Marine Artisanal Fisheries of Iraq

Abdul-Razak M. Mohamed and Laith Abd Jalil Jawad

Abstract In the Arabian Gulf area, the northern part of the Arabian Gulf is usually occupied by the marine waters of Iraq, which represent the main estuarine water resources to the Gulf. The fisheries activities in this part of the world have been reviewed in this chapter.

Keywords Marine artisanal fisheries · Ichthyofaunal · Fishery management · Arabian Gulf · Iraq

1 Introduction

The Iraqi marine waters occupy the most northwestern tip of the Arabian Gulf (Fig. 1) representing the estuarine part of the Gulf. Iraq has only a small coastline to the marine areas of the Gulf that separates the Arabian Peninsula and Iran. Despite the restriction of Iraqi coastline 105 km, continental shelf 1034 km^2 and territorial sea 716 km^2 (EarthTrends 2003), yet, is considered the most productive area in the gulf is due to run off of the Shatt Al-Arab River (Bibik et al. 1971). They function as important nursery, feeding and reproduction areas for both native and migratory species (Hussain and Ahmed 1995). The Shatt Al-Arab River is considered as a major freshwater discharge into Arabian Gulf, the 204 km long waterway which extends south-easterly from the combination of Tigris, Euphrates and Karun Rivers to discharge its waters to the Arabian Gulf near Al-Fao city, about 116 km south of Basrah.

Draining to the Iraqi marine waters also Khor Al-Zubair estuary which is a semi-landlocked tongue extending from Khor Abdullah northward. It has length of 35 km

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Fig. 1 Iraqi marine waters, northwest Arabian Gulf

and a width of 1–2 km depending on the tidal situation. With the connection of the northern tail of this inlet to the main outfall drainage channel by the Shatt Al-Basrah canal, it has become the second most important source of water, other than Shatt Al-Arab to the Gulf.

The Iraqi marine waters slopping gently from the coastal mudflats for 30–40 km south, then a sudden drop in depth occurs due to the formation of relatively deep valleys 'Khors' with the depth of 10–20 m and can be divided into Shatt Al-Arab Estuary (shallow, average depth of 5 m at low water), and several open lagoons such as Khor Al-Kafka and Khor Al-Amaya (deep and narrow, the average depth of 25 m at low water, the substratum is mainly of sandy-clay-silt texture; 48.2% sand, 23.5% silt and 28.3% clay) besides Khor Abdullah a shallow funnel shape water body $>$10 m in depth with wide intertidal zone, the substratum are mainly muddy at the southern entrance and sandy-silt at the northern tip (Albadran 1995; Al-Mahdi et al. 2009).

The region is characterized by arid climate that have a small annual rainfall of order of 150 mm/year and high rates evaporation (<2000 mm/year); most evaporation occurs during winter owing to the higher wind speeds (Reynolds 1993).

Currents in the Iraqi marine water resulted from the effect of tidal force, density variations, winds, slope differences, Coriolis Effect and current of Oman Gulf. It is known that surface current in the Arabian Gulf seems to be counter clockwise, moving along the Iranian side in the northwest direction and recessing along the Arabian side in the southeast direction (Emery 1956). This movement cause a density current driven along the Iraqi coast. Reynolds (1993) postulated that the northern Gulf circulation is predominantly wind driven; this is a true case since northwestern wind is dominant in the area by more than half of the year (55%). Winds tend to push the waves and the surface current to northeast direction (Purser and Seibold 1973).

The type of the tide in the coastal Iraqi waters is mixed semidiurnal (Rzoska 1980). It means there are two high and low waters occurred daily in the Iraqi marine waters, with inequalities in heights and time. Tidal range fluctuations are affected by two main factors. The first is the prevailing northerly winds tend to keep the tide dribble, and southerly winds have the opposite effect, especially in the open sea. The second is the monthly rhythm of spring and neap tides which are controlled on the inland area (Al-Mahdi et al. 2009).

The substratum of this region differs from the other parts of the Gulf, due to terrigenous sediments brought by the river. Hartmann et al. (1971) estimated annual quantity of freshwater discharged to be about 5 km^3. The discharge, however, varies seasonally corresponding to the fluctuations in the rivers Tigris, Euphrates and Karun, and reaches the maximum during the spring flood period of each year (Saad 1978). The total average river runoff into the Gulf ranged from 410 m^3/s in May to 2340 m^3/s in September during the period 1952–1967 (Mohamed et al. 1995) and from 580 m^3/s in June to 1863 m^3/s in August during the period 1993–1994 (Al-Mahdi and Abdullah 1999). It is known that the Shatt Al-Arab River has two periods of flood. The first wave was from Karun River during February–March, which followed by the second wave from Tigris and Euphrates Rivers during April–June (Sudgen 1963). The difference in timing of the two waves is because the source of the Karun is closer to the Gulf than those of the Tigris and Euphrates. Consequently, with first wave a noticeable change occurs in salinity and a partial change in water temperature, while during the second wave, a considerable change in salinity is developed, but there is no effect on temperature. The two waves of spring flood water changed the salinity and temperature of the surface layer but had negligible effect on the bottom ones, probably due to huge difference in density of the waters of the Shatt Al-Arab and the Gulf (Bibik et al. 1971; Mohamed et al. 1995). The effect of Shatt Al-Arab over the year is limited to the lower reaches of the estuary, but drastic horizontal changes in the salinity occur during the spring flood where the flow of Shatt Al-Arab reaches the Kuwaiti waters between Bubiyan and Failakah isles as described by Dubach and Wehe (1959) and was also recorded by Dames and Moore (1983) and to the east of Failakah as shown by Mathews et al. (1980), Lee

(1983) and Lee et al. (1985), and further south to the Saudi coast as reported by Sharaf El-Din (1988).

Mohamed et al. (2005) described the monthly changes in the values of salinity and temperature in the Iraqi marine waters during the ninetieth of last century. During the spring flood, salinity drops to the minimum 6‰ in Shatt Al-Arab estuary and 25‰ in Khor Al-Amaya. In summer, salinity reaches its maximum value (30‰) in Shatt Al-Arab estuary and 40‰ in Khor Al-Amaya. In Khor Abdulla, the salinity ranged between 20‰ during spring and 37‰ during summer. Monthly changes of temperature were pruned from 12 °C in January (winter) to 34 °C in August (summer). Generally, the temperature and salinity were decreased in winter and spring and gradually increased from early summer to autumn. The water column was of isothermal and isohaline form throughout the year, but some indications of vertical gradients were observed in Khor Al-Amaya during April and May, in which the differences in water temperature and salinity between the surface and bottom layers were 2 °C and 3‰, respectively (Mohamed et al. 1995).

The influence of the Shatt al-Arab River discharge on the northern Arabian Gulf results in a gradient of environmental conditions, which change according to river flow volume. As a result of this interaction, different locations and distinct periods may be identified in Kuwaiti waters (Al-Yamani 2008). Polikarpov et al. (2009) show in their study that the northern zone of the Kuwaiti coasts is less saline, more dynamic, turbid and rich in nutrients.

The recent studies indicated that the role of the Shatt Al-Arab on the hydrology of the northwest Gulf confined to the lower reaches of the estuary throughout the year except during spring flood. This decrease in the Shatt Al-Arab discharge is a resultant of several hydrological projects constructed in the riparian countries, and the diversion of the Karun River into Iranian terrene (Al-Yamani 2008; Fawzi and Mahdi 2014; Brandimarte et al. 2015; Yaseen et al. 2016).

2 Ichthyofaunal in the Iraqi Marine Waters

Several systematic publications have been published to identify the fish fauna of the Arabian Gulf (Regan 1905; Blegvad 1944; White and Barwani 1971; Relyea 1981; Kuronuma and Abe 1986; Carpenter et al. 1997). In general the ichthyofauna of the Arabian Gulf is an extension of that of the Indo-Pacific fauna. The number of species inhabiting the Gulf is far less than that of the original (>365 species), because it is the most northern waters of the Indian Ocean (Kurunoma and Abe 1986). Iraqi marine waters have been excluded from all these works, despite being considered as the most productive part of the Gulf (Bibik et al. 1971) which may be due to its shallowness. The first study on Iraqi marine fisheries was carried out by the FAO that concerned with the possibilities of developing the sea fishing industry (Amodea 1956), and the first attempt of fishery surveys in Iraqi marine waters was executed by the Russian research vessels 'Lesnoi' in 1965 (Yesaki 1981) and 'Myslitel' in December 1969 to March 1970 (Bibik et al. 1971).

Many literatures have been published about the taxonomy of freshwater and marine fish in Iraq and the Arabian Gulf (Khalaf 1961; Mahdi 1962, 1971 Mahdi and George 1969; Al-Daham 1977, 1979, 1982, 1984). Jawad (2012) made a comprehensive review about the history of the study of the fish fauna (both freshwater and marine) of Iraq from the taxonomical point of view, based on published literatures over the last 168 years which have been reviewed, and the data derived from such review were analysed for fish biodiversity study. Mohamed et al. (2001) made a checklist of fish collected directly from the Iraqi marine waters in the Arabian Gulf for five successive years (1995–1999).

Table 1 shows a list of these species with an update of their names, in addition to the species that were subsequently recorded by a number of researchers. A total of 134 fish species belonging to 63 families were recorded in the Iraqi marine waters. Sixteen species represent the Chondrichthyes (seven sharks and nine rays); Carcharhinidae was the more diverse family, including five species. Most of the catches of this group were in Khor Amaya. Hundred and twenty eight species of Osteichthyes were recorded. Carangidae, Sparidae, Clupeidae and Mugilidae dominated the catch in number of species consisting of 21, 12, 10 and 6, respectively. Carangidae is the most diverse family.

Several new recorded were added to the Iraqi species list since Mohamed et al. (2001), especially those which belong to Carangidae and few other to Sparidae, Mugilidae, Chaetodontidae and Labridae. Five families were recorded for the first time in the Iraqi marine waters, included Haemulidae, Pomacanthidae, Monocentridae, Acanthuridae and Molidae.

3 Artisanal Fishery in the Iraqi Marine Waters

Artisanal fishery or small-scale fishery is traditional fishery involving both subsistence and commercial fishery, 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, mainly for local consumption (Garcia et al. 2008; FAO 2013a).

The marine artisanal fishery sector has a longstanding tradition in Iraq and includes a multispecies, multi-gear fishery that is directed toward various demersal and pelagic fish species. 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 (Mohamed et al. 2005). These are:

1. Shatt Al-Arab estuary.
2. Khor Abdulla and.
3. Khor Al-Amaya (include the deeper waters in the Open Gulf).

Al-Fao port, southern Basrah, is the main centre of landings and auction of marine fisheries and then transported to the fish markets in Basrah city and other parts of the country by several marketing agencies.

Table 1 Annotated checklist of the fishes recorded in the Iraqi marine waters (Mohamed et al. 2001)

Species		
Class Chondrichthyes	**Class Osteichthyes**	
1-Family Rhynchobatidae	10-Family Clupeidae	16-Family Batrachoididae
Rhynchobatus djiddensis (Forsskål, 1775)	*Sardinella sirm* (Walbaum, 1792)	*Batrachus grunniens* (Linnaeus, 1758)
2-Family Rhinobatidae	*Sardinella perforata* (Cantor, 1849)	17-Family Hemiramphidae
Glaucostegus granulatus (Cuvier, 1829)	*Sardinella longiceps* Valenciennes, 1847	*Hemiramphus marginatus* (Forsskal, 1775)
3-Family Torpedinidae	*Sardinelis fimbriata* (Valenciennes, 1847)	18-Family Belonida
Torpedo panthera Olfers, 1831	*Tenualosa ilisha* (Hamilton-Buchanan, 1822)	*Strongylura strongylura* (van Hasselt, 1823)
4-Family Dasyatidae	*Hilsa kelee* (Cuvier, 1829)	19-Family Syngnathidae
Himantura uarnak (Gmelin, 1789)	*Ilisha megaloptera* (Swainson, 1839)	*Hippocampus kuda* Bleeker, 1852
Dasyatis sephen (Forsskal, 1775)	*Ilisha melastoma* (Swainson, 1839)	20-Family Scorpaenidae
Dasyatis imbricatus (Bloch & Schneider, 1801)	*Nematalosa nasus* (Bloch, 1795)	*Pterois volitans* (Linnaeus, 1758)
Dasyatis gerrardi (Gray, 1851)	*Anodontostoma chacunda* (Hamilton, 1822)	21-Family Synanceiidae
5-Family Gymnuridae	11-Family Engraulidae	*Pseudosynanceia melanostigma* Day, 1875
Gymnura poecilura (Shaw, 1804)	*Thryssa mystax* (Bloch & Schneider, 1801)	*Minous monodactylus* (Bloch & Schneider, 1801)
6-Family Myliobatidae	*Thryssa hamiltoni* (Gray,1853)	22-Family Platycephalidae
Aetomylaeus nichofii (Bloch & Schneider, 1801)	*Thryssa hamiltonii* Gray, 1835	*Platycephalus indicus* (Linnaeus, 1758)
7-Family Hemiscylliidae	12-Family Chirocentridae	23-Family Epinephildae
Chiloscyllium griseum Müller & Henle, 1838	*Chirocentrus dorab* (Forsskal, 1775)	*Epinephelus areolatus* (Forsskål, 1775)
8-Family Carcharhinidae	13-Family Muraenesocidae	*Epinephelus tauvina* (Forsskål, 1775)
Carcharhinus leucas (Müller & Henle, 1839)	*Muraenesox cinereus* (Forsskal, 1775)	24-Family Theraponidae
Carcharhinus dussumieri (Müller & Henle, 1839)	14-Family Ariidae	*Helotes sexlineatus* (Quoy & Gaimard, 1825)
Carcharhinus limbatus (Müller & Henle, 1839)	*Arius bilineatus* (Valenciennes, 1840)	*Terapon theraps* Cuvier, 1829
Carcharhinus sorrah (Müller & Henle, 1839)	15-Family Synodontidae	*Terapon puta* Cuvier, 1829
Carcharhinus menisorrah (Müller & Henle, 1839)	*Saurida tumbil* (Bloch, 1795)	25-Family Apogonidae

(continued)

Table 1 (continued)

Species		
9-Family Sphyrnidae	*Saurida undosquamis* (Richardson, 1848)	*Ostorhinchus aureus* (Lacepède, 1802)
Sphyrna mokarran (Rüppell, 1837)		
26-Family Sillaginidae	30-Family Tetradontidae	37-Family Sciaenidae
Sillago sihama (Forsskål, 1775)	*Lagocephalus lunaris* (Bloch & Schneider, 1801)	*Otolithes ruber* (Bloch & Schneider, 1801)
27-Family Rachycentridae	31-Family Menidae	*Protonibea diacanthus* (Lacepède, 1802)
Rachycentron canadum (Linnaeus, 1766)	*Mene maculata* (Bloch & Schneider, 1801)	*Johnius belangerii* (Cuvier, 1830)
28-Family Echeneididae	32-Family Leiognathidae	*Johnius sina* (Cuvier, 1830)
Echeneis naucrates Linnaeus, 1758	*Leiognathus bindus* (Valenciennes, 1835)	38-Family Mullidae
29-Family Carangidae	*Leiognathus equulus* (Forsskål, 1775)	*Upeneus sulphurus* Cuvier, 1829
Scomberoides commersonianus Lacepède, 1801	33-Family Nemipteridae	*Upeneus tragula* Richardson, 1846
Scomberoides tol (Cuvier, 1832) [a]	*Nemipterus japonicus* (Bloch, 1791)	39-Family Ephippidae
Selar crumenophthalmus (Bloch, 1793) [a]	*Scolopsis phaeops* (Bennett, 1832)	*Ephippus orbis* (Bloch, 1787)
Trachurus trachurus (Linnaeus, 1758)	34-Family Pomadasyidae	40-Family Scatophagidae
Carangoides armatus (Rüppell, 1830) [a]	*Pomadasys argenteus (Forsskal, 1775)*	*Scatophagus argus* (Linnaeus, 1766)
Carangoides bajad (Forsskål, 1775) [a]	*Plectorhinchus schotaf* (Forsskål, 1775)	41-Family Chaetodontidae
Carangoides malabaricus (Bloch & Schneider, 1801)[a]	35-Family Lethrinidae	*Pomacanthus imperator* (Bloch, 1787)
Seriolina nigrofasciata (Rüppell, 1829) [a]	*Lethrinus nebulosus* (Forsskal, 1775)	*Heniochus acuminatus* (Linnaeus, 1758) [f]
Carangoides chrysophrys (Cuvier, 1833)	36-Family Sparidae	42-Family Mugilidae
Alepes vari (Cuvier, 1833) [a]	*Crenidens crenidens* (Forsskål, 1775)	*Planiliza macrolepis* (Smith, 1846)
Alepes djedaba (Forsskål, 1775) [a]	*Acanthopagrus arabicus* Iwatsuki, 2013	*Planiliza subviridis* (Valenciennes, 1836)
Atule mate (Cuvier, 1833) [a]	*Acanthopagrus bifasciatus* (Forsskal, 1775)	*Planiliza klunzingeri* (Day, 1888)
Gnathanodon speciosus (Forsskål, 1775) [a]	*Acanthopagrus berda* (Forsskal)	*Planiliza carinata* (Valenciennes, 1836)
Alepes kleinii (Bloch, 1793) [a]	*Sparus sarba* Forskål, 1775	*Osteomugil cunnesius* (Valenciennes, 1836) [g]
Megalaspis cordyla (Linnaeus, 1758) [a]	*Diplodus sargus* (Linnaeus, 1758)	*Osteomugil speigleri* (Bleeker, 1858) [i]

(continued)

Table 1 (continued)

Species		
Atropus atropos (Bloch & Schneider, 1801)	*Sparidentex hasta* (Valenciennes, 1830)	43-Family Sphyraenidae
Trachinotus mookalee Cuvier, 1832	*Argyrops spinifer* (Forsskål, 1775)	*Sphyraena chrysotaenia* Klunzinger, 1884
Parastromateus niger (Bloch, 1795)	*Acanthopagrus catenula* (Lacepède, 1801) [e]	44-Family Polynemidae
Alectis indica (Rüppell, 1830)[a]	*Argyrosomus heinii* (Steindachner, 1902)	*Eleutheronema tetradactylum* (Shaw, 1804)
Alectis ciliaris (Bloch, 1787) [b]	*Atractoscion aequidens* (Cuvier, 1830)	*Polydactylus sextarius* (Bloch & Schneider, 1801)
Uraspis helvola (Forster, 1801) [c]	*Johnius majan* Iwatsuki, Jawad & Al-Mamry, 2012 [g]	
45-Family Scaridae	51-Family Stromateidae	57-Family Balistidae
Scarus ghobban Forsskål, 1775	*Pampus argenteus* (Euphrasén, 1788)	*Abalistes stellatus* (Anonymous, 1798)
46-Family Gobiidae	52-Family Psettodidae	58-Family Molidae
Pseudapocryptes elongatus (Cuvier, 1816)	*Psettodes erumei* (Bloch & JSchneider, 1801)	*Ranzania laevis* (Pennant, 1776)[d]
Scartelaos tenuis (Day, 1876)	53-Family Bothidae	59-Family Acanthuridae
Periophthalmus waltoni Koumans, 1941	*Pseudorhombus arsius* (Hamilton, 1822)	*Zebrasoma xanthurum* (Blyth, 1852) [f]
Bathygobius fuscus (Rüppell, 1830)	*Bothus pantherinus* (Rüppell, 1830)	60-Family Monocentridae
47-Family Trypauchenidae	54-Family Soleidae	*Monocentris japonica* (Houttuyn, 1782) [d]
Trypauchen vagina (Bloch & Schneider, 1801)	*Synaptura orientalis* (Bloch & Schneider, 1801)	61-Family Labridae
48-Family Siganidae	*Zebrias synapturoides* (Jenkins, 1910)	*Bodianus macrognathos* (Morris, 1974)
Siganus oramin (Bloch & Schneider, 1801)	*Solea elongata* Day, 1877	*Coris nigrotaenia* Mee & Hare, 1995 [h]
49-Family Trichiuridae	*Solea bleekeri* Boulenger, 1898	62-Family Pomacanthidae
Trichiurus haumela (Forsskål, 1775)	55-Family Cynoglossidae	*Pomacanthus maculosus* (Forsskål, 1775) [f]
Trichiurus lepturus Linnaeus, 1758	*Cynoglossus arel* (Bloch & Schneider, 1801)	63-Family Haemulidae
50-Family Scombridae	56-Family Triacanthidae	*Plectorhinchus sordidus* (Kluzinger 1870) [f]
Scomberomorus commerson (Lacepède, 1800)	*Triacanthus biaculeatus* (Bloch, 1786)	*Pomadasys olivaceus* (Day 1875) [f]
Scomberomorus guttatus (Bloch & Schneider, 1801)		*Pomadasys punctulatus* (Rüppell 1838) [f]
Auxis thazard (Lacepède, 1800)		

[a]Al-Faisal et al. (2016), [b]Al-Faisal et al. (2016), [c]Mohamed et al. (2017)
[d]Jawad et al. (2014), [e]Al-Badri and Jawad (2014), [f]Jawad et al. (2014)
[g]Jawad (2015), [h]Jawad and Al-Badri (2015), [i]Mohamed et al. (2016)

Khayat (1978) conducted a comprehensive socio-economic study of fish resources in Iraq and documented the marine artisanal landings for the period 1965–1973. 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. Al-Dubakel (2011) updated information about the fishing methods, landings and marketing of river shad *Tenualosa ilisha* at the Al-Fao fish landing site. Lately, Mohamed and Qasim (2014) analysed the data for the total and species landings and fishing effort of the marine artisanal fishery in the Iraqi marine waters, northwest Arabian Gulf from 2007 to 2011, and compared with historical fishing information for the period 1965–2006. They described the trends of Iraqi marine artisanal fishery from 1965 to 2011 with emphasis on river shad fishery.

The data dealt with this chapter 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. Also, the numbers and types of fishing boats were recorded during 2011. These are composed of 538 fiberglass speed boats fitted with outboard motors using mainly drift gill nets for target species (such as silver pomfret and river shad), 403 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. The historical information about the annual landings and fishing efforts of the artisanal fishery provided in this chapter was derived essentially from reviews of literatures (Khayat 1978; Ali et al. 1998; Al-Dubakel 2011).

4 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 which are shown in Table 2. 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 belonging to family of Penaeidae were present. Mixed fish referred to small sizes of different fish species.

5 Annually Variations in Species Landings (2008–2016)

Figure 2 provides information on annual variations in the total, mixed fish and shrimps landings of the Iraqi marine artisanal fisheries from 2008 to 2016. The figure shows a clear fluctuation in the total landings with three peaks. The highest

Table 2 Landing composition of the artisanal marine fisheries (2007–2016)

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

peak was recorded in 2014 and reached 5449.00 tons and represented 18.1% of the total landings, while the second peak 4907.95 tons which formed 16.3% was obtained in 2009. The third peak (4483 tons) which took 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 3000 tons.

The total mixed fish landings attained 4319 tons during 2008–2016 and constituted 14.4% from the total landings. There are fluctuations in the landings of mixed

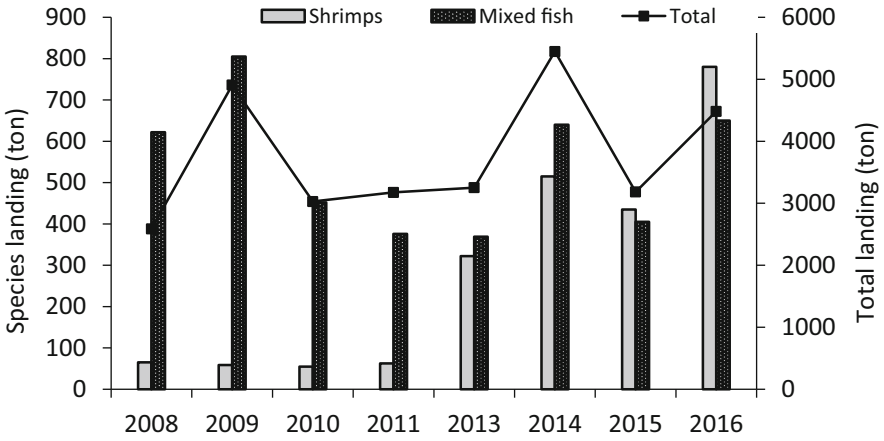

Fig. 2 The annual shrimps, mixed fish and total landings from 2008 to 2016

fish, and the highest landing was 805 tons during 2009. The total landing of shrimps during 2008–2016 was 2293 tons consisting 7.6% from the total landings. There are gradually increase in the landing of shrimps and reached to maximum landing (780 tons) during 2016.

The annual variations in the species landings of the Iraqi marine artisanal fisheries from 2008 to 2016 are illustrated in Fig. 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), carangids (409.5 tons) and mixed fish (805.0 tons) were recorded during 2009, whereas other species like river shad (872.0 tons), emperor (221.0 tons) and sea breams (150.0 tons) recorded during 2014. The maximum annual landings of croakers (544.9 tons) and flounder (198.0 tons) were found during 2011 and 2013, respectively. However, the highest annual landings of threadfin bream (841.0 tons) and shrimps (780.0 tons) were documented during 2016.

Also, the annual percentage compositions of the species in the artisanal fisheries during the period 2008–2016 were varied from year to year (Fig. 4). River shad, mullets and wolf herring were the most dominated species during 2008 constituted 24.3%, 16.2% and 10.4%, respectively. The three most abundant species in the fisheries during 2009 and 2010 were mullets, river shad and carangids constituted 37.2%, 14.6% and 11.4%, respectively, during 2009, and 33.4%, 19.6% and 14.5%, respectively, during 2010. Mullets, croakers and carangids were the most dominated species during 2011 comprised 22.6%, 18.1% and 14.3% of the total landing, respectively. The dominated species in the artisanal fisheries were river shad, mullets and threadfin bream during 2013 and 2014, represented 14.2%, 10.5% and 7.2%, respectively, during 2013, and 16.0%, 14.5% and 11.3%, respectively, during 2014. During 2015, mullets, threadfin bream and wolf herring were the most dominated species formed 24.8%, 15.8% and 5.8%, respectively, whereas threadfin bream,

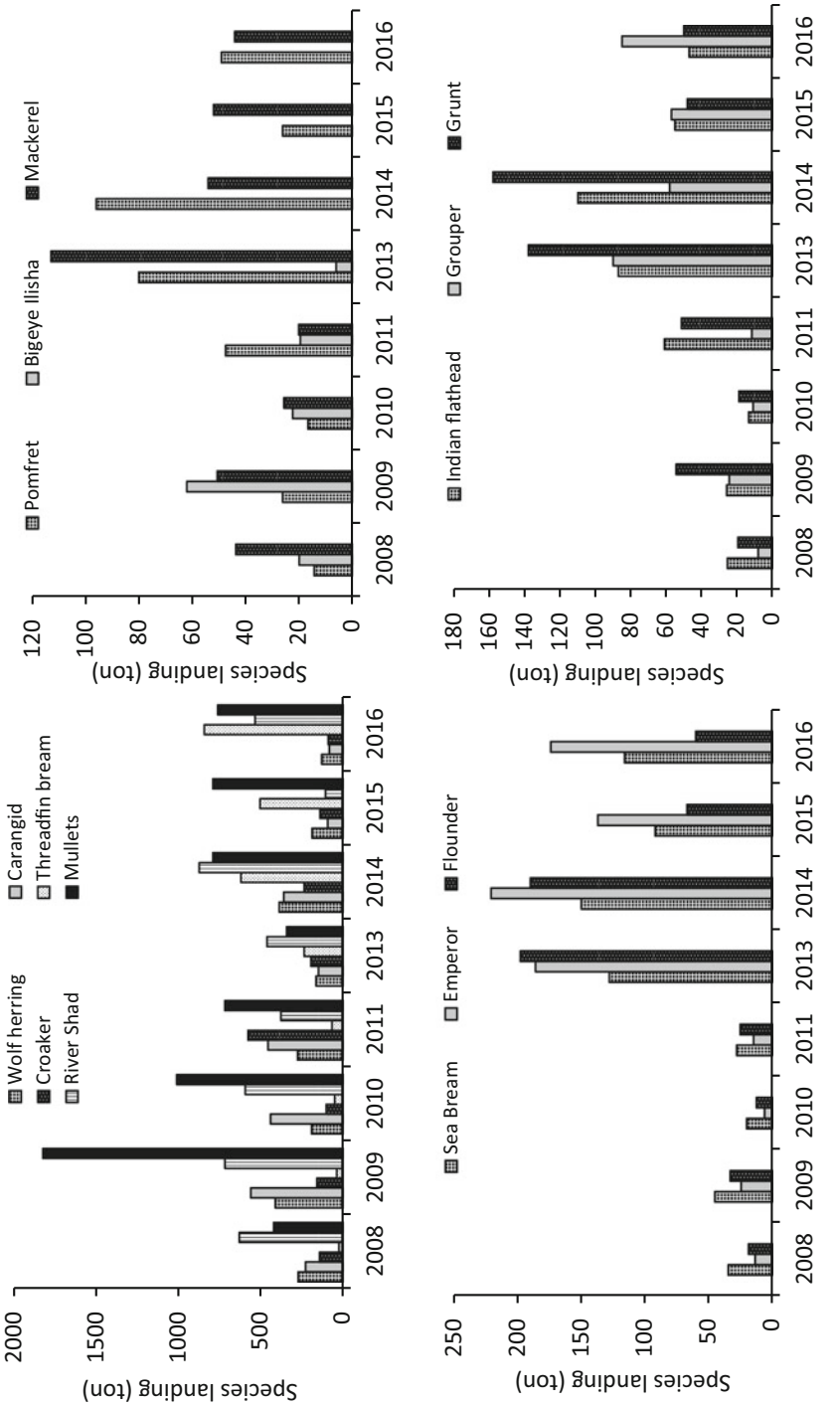

Fig. 3 The annual variations in the species landings of the Iraqi marine artisanal fisheries from 2008 to 2016

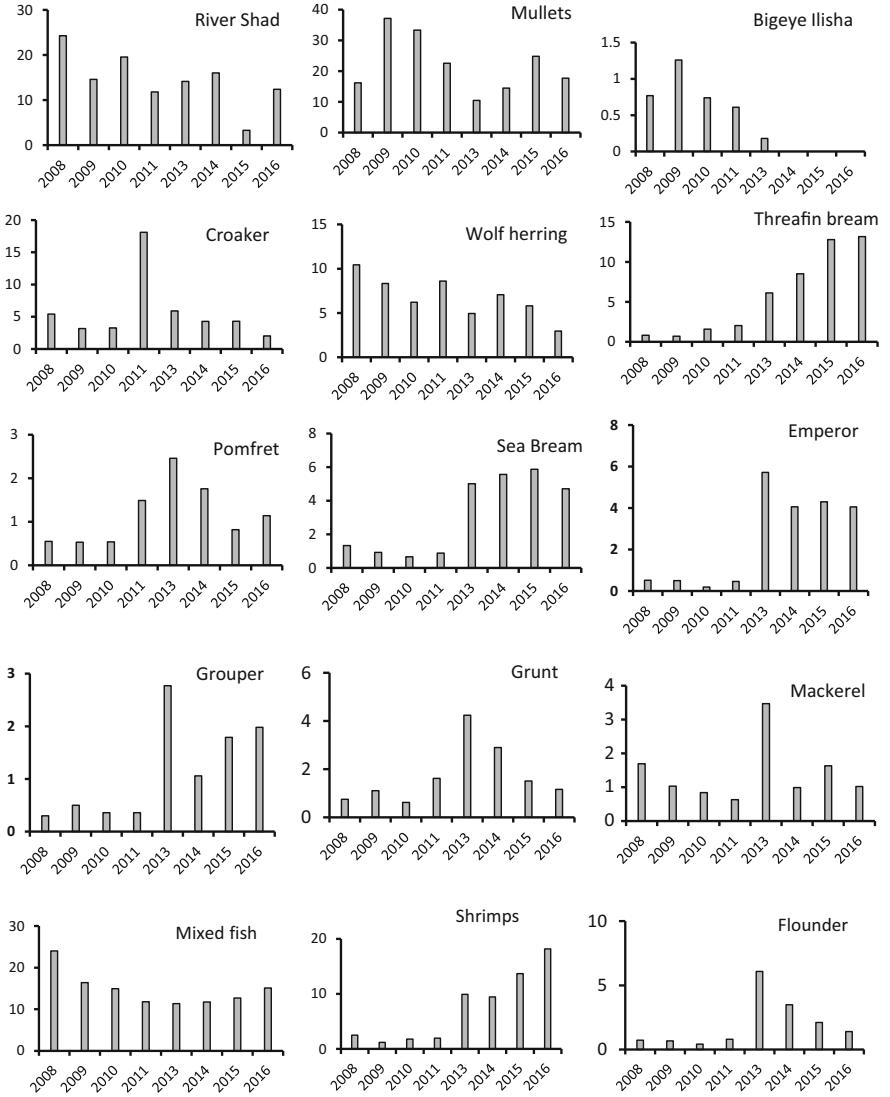

Fig. 4 Percentages of fish species in the landings of artisanal marine fisheries (2008–2016)

mullets and river shad during 2016 comprised 18.8%, 17.0% and 11.9%, respectively.

In general, the three most abundant species in the Iraqi marine artisanal fisheries during 2008–2016 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 during 2008–2016.

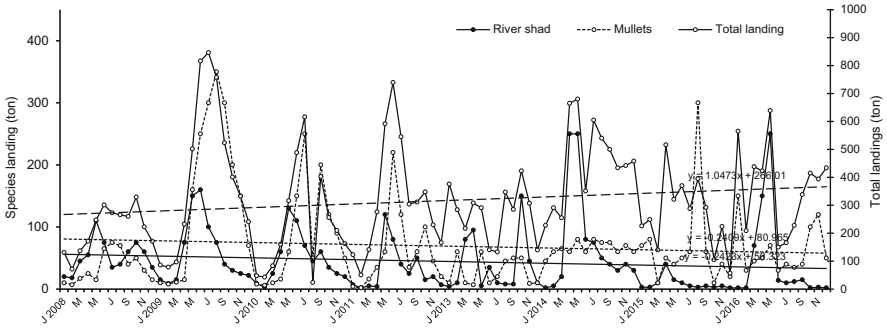

Fig. 5 The monthly variations in landings of river shad, mullets and total species from 2008 to 2016

6 Monthly Variations in Species Landings (2008–2016)

The monthly variations in the total landings of the Iraqi marine artisanal fisheries during 2008–2016 are presented in Fig. 5. 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, 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, April 2015 and May 2016, respectively. The general trend of the total landings of artisanal fisheries in Iraqi marine waters during 2008–2016 showed gradual increase (slop of trend line (b) = 1.029) along the investigated period.

The contribution, monthly landing, trend, fishing area and fishing method for fish species are as follows (Figs. 5, 6, 7, 8, 9, and 10):

7 Mullets

Fish of the family Mugilidae are commonly known as 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; Nelson 2006).

The intertidal zones of Khor Abdullah and Shatt Al-Arab estuary are the main fishing areas throughout the year with clear peak during June–October. Mullets mainly caught by drift gill nets.

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

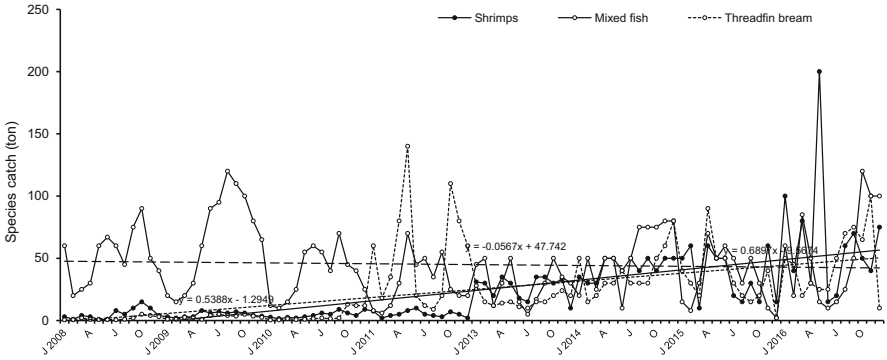

Fig. 6 The monthly variations in landings of shrimps, mixed fish and threadfin bream from 2008 to 2016

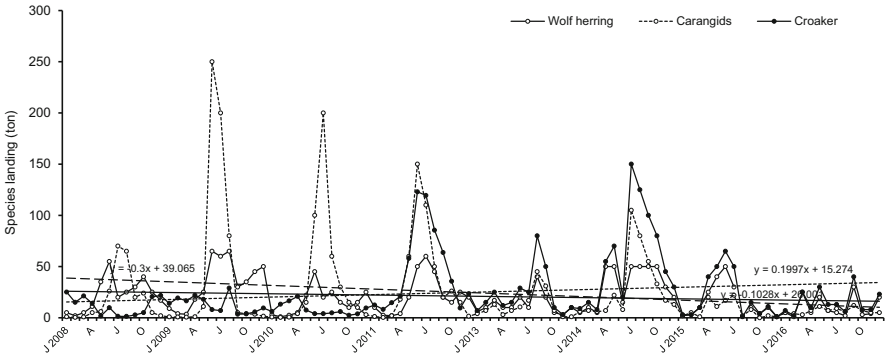

Fig. 7 The monthly variations in landings of wolf herring, carangids and croakers from 2008 to 2016

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. 5). The general trend of mullets landings in Iraqi marine waters during 2008–2016 showed gradual declined ($b = -0.240$) along the investigated period (Fig. 5).

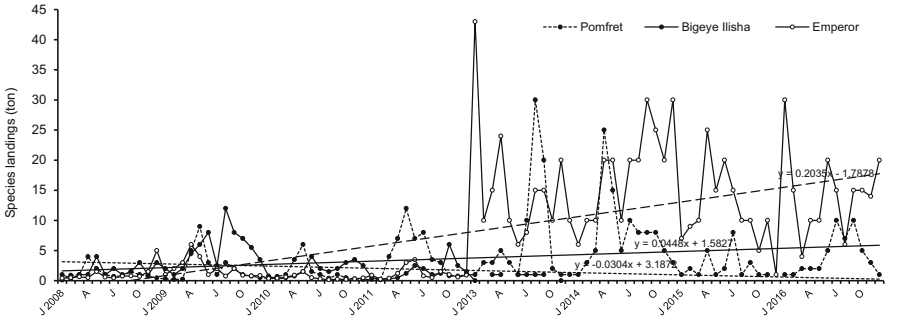

Fig. 8 The monthly variations in landings of pomfrets, big-eye ilish and emperors from 2008 to 2016

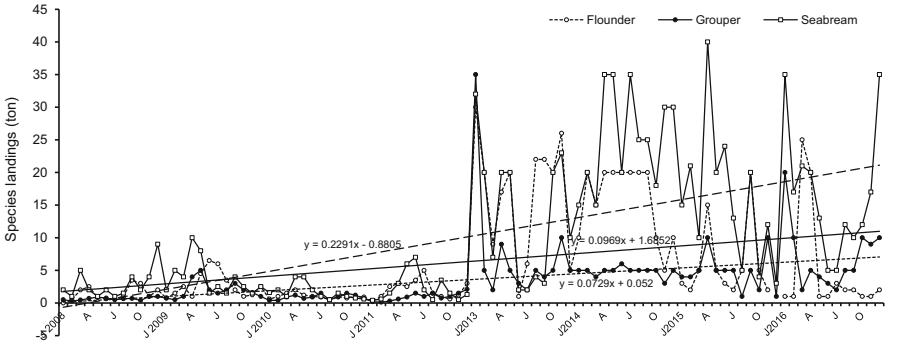

Fig. 9 The monthly variations in landings of flounders, groupers and sea breams from 2008 to 2016

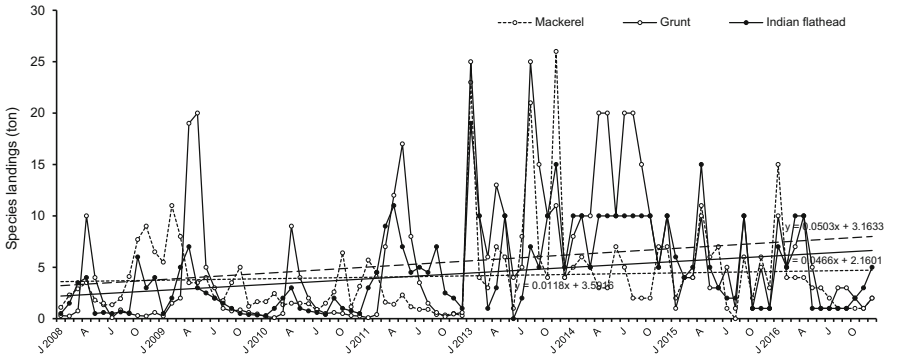

Fig. 10 The monthly variations in landings of mackerels, grunts and Indian flatheads from 2008 to 2016

8 River Shad

River shad, *Tenualosa ilisha* belongs to the family Clupeidae, locally known as 'sbour'. Its geographical distribution extends from Shatt Al-Arab River, along the coasts of Iran, Pakistan, India, Bangladesh and Burma to South Vietnam (Fischer and Bianchi 1984). The species is largely anadromous in nature, migrating up rivers during the breeding season and after spawning return to the original habitat where they remain until the next breeding season (Pillay and Rosa 1963).

This species is considered as one of the most commercial species in the Iraqi marine artisanal fisheries. River shad ascend to the upper reaches of Shatt Al-Arab River for spawning (Hussein et al. 1991; Hussain 1997; Al-Noor 1998; Al-Hassan 1999; Mohamed et al. 2012). Therefore, 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. 5). Most of the catches of this species are made by dhow boats and speedboats using drifting gill nets.

The overall landing of river shad during the period 2008–2016 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. 5). The general trend of river shad landings in Iraqi marine waters during 2008–2016 showed gradual declined ($b = -0.242$) along the investigated period (Fig. 5).

9 Therafin Bream

The threadfin bream, *Nemipterus japonicus*, belongs to the family Nemipteridae, locally known as 'Bassi'. The threadfin bream is widely distributed throughout the Indo-West Pacific, including Arabian Gulf, Red Sea, eastward to coast of India, East Indies, Japan, East China Sea and thence southward to northern coast of Australia (Kuronuma and Abe 1986).

The threadfin bream is mainly caught by trawl nets in the open Iraqi marine waters. The total landing of the species from 2008 to 2016 was amounted to be 1803.9 tons, consisted of 6.0% from the total landings. The annual landing of the species changed from 21.3 tons in 2008 to 565.0 tons in 2016, and their contribution from the annual landing varied from 0.71% in 2009 to 13.2% in 2016.

The highest landings of threadfin bream were 5, 5, 13, 140, 28, 80, 90 and 100 tons in October 2008, July and October 2009, October 2010, May 2011, January 2013, December 2014, April 2015 and November 2016, respectively

(Fig. 6). The general trend of threadfin bream landings in Iraqi marine waters during 2008–2016 showed gradual increase (b = 0.539) along the investigated period (Fig. 6).

10 Mixed Fish

Mixed fish refer to the small sizes of unidentified fish species and unmarketable fish from various species which are landed together. The total landing of mixed fish from 2008 to 2016 was amounted to be 4319 tons, consisted of 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 annual landing ranged from 114% in 2013 to 15.14% in 2016.

The highest 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. 6). The general trend of mixed fish landings from Iraqi marine waters during 2008–2016 showed gradual decline (b = −0.057) along the investigated period (Fig. 6).

11 Shrimps

Shrimps are locally known as 'Rubiyan' and represented by Green tiger prawn, *Penaeus semisulcatus*, and penaeid shrimp, *Metapenaeus affinis*, in the Iraqi marine waters, and both of them belong to the family Pomadasyidae. These species are widely distributed in warm coastal waters from Arabian Gulf, Red Sea, N.E. coast of Africa, coast of India and southern of Japan to eastern coasts of Australia (Kuronuma and Abe 1986). The prawn mainly fished in the deeper regional areas and Khor Abdullah and the shrimp in Shatt Al-Arab estuary. Trawl net locally known Goofa is the fishing gear utilized in capturing this group as well as in seines and traps in shallow inshore waters.

The total landing of shrimps from 2008 to 2016 was amounted to be 2293 tons, consisted of 7.6% from the total landings. The annual landing of shrimps varied from 54.7 tons in 2010 to 780.0 tons in 2016, and their contribution from the annual landing varied from 1.2% in 2009 to 18.2% in 2016.

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. 6). The general trend of shrimps landings in Iraqi marine waters during 2008–2016 showed gradual increase (b = 0.690) along the investigated period (Fig. 6).

12 Carangids

The carangids are marine fish found in the Atlantic, Indian and Pacific oceans, and there are altogether 30 genera and 147 species in the worldwide (Eschmeyer and Fong 2016). Recently, Al-Faisal (2016) identified 20 species of carangid fish in Iraqi marine waters. Most of carangids species are sold in the auction without recording their quantities as separate species, except some species like spotted leatherskin (*Scomberoides commersonianus*) and black pomfret (*Parastromateus niger*), which are locally known as Dhal'a and Halwayuh, respectively. The spotted leatherskin is widely distributed throughout the Indo-West Pacific from Arabian Gulf, Red Sea, northeast coast of Africa, coast of India, East Indies and thence southward to northern coast of Australia (Kuronuma and Abe 1986), while, the geographical distribution of the black pomfret extends from Arabian Gulf, eastern coast of Africa, eastward to coast of India, East Indies, southern Japan and East China Sea and southward to Lesser Sunda Islands (Kuronuma and Abe 1986).

Carangids mainly caught by trawl nets in the open Iraqi marine waters and drift gill nets in other fishing areas. The total landing of carangids from 2008 to 2016 was amounted to be 2354.2 tons, consisted of 7.83% from the total landings. The annual landing of carangids ranged from 81.0 tons in 2016 to 558.3 tons in 2009, and their contribution from the annual landing varied from 1.8% in 2016 to 14.5% in 2010.

The highest landings of carangids were 70, 250, 200, 150, 45, 105, 22 and 12 tons in July 2008, June 2009, July 2010, June 2011, August 2013, July 2014, July 2015 and September 2016, respectively (Fig. 7). The general trend of carangids landings in Iraqi marine waters during 2008–2016 showed gradual decline ($b = -0.32$) along the investigated period (Fig. 7).

13 Wolf Herrings

Chirocentridae is represented by single genus *Chirocentrus* and two species, namely, *Chirocentrus dorab* and *C. nudus* in the Arabian Gulf, and locally known as 'Hiff'. The family is widely distributed in warm coastal waters from Arabian Gulf, Red Sea, northeast coast of Africa, coast of India and southern of Japan to eastern coasts of Australia (Kuronuma and Abe 1986). The annual mean catch rates of Chirocentridae in Iraqi marine waters was 1.3 kg/ha, and the highest catch rate was 6.8 kg/ha (Mohamed 1993).

Wolf herrings are mainly caught from Khor Abdullah and open waters by drift gill nets. The total landing of wolf herrings from 2008 to 2016 was amounted to be 1999.5 tons, consisted of 6.7% from the total landings. The annual landing of wolf herrings varied from 127 tons in 2016 to 409.5 tons in 2009, and their contribution from the annual landing varied from 2.8% in 2016 to 8.6% in 2011.

The highest landings of wolf herrings were 55, 65, 45, 60, 40, 50, 50 and 30 tons in June 2008, June and August 2009, June 2010, July 2011, August 2013, July 2014,

June 2015 and September 2016, respectively (Fig. 7). The general trend of wolf herrings landings in Iraqi marine waters during 2008–2016 showed gradual decline ($b = -0.10$) along the investigated period (Fig. 7).

14 Croakers

The croaker (sciaenid) fish belong to the family Sciaenidae and are widely distributed in coastal waters from Arabian Gulf, eastern coast of Africa, eastward to coast of India, East Indies, northward to Philippines, and South China Sea to coasts of Australia (Kuronuma and Abe 1986). The most abundant croakers in the Iraqi marine waters are tigertooth croaker, *Otolithes ruber*, blotched croaker *Johnius maculatus* and silvery croaker, *Johnius sina* and *Johnieops belangerii* which are locally known as newaiby, shmahy and Tatooa, respectively. Croakers are mainly collected from the Open Gulf area within the Iraqi waters by trawlers and to lesser extent by handlines.

The total landing of croakers from 2008 to 2016 was amounted to be 1619 tons, consisted of 5.4% from the total landings. The annual contribution of croakers from the annual landing varied from 1.8% (87 tons) in 2016 to 18.1% (574.9 tons) in 2011.

The highest landings of croakers were 25, 29, 21, 123, 85, 155, 67 and 42 tons in January 2008, August 2009, April 2010, June 2011, August 2013, July 2014, June 2015 and September 2016, respectively (Fig. 7). The general trend of croakers landings in Iraqi marine waters during 2008–2016 showed gradual increase ($b = 0.199$) along the investigated period (Fig. 7).

15 Silver Pomfret

The silver pomfret, *Pampus argenteus* belongs to the family Stromateidae, locally known zubaidy is widely distributed in East China Sea, Southeast Asian Sea, Indian Ocean and the Arabian Gulf, not recorded from Australasia (Kuronuma and Abe 1986). The species is oceanodromous, exercise annual migration to the Iraqi marine waters to spawn in Khor Abdulla from May to September, with a peak during June–July (Mohamed and Ali 1993). The main fishing grounds in the Iraqi marine waters are Khor Al-Amaya and Khor Abdullah using both the trawl net and drift gill nets, and the fishing season extends March to November (Mohamed and Ali 1992). The species occupy a prominent place among the commercial fishery in Iraq and other Arabian Gulf countries.

The overall landing of silver pomfret from 2008 to 2016 was amounted to be 355.1 tons, constituted of 1.2% from the total landings. The annual landing of silver pomfret varied from 14.2 tons in 2008 to 96.0 tons in 2014, and its contribution from the annual landing ranged from 0.53% in 2008 to 2.46% in 2013.

The highest landings of silver pomfret were 4, 9, 6, 12, 30, 25, 8 and 10 tons in April 2008, May 2009, May 2010, May 2011, August 2013, April 2014, July 2015 and July and September 2016, respectively (Fig. 8). The general trend of silver pomfret landings in Iraqi marine waters during 2008–2016 showed gradual increase ($b = 0.044$) along the investigated period (Fig. 8).

16 Emperor

Emperor, *Lethrinus nebulosus* belongs to the family Lethrinidae, locally known as 'Shaary'. Its geographical distribution extends from Arabian Gulf, the Red Sea and eastern coast of Africa, eastward to the coast of India and the East Indies, East China Sea to southward to northern coast of Australia (Kuronuma and Abe 1986). Emperor is mainly collected from the Open Gulf area within the Iraqi waters by trawlers.

The total landing of Emperor from 2008 to 2016 was amounted to be 776.1 tons, consisted of 2.6% from the total landings. The annual landing of Emperor ranged from 5.9 tons in 2010 to 221.0 tons in 2014, and its contribution from the annual landing ranged from 0.19% in 2010 to 5.72% in 2013.

The highest landings of Emperor were 1.5, 6.0, 1.5, 3.5, 43, 30, 25 and 30 tons in May 2008, April 2009, May 2010, June 2011, January 2013, September and December 2014, April 2015 and January 2016, respectively (Fig. 8). The general trend of Emperor landings in Iraqi marine waters during 2008–2016 clearly showed increase ($b = 0.203$) along the investigated period (Fig. 8).

17 Big-Eye Shad

The big-eye shad fish belongs to the family Pristigasteridae and is widely distributed in coastal waters from Arabian Gulf, coast of India, East Indies, South Japan and East China Sea to western New Guinea (Kuronuma and Abe 1986). The most abundant big-eye shad in the Iraqi marine waters are *Ilisha megaloptera*, *I. melastoma* and *I. elongate* which are locally known as Abu-Owaina or Sawayah. Big-eye shad are mainly collected from Khor Abdulla and Shatt Al-Arab estuary by gill nets.

The total landing of big-eye shad from 2008 to 2016 was amounted to be 129.6 tons, consisted of 0.4% from the total landings. The annual landing of big-eye shad ranged from 6.0 tons in 2013 to 62.0 tons in 2009, and its contribution from the annual landing ranged from 0.18% in 2013 to 1.3% in 2009.

The highest landings of big-eye shad were 6, 7, 3, 11, 19, 11, 15 and 11 tons in October 2008, April 2009, April 2010, April 2011, January 2013, July 2014, April 2015 and April 2016, respectively (Fig. 8). The general trend of big-eye shad landings in Iraqi marine waters during 2008–2016 showed gradual increased ($b = 0.047$) along the investigated period (Fig. 8).

18 Sea Breams

The sea breams (sparids) fish belong to the family Sparidae and are widely distributed in coastal waters from Arabian Gulf and eastern coast of Africa down to Durban and then eastward the coast of Arabian Sea, the coasts of Indian peninsula, Philippines, Japan and Northern Australia (Fischer and Bianchi 1984; Kuronuma and Abe 1986). The most abundant sea breams in the Iraqi marine waters are yellowfin bream, *Acanthopagrus arabicus*; the goldsilk sea bream, *A. berda*; blackfin bream, *Sparidentex hasta*; and long spine sea bream, *Argyrops spinifer*, which are locally known as Shank or Shim and Andaq for the last species. The larvae and juveniles of yellowfin sea bream migrate from the sea for the estuaries in southern Iraq (Shatt Al-Arab River and Shatt Al-Basrah Canal) for protection and feeding and return back to higher salinity and deeper waters of the Arabian Gulf for maturation (Hussain et al. 1987; Al-Daham et al. 1993). These species are mainly collected from the Iraqi waters by trawlers, gill nets, traps (Gargoor) and handlines.

The total landing of sparids from 2008 to 2016 was amounted to be 982.3 tons, consisted of 3.3% from the total landings. The annual landing of sparids ranged from 20.0 tons in 2010 to 303.0 tons in 2014, and its contribution from the annual landing ranged from 0.7% in 2010 to 5.9% in 2015.

The highest landings of sparids were 9, 10, 4, 7, 32, 35, 40 and 35 tons in December 2008, April 2009, May and June 2010, June 2011, January 2013, April, May and July 2014, April 2015 and January and December 2016, respectively (Fig. 9). The general trend of sparids landings from Iraqi marine waters during 2008–2016 showed gradual increase ($b = 0.229$) along the investigated period (Fig. 9).

19 Grouper

The groupers (sciaenid) fish belong to the family Sciaenidae and are widely distributed in coastal waters from Arabian Gulf, eastern coast of Africa, coast of India, East Indies, Philippines and South China Sea to coasts of Australia (Kuronuma and Abe 1986). The most abundant groupers in the Iraqi marine waters are Arabian grouper, *Epinephelus tauvina*, and areolate grouper, *E. areolatus*, which are locally known as Hamoor. Groupers are mainly collected from the Open Gulf area within the Iraqi waters by trawlers and traps (Gargoor) and to lesser extent by handlines.

The total landing of groupers from 2008 to 2016 was amounted to be 344.5 tons, consisted of 1.2% from the total landings. The annual landing of groupers varied from 7.9 tons in 2008 to 90.0 tons in 2013.

The highest landings of groupers were 1.0, 5.0, 1.5, 2.1, 35, 6, 10 and 20 tons in November 2008, May 2009, July 2010, December 2011, January 2013, July 2014, April 2015 and January 2016, respectively (Fig. 9). The general trend of groupers

landings in Iraqi marine waters during 2008–2016 showed gradual increased (b =0.096) along the investigated period (Fig. 9).

20 Flounders

Flatfishes refer to fish belonging to the families Paralichthyidae, Soleidae and Cynoglossidae and are widely distributed in coastal waters from Arabian Gulf, Red Sea and eastern coast of Africa down to Durban, eastward the coast of Arabian Sea, east coast of Africa and the coasts of Indian peninsula, Philippines, Japan and Northern Australia (Fischer and Bianchi 1984; Kuronuma and Abe 1986). The most abundant Flatfishes in the Iraqi marine waters are largetooth flounder, *Pseudorhombus arsius*; Oriental sole, *Brachirus* (*Euryglossus*) *orientalis*; and large-scale tongue sole, *Cynoglossus arel*, which are locally known as Mazlag (Khaufa) and Lisan Al-Thor. Flatfish's species are landed in small quantities in Iraq, as mixed species, and none of these comprises a single species fishery.

Flatfish captured by trawlers in the Open Gulf and stake nets (Hadra) in the coastal areas. The total landing of flatfish from 2008 to 2016 was amounted to be 604.1 tons, consisted of 2.0% from the total landings. The annual landing of flatfish fluctuated from 12.4 tons in 2010 to 198.0 tons in 2013, and their contribution from the annual landing varied from 0.4% in 2008 to 6.1% in 2013.

The highest landings of flatfish were 3.5, 6.5, 2.0, 3.5, 30, 21, 20 and 25 tons in September 2008, June 2009, April 2010, June 2011, January 2013, June 2014, September 2015 and March 2016, respectively (Fig. 9). The general trend of flatfish landings in Iraqi marine waters during 2008–2016 showed gradual declined (b = 0.072) along the investigated period (Fig. 9).

21 Mackerels

The mackerel fish belong to the family Scombridae and are widely distributed in coastal waters from Arabian Gulf, eastward to coast of India and East Indies, thence South China Sea and southward to Lesser Sunda Islands (Kuronuma and Abe 1986). The most abundant mackerel fish in the Iraqi marine waters are spotted Spanish mackerel, *Scomberomorus guttatus* and Barred Spanish mackerel, *S. commerson*, which are locally known as Khubbat and Chanied, respectively. Mackerels are mainly collected from the Open Gulf area within the Iraqi waters by trawlers and gill nets.

The total landing of mackerels from 2008 to 2016 was amounted to be 402.7 tons, consisted of 1.34% from the total landings. The annual contribution of mackerels from the annual landing varied from 0.64% (20 tons) in 2011 to 3.47% (113 tons) in 2013.

The highest landings of mackerels were 7.7, 11.0, 6.4, 5.7, 26.0, 7.0, 110 and 15.0 tons in October 2008, February 2009, October 2010, January 2011, November 2013, June, November and December 2014, April 2015 and January 2016, respectively (Fig. 10). The general trend of mackerels landings in Iraqi marine waters during 2008–2016 showed gradual increase (b = 0.011) along the investigated period (Fig. 10).

22 Grunts

The grunt fish belong to the family Pomadasyidae and are widely distributed in coastal waters from Arabian Gulf, Red Sea, eastern coast of Africa, eastward coasts of Indian and East Indies, Philippines, Japan and Northern Australia (Fischer and Bianchi 1984; Kuronuma and Abe 1986). The most abundant sea breams in the Iraqi marine waters are *Scolopsis phaeops*, *Plectorhinchus schotaf* and *Pomadasys argenteus* which are locally known as Nagroor. These species are mainly collected from the Iraqi waters by trawlers, gill nets, traps (Gargoor) and handlines.

The total landing of grunts from 2008 to 2016 was amounted to be 538 tons, consisted of 1.8% from the total landings. The annual landing of grunts ranged from 18.9 tons in 2010 to 158.0 tons in 2014, and its contribution from the annual landing ranged from 0.62% in 2010 to 4.24% in 2013.

The highest landings of grunts were 10, 20, 9,17, 25, 21, 10 and 10 tons in April 2008, April 2009, May 2010, May 2011, January and August 2013, May 2014, April and September 2015, and January and April 2016, respectively (Fig. 10). The general trend of grunts landings from Iraqi marine waters during 2008–2016 showed gradual increase (b = 0.050) along the investigated period (Fig. 10).

23 Indian Flathead

The India flatheads fish belong to the family Platycephalidae and are widely distributed in coastal waters from Arabian Gulf, Red Sea, eastern coast of Africa, coast of India, East Indies, Philippines and South China Sea to coasts of Australia (Kuronuma and Abe 1986). The most abundant India flatheads in the Iraqi marine waters are *Platycephalus indicus* and *Gramolites scaber* which are locally known as Wahra. India flatheads are mainly collected from the Open Gulf area within the Iraqi waters by trawlers and to lesser extent by gill nets.

The total landing of India flatheads from 2008 to 2016 was amounted to be 424.4 tons, consisted of 1.4% from the total landings. The annual landing of India flatheads ranged from 13.3 tons in 2010 to 110.0 tons in 2014, and its contribution from the annual landing ranged from 0.44% in 2010 to 2.7% in 2013.

The highest landings of India flatheads were 6, 7, 3, 11, 19, 11, 15 and 11 tons in October 2008, April 2009, April 2010, April 2011, January 2013, July 2014, April

2015 and April 2016, respectively (Fig. 10). The general trend of India flatheads landings in Iraqi marine waters during 2008–2016 showed gradual increase (b = 0.047) along the investigated period (Fig. 10).

24 Trends of Iraqi Artisanal Marine Fisheries (1965–2016)

The contributions of river shad from the total fish landings in Iraqi artisanal marine waters from 1965 to 2016 are illustrated in Fig. 11. It is clear that the river shad was the major contribution to the total landings from 1965 to 1973 constituted 90.2% and then decreased to 52.9% during 1991–1994; to 41.8% and 30.7% during 1995–1999 and 2000–2006, respectively; to 18.1% during 2007–2011; and to 12.2% during 2013–2016. The overall contribution of river shad over the period from 1965 to 2016 was 40.5% from the total landings, which means that the river shad fishery considered the main contribution to the Iraqi artisanal marine fisheries.

Figure 12 illustrates the general trends in the river shad and total landings in the Iraqi marine artisanal fishery for the period from 1965 to 2016; both of them exhibit a similar trend because the river shad was the major target species and is a significant contributor to the artisanal marine fishery of Iraq over the last 50 years. It is clear from the figure that the river shad and total landings have two distinctive peaks of landings for both of them (Fig. 12). The first peaks were in 1971 and then dropped to low levels in the following years, as a result of overfishing for the river shad during 1971–1972 (personal observations). After that, the river shad and total landings expanded rapidly during the mid-late 1990s reaching to the highest figure in the history of Iraqi marine artisanal fishery in 2002. This expansion in fish landings is due to several reasons, including the virtual cessation of fishing activities in Iraqi marine waters due to 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 change of

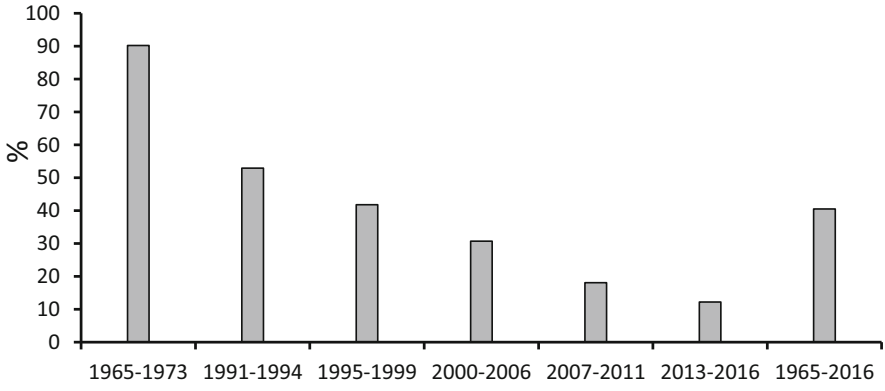

Fig. 11 Contributions of river shad from the total fish landings (1965–2016)

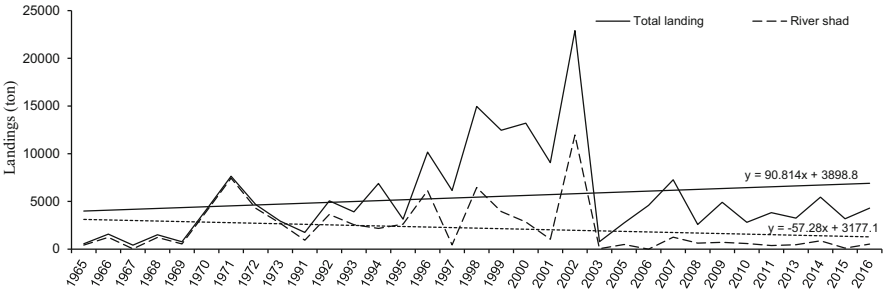

Fig. 12 The general trends of the river shad and total landings in the Iraqi marine artisanal fishery from 1965 to 2016

place of the fish auction site from Khor Abdullah to the new auction site at Al-Fao port on the Shatt Al-Arab estuary, which offers large facilities to fishing boats and marketing agencies (Ali et al. 1998), and the expansion in fishing activity over the period from 1994 to 2001. In this period, the number of fishing boats (steel dhows and small trawlers) reached to 2503 boats in the late 1990s which resulted in tremendous fishing pressure and with the increase in the number of workers in the fishery 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. The Iraqi marine fishing activities declined again as a result of the occupation of Iraq during the second Gulf war in 2003 and subsequent events. After that the landings gradually increased to form a small peak in 2007 and then dropped again with some fluctuations to lower levels during the recent years as compared with the mid-late 1990s.

It may be due to the declined number of vessels to 941 by 2011. However, the general trend of the total landings of artisanal fisheries in Iraqi marine waters from 1965 to 2016 showed gradual increase (slop of trend line, $b = 90.8$) along this period (Fig. 12), while the general trend of river shad landings showed gradual decline ($b = -57.3$). This applies to other important species, such as mullets and shank, while other species have increased their landings during this period.

There appears to be several possible reasons that may have contributed to the decline of the river shad and consequently the level of the total landings in Iraqi artisanal marine fisheries over recent years, such as the large reduction in the discharge rates of the Shatt Al-Arab River, the overfishing of key species in the last two decades and the lack of the regulations to protect and manage the marine resources (Mohamed and Qasim 2014).

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 (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 35 km^3/year (Saad 1978) to 45 km^3/year (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, Alaidani (2014) stated that the average rate of discharge in the upstream of the Shatt Al-Arab River was declined from 207 m^3/s during 1977–1978 to 60 m^3/s during 2014. 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 toward Iranian lands during 2009 (Hameed and Aljorany 2011). This reduction in freshwater inflow in the Shatt Al-Arab River and thus nutrients should affect the biological productivity of the northwest Arabian Gulf (FAO 2011). Consequently, the annual fish migration and breeding, especially the main migratory fish stock (river shad), will be disrupted due to changes in the hydrological regime and marine environment that are associated with the freshwater flow system and will have an impact on fish spawning activity, recruitment, and, hence, stock productivity (Al-Husaini 2003).

The river shad stock (s) 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 stocks 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 (Roomiani and Jamili 2011; Hashimi et al. 2010). Also, the river shad stocks 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 declined from 17.05% in 1995 to 4.39% in 2013 (Al-Husaini et al. 2015). Therefore, the regional co-ordination and co-operation in fishery management are essential between these countries.

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 fishery 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.

25 Management Policy of River Shad Stock

Therefore, the management policy must take into consideration the status of river shad stock in Shatt Al-Arab River and the upper stretches (Mohamed and Qasim 2014). According to Jabir (1995) who carried out a preliminary stock analysis for river shad in Shatt Al-Arab River found heavy exploited for the species during their reproductive migration which was 0.8 and fishing mortality rates were 3.5 for males and 5.5 for females. Also, the stock was exposed to high exploitation rate, as 0.56 in their spawning and nursery grounds in East Hammar Marsh (Mohamed et al. 2016). They stated that illegal fishing methods employed include use of explosives, poisons and small-sized mesh nets. Added to this, small river shad (called Milat) are caught in large amount from north Shatt Al-Arab River and East Hammar Marsh using small-sized mesh nets during nursery period by artisanal fishers. These fish are sold cheaply on the local fish markets in Basrah Province together with large quantity of egg-carrying females (personal observations). Similarly, Nurul Amin et al. (2008) mentioned that 19,000 tons of small river shad (Jatka) were captured in inland rivers in Bangladesh in early 2000s.The harvesting of these valuable resources at a stage when the individuals have reached only a small part of their growth potential seems to be a waste of biological resources and probably will have a negative effect on the species population.

Therefore, we 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. We suggest the following administrative points to keep the species stock at least in Iraqi waters:

- Close 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.
- Small river shad (Milat) (up to 23.0 cm size) catch, transportation, marketing, selling and possessing must be banned in the spawning and nursery areas.
- Pollution from domestic, industrial and agricultural sources continues to be a serious problem, and several water quality parameters were seasonally correlated with fish species catch.
- Regional co-operation in fisheries management is essential for Iraq, as well as for other countries in the region (Iran and Kuwait).

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