catch, transportation, marketing, selling and possessing of small river shad (up to 23.0 cm TL) must be banned in the spawning and nursery areas.
- Pollution from domestic, industrial and agricultural sources continues to be a serious problem in Shatt Al-Arab River, and several water quality parameters are seasonally correlated with fish species catch.
- There is a need for legislation governing fishing in Iraqi territorial waters in the Arabian Gulf, despite the Act of Regulating Fishing and Aquatic Exploitation and Protection No. 48, 1976 has been allocated Article No. 9 of the Act to regulate marine fishing, it has not yet been initiated.
- Regional cooperation in fisheries management is essential for Iraq, as well as for other countries in the region (Iran and Kuwait).
- Regional cooperation in the management of the water systems of the Tigris, Euphrates and Karun rivers with Turkey, Syria and Iran for the purpose of obtaining a sufficient share of water for Iraq.

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Abdul-Razak M. Mohamed. Assessment and Management of Iraqi Marine Artisanal Fisheries, Northwest of the Arabian Gulf." IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS) 11.9 (2018): 85-92.