Trends in the Artisanal Fishery in Iraqi Marine Waters, Arabian Gulf (1965-2011)

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ABSTRACT---- ***The status of the marine artisanal fishery in the northwest Arabian Gulf was evaluated for the period 1965 to 2011. The data for total and species landings and fishing effort were collected from the landings site in Al-Fao port, Iraq during 2007- 2011, and compared with historical fishing information for the period 1965-2006. Annual total landings fluctuated from 582 t in 1965 to 22901 t in 2002. The monthly trend of the total catches followed the variations in landings for river shad, Tenualosa ilisha and mullet species. The contributions of river shad to total landings declined gradually from 90.2% (1965-1973), 52.9% (1991-1994), 41.8% (1995-1999), 30.7% (2000-2006) and 18.9% (2007-2011). The number of fishing boats decreased significantly during 2011 compared to that during the late 1990s. There are several reasons that may have contributed to the decline in marine fish landings over recent years, such as large reduction in the discharge rates of the Shatt Al-Arab River, over-fishing of key species and no regulations to protect and manage marine resources.***

Keywords--- Iraq, Arabian Gulf, marine artisanal fishery, over-fishing

1. INTRODUCTION

The artisanal fishery or small-scale fishery is a traditional fishery involving both subsistence and commercial components, practiced by professional fisher folk directly, independently or in a household system, with their own means of production or under contractual partnership, using small vessels, making short fishing trips, close to shore and mainly for local consumption (Garcia *et al*., 2008; FAO, 2013a).

The marine waters of Iraq occupy the most northwestern tip of the Arabian Gulf (Fig. 1) and represent the estuarine part of the Gulf which is considered its most productive part due to run off from the Shatt Al-Arab River (Bibik *et al.*, 1970). The surface water temperature ranged from 12^{o}C in January to 34^{o}C in August (Mohamed *et al.*, 2005). The discharge of the Shatt Al-Arab River has been estimated at a maximum of 180 km^{3} per year in April and minimum of 22 km^{3} per year in October (Grasshoff, 1976). The Shatt Al-Arab River plays a very important role in the maintenance of the economically important shrimp and finfish fisheries of the northern Gulf, the reduced freshwater inflow to the Gulf from the Tigris and Euphrates rivers (a result of damming on the upper reaches of these rivers) has reduced the availability of nutrients, resulting in a shift in the dominant planktonic phytoplankton and zooplankton, which in turn impacts food web dynamics of the fisheries ecosystem (AL-Husaini, 2003; Morgan, 2006). 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 marine artisanal fishery sector has a longstanding tradition in Iraq and includes a multi-species, multi-gear fishery that is directed towards various demersal and pelagic fish species. The fishers exploit three fishing grounds, the Shatt Al-Arab estuary, Khor Abdulla and Khor Al-Amaya (include the deeper waters in the open Gulf) within Iraqi marine waters (Mohamed *et al.*, 2005). Al-Fao port, southern Basrah is the main centre of landings and auction of marine fishery.

Khayat (1978) conducted a comprehensive socio-economic study of fish resources in Iraq and documented the marine artisanal landings for the period 1965 to 1973. Since then, limited works have been published on fish landings and marketing at Al-Fao port (Salman, 1983; Ali *et al.*, 1998). Morgan (2006) reviewed the status of marine capture fisheries in Iraq during the period 1991-2004. Recently, Al-Dubakel (2011) updated information about the fishing methods, landings and marketing of river shad *Tenualosa ilisha* at the Al-Fao fish landing site, several studies have also been conducted on fishery and stock assessment of the some commercial species in the marine waters of Iraq (Mohamed *et al.*, 1998; Ali, 2002).

The present study aims to describe the landings of the Iraqi marine artisanal fishery, northwest Arabian Gulf for the period 2007 to 2011 and evaluate the status of fish landings from 1965 to 2011.

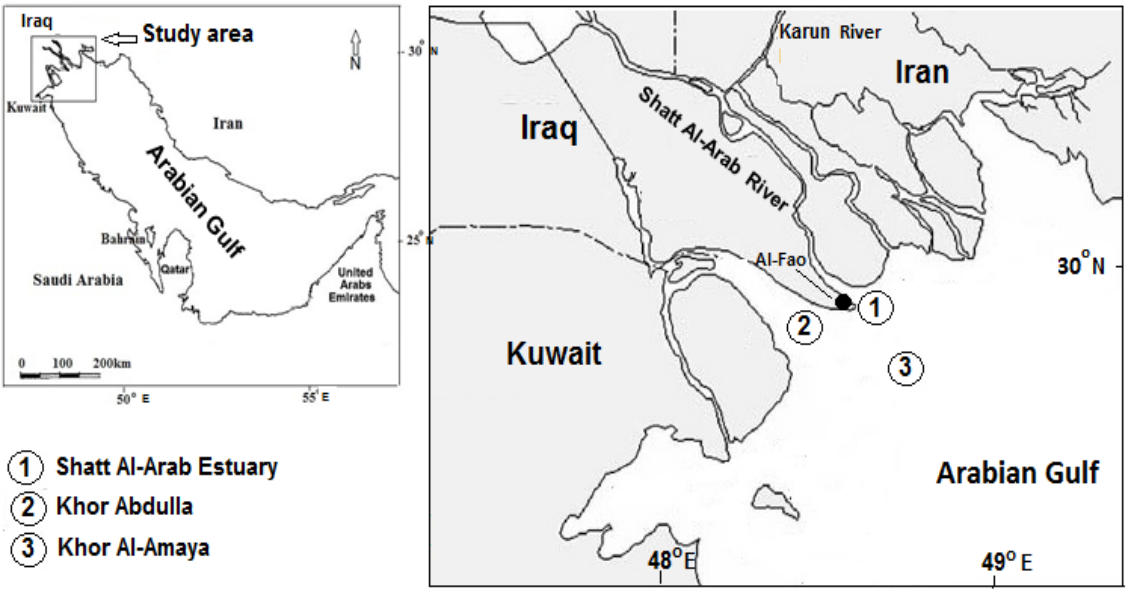

Fig. 1. Study area in the Iraqi marine waters, northwest Arabian Gulf.

2. MATERIALS AND METHODS

Data for this study are sourced from daily raw data of the total and species landings at the Al-Fao port, south of Basrah, Iraq by employees of the Al-Fao Fisherman's Co-operative, as documented by the Basrah Agriculture Directorate. The data cove the period from January 2007 to December 2011. Also, the numbers and types of fishing boats were recorded. The data were arranged by species on monthly and yearly bases, and the collected data were processed and analyzed using Microsoft Excel 2007. Historical information about annual landings and effort of the artisanal fishery provided in this paper was derived essentially from reviews of the literature (Khayat, 1978; Ali *et al.*, 1998; Al-Dubakel, 2011). 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):

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

Where $C\lambda$ is the similarity level, X_i and Y_i the weight percent of ith species in each year of landing. The variations between landing years were tested using analysis of variance. All statistical computations were made using SPSS software (version 11, 2001) statistical package.

3. RESULTS

Landing Composition

Fishes belonging to each family in the artisanal fishery over five years were classified by species together with their scientific, common and local names are shown in Table 1. The catches were comprised of 31 fish species belonging to 15 families, namely Clupeidae, Mugilidae, Stromateidae, Sciaenidae, Scombridae, Pristigasteridae, Sparidae, Carangidae, Platycephalidae, Serranidae, Chirocentridae, Nemipteridae, Pomadasyidae, Bothidae and Lethrinidae. Mixed fish referred to small sizes of different fish species. In addition, two species of shrimps belonged to family Penaeidae are also recorded.

Monthly landings

The monthly landings of the major fish species (> 5% of the total landing) in the artisanal fishery during 2007-2011 are presented in Figures 2 and 3. Generally, the period of highest landings extended from April to November each year, while the lowest was during the cold months of December-February. The monthly trend of total landings followed the variations in river shad and mullet landings. The level of peak landings showed clear fluctuations between months and years; the highest landings each year were 1212, 329.1, 846.5, 616.1 and 739.5 t in April 2007, October 2008, July 2009, July 2010 and June 2011, respectively (Fig. 2). River shad was landed throughout the year, but landings increased to maximum during May and June. The highest harvests of river shad were 250, 110, 130 and 120 t in May of 2007, 2008, 2010 and 2011, respectively (Fig. 2), while in 2009 the highest landing for that year was 160 t in June. The maximum landings of mullet were recorded during the last years, amounted 350, 250 and 220 t in August 2009, July 2010 and June 2011, respectively. The leatherskin landings have one peak during June or July each year, amounted 400, 70, 250, 200 and 150 t over the five years, respectively (Fig. 3). The landings of croakers and wolf herrings recorded higher levels

during April 2007 (345 and 350 t, respectively) compared with other years (Fig. 3). The croaker harvest increased again during July 2011 (123 t), whereas the landings of wolf herring were maintained a steady level in recent years.

Table 1. Landing composition of the artisanal fishery during 2007-2011

Family	Scientific name	Common name	Local name
Clupeidae	*Tenualosa ilisha*	River shad	Sboor
Mugilidae	*Liza subviridis, L. carinata & L. klunzingeri*	Mullet	Beyah
Stromateidae	*Pampus argenteus*	Silver pomfret	Zobaidy
Sciaenidae	*Otolithes ruber*	Tigertooth Croaker	Newaiby
Sciaenidae	*Johnius maculates*	Croaker	Shmahy
Sciaenidae	*Johnius sina & Johnieops belangerii*	Silvery Croaker	Tatooa
Scombridae	*Scomberomorus commerson*	Barred Spanish mackerel	Chanied
Scombridae	*Scomberomorus guttatus*	Spotted Spanish mackerel	Khubbat
Pristigasteridae	*Ilisha megaloptera, I. Melostoma & I. elongate*	Big-eye shad (Slender shad)	Abu-Owaina (Sawayah)
Sparidae	*Acanthopagrus latus, A. berda & Sparidientex hasta*	Yellow fin-bream and black fin-bream (Sea bream)	Shanak
Carangidae	*Scomberoides commersonianus*	Spotted leatherskin	Thelah
Platycephalidae	*Platycephalus indicus & Gramolites scaber*	Indian flathead	Wahara
Serranidae	*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	*Bothus pantherinus & Euryglossus orientalis*	Large-toothed flounder	Khofaah (Mizlak)
Lethrinidae	*Lethrinus nebulosus*	Emperor	Sherry
Penaeidae	*Penaeus semisulcatus* & *Metapenaeus affinis*	Green tiger prawn & Penaeid shrimp	Robian

Annual landings

The annual landings in the artisanal fishery from 2007 to 2011 are presented in Table 2. The annual total landings varied from 2587 t in 2008 to 7274 t in 2007. The analysis of variance between the landings over the five years showed significant differences between these years ($F= 3.638$, $P> 0.05$). 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 ($C\lambda= 68.6$) between 2007 and 2009.

The highest annual landings of most species were recorded during 2007 included croaker (1578 t), river shad (1323 t), wolf herring (1082 t), leatherskin (764 t), sea bream (120 t), bigeye ilisha (119 t), grouper (80.7 t), flounder (61.2 t), pomfret (51.2 t) and mixed fish (836.5 t). For species like mullet (1824 t), grunt (54.4 t), mackerel (50.6 t) and emperor (24.3 t) the highest landings were recorded during 2009. The maximum annual landings of threadfin bream (644 t) and Indian flathead (61 t) were recorded during 2011. The annual shrimp landings ranged from 54.7 t in 2010 to 378 t in 2007.

The annual percentage composition of the major fish species in the artisanal fishery during 2007-2011 is shown in Table 2. There are considerable changes in the percentage composition of the fishery each year. For example, in 2007, Croaker landings dominated the fishery (21.7%), followed by river shad (18.2%) and wolf herring (14.9%). By contrast, the most landed species during 2008 were river shad (24.3%), mullet (16.2 %) and wolf herring (10.4%), while mullet was the dominant species during 2009-2011, comprising 37.2, 33.3 and 19.1%, respectively. River shad was the second most harvested species during 2009 and 2010 constituted 14.6 and 19.5%, respectively, while leatherskin ranked third comprising 11.4, 14.5 and 12.1% of the total landings during the last three years, respectively. However, threadfin bream was the second most landed species during 2011, constituting 17.2% of the fishery. The mixed fish catches constituted 11.5, 24, 16.4, 14.9 and 10% of the fishery during the landing years, respectively. The shrimp landings formed 5.2, 2.5, 1.2, 1.8 and 1.7% from the total landings over the five years, respectively. The overall percentages of the major fish species in the artisanal fishery during 2007-1011 were mullet (22.3 %), river shad (16.9%), croaker (11.8%), leatherskin (11.3%) and wolf herring (10.3%).

Table 2. Annual landing (catch, ton) and percentage (%) of different species in the artisanal fishery during 2007-2011

	2007		2008		2009		2010		2011		Total
Species	Catch	%	Catch	%	Catch	%	Catch	%	Catch	%	%
Mullet	836	11.5	419	16.2	1824	37.2	1010	33.3	717	19.1	22.3
Shad	1323	18.2	628	24.3	716	14.6	592	19.5	375	10	16.9
Croaker	1578	21.7	140	5.4	156	3.2	98.8	3.3	575	15.3	11.8
Leatherskin	764	10.5	225	8.7	558	11.4	439	14.5	454	12.1	11.3
Wolf herring	1082	14.9	270	10.4	410	8.3	189	6.2	274	7.3	10.3
Threadfin bream	4.0	0.1	21.3	0.8	35	0.7	48.2	1.6	644	17.2	3.5
Bigeye ilisha	119	1.6	19.9	0.8	62	1.3	22.3	0.7	19.4	0.5	1.1
Sea bream	120	1.6	34.5	1.3	45	0.9	20	0.7	27.8	0.7	1.1
Pomfret	51.2	0.7	14.2	0.5	26	0.5	16.5	0.5	47.4	1.3	0.7
Indian flathead	34.1	0.5	25.3	1	25.8	0.5	13.3	0.4	61	1.6	0.7
Flounder	61.2	0.8	18.6	0.7	33	0.7	12.4	0.4	25.1	0.7	0.7
Mackerel	4.1	0.1	43.6	1.7	50.6	1.0	25.5	0.8	20	0.5	0.7
Grunt	1.1	0	19.4	0.7	54.4	1.1	18.9	0.6	51.4	1.4	0.7
Grouper	80.7	1.1	7.9	0.3	24.4	0.5	10.8	0.4	11.5	0.3	0.6
Emperor	1.0	0	13.4	0.5	24.3	0.5	5.9	0.2	14.6	0.4	0.3
Mixed fish	836.5	11.5	622	24	805	16.4	452	14.9	376	10	14.3
Shrimps	378	5.2	64.9	2.5	58.5	1.2	54.7	1.8	62.5	1.7	2.9
Total	7274		2587		4908		3029		3755		

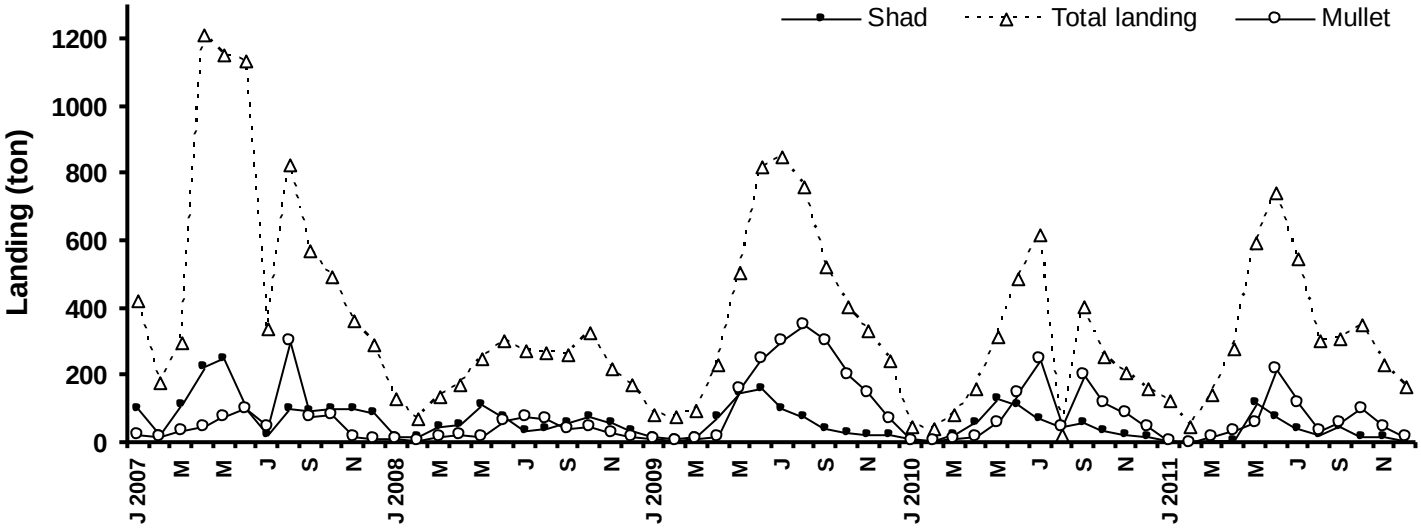

Fig. 2. Monthly variations in total, shad and mullet landings in artisanal fishery during 2007-2011

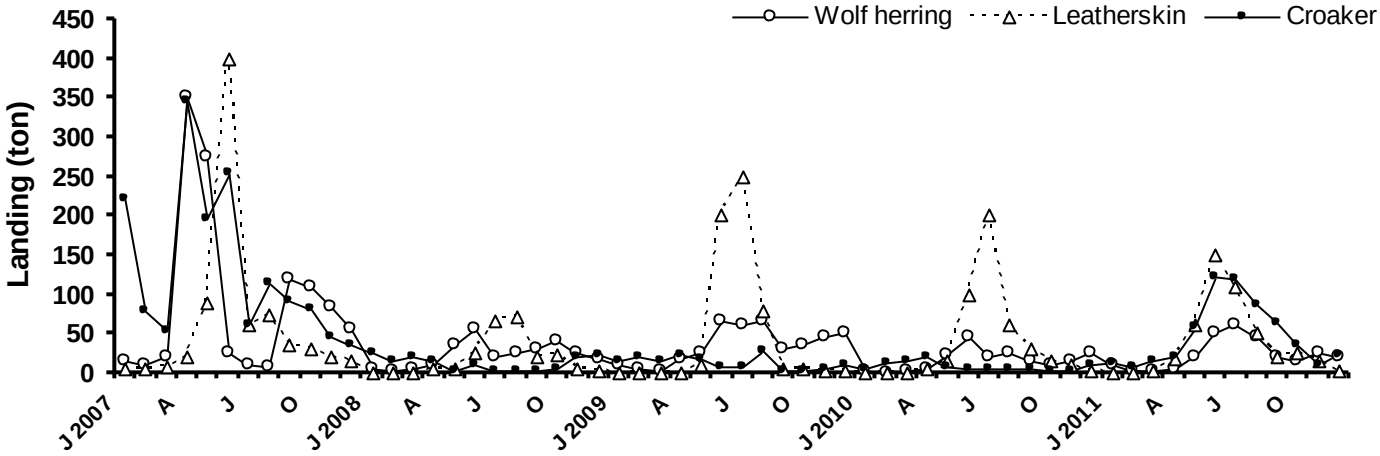

Fig. 3. Monthly variations in croaker, leatherskin and wolf herring landings in artisanal fishery during 2007-2011

Fishing effort

The marine fishery in Iraq is artisanal in nature with no large-scale industrial fishery currently being undertaken. Nine hundred and forty-one licensed fishing boats operating in the marine waters of Iraq during 2011 (Table 3). These are comprised of 538 were fiberglass speed boats fitted with outboard motors using mainly drift gill nets for target species (such as silver pomfret and river shad), and 403 were wooden and steel-hulled dhows and small trawlers using drift gill nets, traps (gargoor), stake nets (hadra), handlines and small trawl nets to take demersal and pelagic fish species as well as shrimp**.**

Table 3. The number of fishing boats operating in Iraqi marine waters

Boat Type	Boat length (m)	Number of Boats		
		1994*	2001+	2011
Fiberglass speed boats	3-6	250	250	538
Dhows and small trawlers	13-20	305	2250	403
Big trawlers	60-70	3	3	-
Total		558	2503	941

* Ali et al. 1998 + Mohamed et al. 2005

4. DISCUSSION

According to Mohamed *et al.*, (2001), whilst around 125 fish species have been recorded in Iraqi marine waters, of these, only 31 fish species are marketed from the marine artisanal fishery. Ali *et al.* (2000) found that, during the period 1997-1998, 25% of the total catches in Iraqi marine waters were commercial fish (about 25 marketable species), 17.2 % were shrimps and 57.8% were non-commercial catch of unmarketable fishes and other invertebrates. It means that more than 50% of the catch was either discarded or used in the fishmeal industry and, as such most of the catches are not documented in the statistics of fish landings at the Al-Fao landing site. Grantham (1980) reported that at least one-half of the commercial by-catch in the Arabian Gulf (which was estimated to be 32,000 ton during 1979) was discarded at sea.

This study shows that landings gradually increase from April to November each year, from a low period during December-February. This fact has been previously stated for the landings from Iraqi marine waters (Salman, 1983; Ali *et al.*, 1998; Mohamed *et al.*, 2002). The previous studies dealt with monthly fluctuations in species composition and also indicated that the fishery resources in the Iraqi marine waters declined sharply in cold months (Mohamed, 1993). This may be due to fish migration as suggested by Al-Kholy and Soloviov (1978) who suggested that most fish species moved toward the deeper waters of the Gulf during the cold season.

Figure 4 illustrates the general trends in the total and river shad landings for the period from 1965 to 2011, both of which exhibit a similar trend. From 1965 to 2005, the major contribution to the total landings came from the river shad landings. The contribution of river shad has declined to lower levels over recent years, in contrast with the contributions of other species, such as mullet, croaker, wolf herring and leatherskin which have increased considerably. The percentage of river shad landings during 1965-1973 constituted 90.2% of total landings (Khayat 1978), and this decreased to 52.9% during 1991-1994 (Ali et al. 1998), and to 41.8% and 30.7% during 1995-1999 and 2000-2006, respectively (Al-Dubakel, 2011), and to 18.9% over recent years, while the contribution of pomfret catches dropped also from 2.26% during 1991-1994 (Ali *et al.*, 1998) to 0.7% from the total landings in the present study.

Many marine resources, like pomfret and river shad stocks are shared by Iraq, Iran and Kuwait and hence any increased exploitation of these stocks by any country fleet may impact landings in neighboring countries (AL-Husaini, 2003; Morgan, 2006). Pomfret landings in Kuwait declined from 1100 t in 1994 to 120 t in 2000. A similar decline was also experienced in Iran where catches decreased substantially from 1142 t in 1996 to only 114 t in 2000, despite the an increase in fishing effort (number of speedboats and dhows) from 2009 boats in 1996 to 2332 boats in 2000 (AL-Husaini, 2003).

The contribution of mullet species increased from 11.7% during 1991-1994 (Ali et al. 1998) to 22.3% from the total landings during 2007-2011. Mullet constituted a very significant contribution (30%) to the production of pelagic fish in the northwest Arabian Gulf (Sivasubramaniam, 1981).

Fishery landings from marine waters started to rise in 1992 and expanded rapidly during the mid-late 1990s reaching the highest figure in the history of Iraqi marine fishery in 2002, before experiencing a sharp decline due to the 2nd Gulf war. Al-Dubakel (2011) stated that this figure was not very precise, possibly due to misreporting. Since 2003, landings gradually increased to a small peak in 2007 and then dropped to lower levels over recent years as compared with the mid-late 1990s.

Over the last 46 years the landings of river shad (a major target species and significant contributor to the marine fishery of Iraq), had two distinctive peaks (Fig. 4). The first was in 1971 which preceded a drop to low levels in the following years, as a result of overfishing (personal observations). The second peak was in 2002 following the virtual cessation of fishing during the Iraq-Iran war during 1980-1988 which gave a chance for the fishery resources to be restored (Mathews, 1994), and as a result of the move to the new auction site at Al-Fao port, which offers largely facilities to marketing agencies (Ali *et al.*, 1998), and the expansion in fishing activity over the period 1994 to 2001. The number of steel dhows and small trawlers, grew in number to 2503 boats in the late 1990s which resulted in tremendous fishing pressure and the number of workers in the fishery increased as people sought alternative sources of employment following, in part, the imposition of UN economic sanctions and the reduction in fishing effort in the inland fishery due to the draining of the marshes in the south. After 2002, the number of vessels declined to 941 by 2011 (Table 3), especially in the number of steel dhows and small trawlers. A combination of the high operating costs of fishing trips, low income to the workers compared with previous years (Al-Dubakel, 2011), and the availability of employment opportunities in oil companies in recent years has pushed many workers in fishing to depart the fishing sector.

There are several possible reasons that may have contributed to the decline in the marine fishery landings over recent years, such as the large reduction in the discharge rates of the Shatt Al-Arab River, the over-fishing of key species in the late 1990s and the lack of the regulations to protect and manage the marine resources.

The higher 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 (Abaychi *et al.*, 1988; FAO, 2011). This discharge covers the northwestern edges of Kuwait Bay 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 35km^{3}yr^{-1} (Saad 1978) to 45km^{3}yr^{-1} (Reynolds, 1993). The construction of dams on the Mesopotamia Rivers in Turkey, Syria, Iran and Iraq has reduced riverine discharge to the northern Arabian Gulf. Recently, Al-Mahmood *et al.*, (2008) stated that the discharge rate of the Shatt Al-Arab River has declined from 626m^{3}s^{-1} during 1997-1998 to 300 m^{3}s^{-1} during 2005-2006. Moreover,

the Karun River, which has a mean annual flow of 24.7 km^3 and previously brought a large volume of water into the Shatt Al-Arab just before it reaches the Gulf (FAO, 2013b), was diverted towards Iranian lands during 2009 (Hameed and Aljorany, 2011). This reduction in freshwater inflow and thus nutrients should affect the biological productivity of the northwest Arabian Gulf (FAO, 2011).

Several fish species in the marine fishery in the northwest Arabian Gulf in particular, river shad and pomfret, both valuable species in Iraq were heavily exploited during the late 1990s and early 2000s. The exploitation rates (E) of river shad, pomfret, mullet (*L. carinata*) and croaker (*J. belangerii*) were 0.71, 0.72, 0.61 and 0.64 respectively (Roomiani and Jamili, 2011; Narges *et al.*, 2011; Mohamed *et al.*, 1998; Ali 2002), which exceeded the optimal level of exploitation rate (0.5).

So far there is no dedicated system to regulate 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. This basic fisheries Act has not been formally updated since 1976 and has clearly failed to create a long term sustainable fishery. Legislation is required that regulates the marine fishery (including controlling fishing effort and fishing gears such as net mesh sizes), controls coastal development and protects freshwater inflows. Most importantly, because Iraq's marine fisheries are small and the stocks upon which they rely are shared with other countries of the region, regional co-operation in fisheries management is essential for Iraq, as well as for other countries in the region (Morgan, 2006). It is therefore important that the government participates in regional and international activities, such as the Regional Fisheries Commission (RECOFI) and regional co-operation, and it should consider ratifying the UN Fish Stocks Agreement and/or the FAO Compliance Agreement.

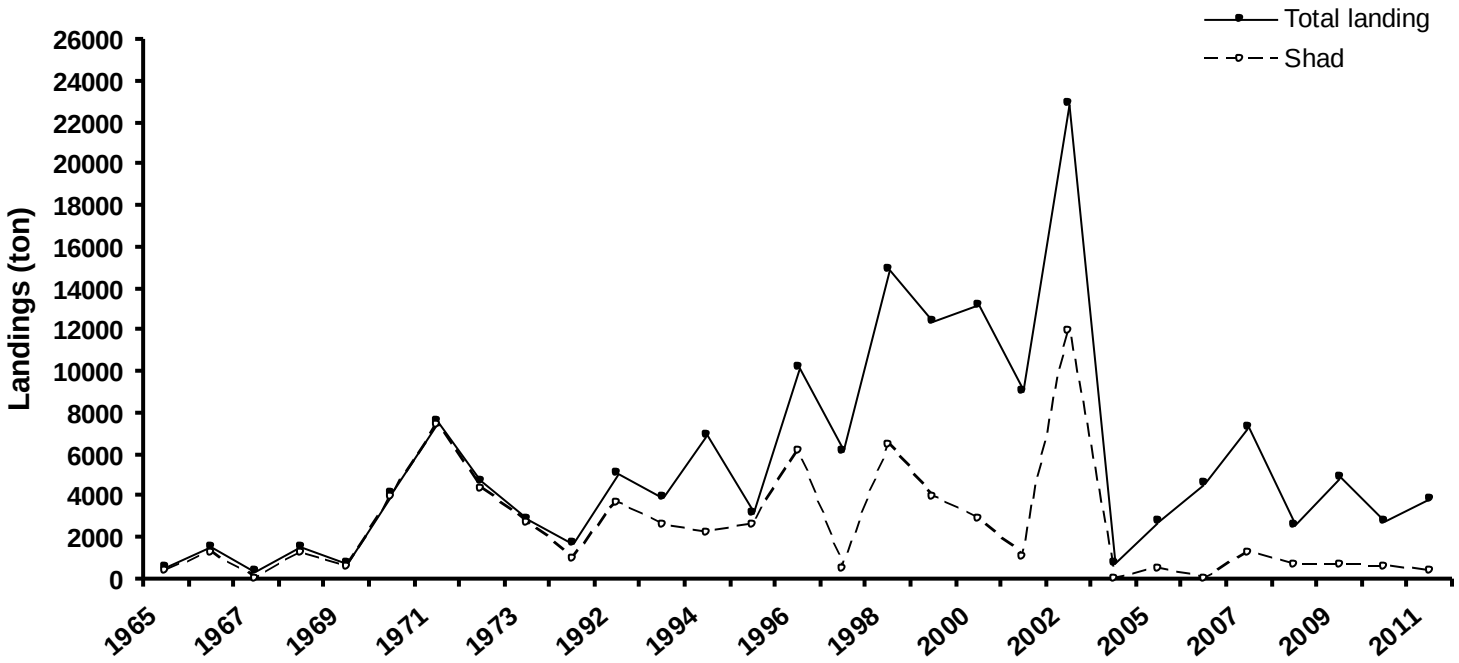

Fig. 4. Annual fluctuations in total and shad landings in the artisanal fishery during 1965-2011

5. ?/

6. CONCLUSION

Generally, there was an increasing trend in the marine artisanal fishery started to rise in 1992 and expanded widely during the mid-late of 1990s, reaching to the highest figure in the history of Iraqi marine fishery during 2002, afterward a sharp decline has changed the general trend. Several reasons may be behind the decline in the marine fish landings over recent years, due to changes in the discharge rates of the Shatt Al-Arab River, over-fishing of target species and no regulations to protect and manage the marine resource.

7. ACKNOWLEDGMENTS

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