Checklist of the fishes of the newly discovered coral reef in Iraq, north-west Arabian Gulf, with 10 new records to the Arabian Gulf

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Abstract
An account of the fishes of a newly discovered coral reef area in Iraq is presented. During ichthyological surveys in the area in 2012 and 2013, a total of 93 species in 48 families were recorded from the region. The most speciose families containing 8 species are Haemulidae and Sparidae. There is one family with 6 species (Carangidae) and there are 31 monospecific families. A total of 33 and 10 new species are recorded from the newly discovered coral reef area for Iraq and the Arabian Gulf area, respectively. In addition, 8 species are confirmed for Iraqi waters, and 6 more are confirmed for the Arabian Gulf. The reef area contains several species with estuarine habits, as well as a number of typical coral reef-associated species. Species with small bodies or cryptic behaviour seem to be missing from the record as a consequence of sampling methodology. Hence, the present list is likely to be extended along with future sampling efforts. Anthropogenic impacts in the form of climate change and pollutants from the Shatt al-Arab River, as well as environmental factors, such as strong tidal currents and high turbidity caused by sediments discharge by Shatt al-Arab River, are considered sources for threats to the newly discovered coral reef area.

Zusammenfassung
Ein Bericht über die Fische eines neu entdeckten Korallenriffs im Irak wird vorgestellt. Während den ichthyologischen Untersuchungen in der Gegend in den Jahren 2012 und 2013 wurden insgesamt 93 Arten in 48 Familien aus der Region registriert. Die artenreichsten Familien mit 8 Spezies sind Haemulidae und Sparidae. Es gibt eine Familie mit 6 Arten (Carangidae) und es gibt 31 monospezifische Familien. Insgesamt wurden 33 Arten und 10 neue Spezies in dem neu entdeckten Korallenriffgebiet für den Irak bzw. den Arabischen Golf registriert. Zusätzlich werden 8 Arten für irakische Gewässer bestätigt, und 6 weitere für den Arabischen Golf bestätigt. Das Riffgebiet enthält mehrere Arten mit Mündungsgewohnheiten sowie eine Reihe von typischen Korallenriff-assoziierten Arten. Arten mit kleinen Körpern oder kryptischem Verhalten scheinen als Ergebnis der Probenahme-Methodik aus den Aufzeichnungen zu fehlen. Daher wird die vorliegende Liste wahrscheinlich mit zukünftigen Probenahmen erweitert. Anthropogene Auswirkungen in Form von Klimawandel und Schadstoffen aus dem Shatt al-Arab River sowie Umweltfaktoren wie starke Gezeitenströmungen und hohe Trübung durch Sedimentabflüsse des Shatt al-Arab-Flusses gelten als Quellen für Bedrohungen des Shatt al-Arab neu entdecktes Korallenriffgebiet.

Sommario
Viene presentato un resoconto dei pesci presenti in una nuova area di barriera corallina in Iraq. Durante le indagini ittiologiche condotte nel 2012 e 2013, sono state registrate nella regione un totale di 93 specie in 48 famiglie. Le famiglie più ricche di specie contenenti 8 specie ciascuna sono Haemulidae e Sparidae. C'è una famiglia con 6 specie (Carangidae) e ci sono 31 famiglie monospecifiche. Un to-

tale di 33 e 10 nuove specie sono state registrate dalla nuova area della barriera corallina scoperta in Iraq e l'area del Golfo Arabico, rispettivamente. Inoltre, sono confermate 8 specie per le acque irachene e altre 6 sono confermate per il Golfo Arabico. L'area della barriera corallina contiene diverse specie che si ritrovano anche in estuari, oltre a un certo numero di specie tipiche associate alla barriera corallina. Le specie di piccole dimensioni o con comportamenti criptici sono assenti da questa checklist come conseguenza della metodologia di campionamento. Pertanto, è probabile che l'elenco attuale venga ampliato da future campagne di campionamento. Impatti antropogenici sotto forma di cambiamenti climatici e inquinanti portati dal fiume Shatt al-Arab, nonché fattori ambientali, come forti correnti di marea e elevata torbidità causata dai sedimenti di scarico da parte del fiume Shatt al-Arab, sono considerati fonti di rischio per la nuova area di barriera corallina scoperta.

INTRODUCTION

The Arabian Gulf is a shallow embayment of the Arabian Sea in the north-west Indian Ocean, to which it is connected through the narrow Strait of Hormuz (Price & Sheppard 1991; Carpenter et al. 1997a). The Gulf has a relatively recent origin about 16 000 BP, with current water levels being reached around 6000 BP (Sheppard et al. 1992). Hence, the fauna is largely established from nearby areas of the Indian Ocean (Grandcourt 2012). However, the limited size and depth (average around 35 m, with the main part of the basin being shallower than 60 m) of the embayment, its limited environmental diversity (bottoms are generally featureless, consisting of sand and mud), and its sometimes-extreme abiotic conditions (temperature: 11.5-36°C; salinity: 37-50‰) makes the number of taxa restricted (Carpenter et al. 1997a; Grandcourt, 2012). However, biodiversity hotspots in the form of coral assemblages and reefs occur at several places (Carpenter et al. 1997a: Grandcourt 2012).

The unique features of the Arabian Gulf in general, and Iraqi coastal waters in particular (see below), makes the area highly interesting from a global biodiversity perspective. Given the lack of information on the biodiversity in the area, species checklists for the area provide an initial foundation for further taxonomic, biogeographic, and conservation research, and are crucial for agencies interested in the biodiversity of the Iraqi marine waters and its conservation. The present study aims to contribute an important addition to the literature of the fish fauna of Iraq and the Arabian Gulf, by providing a justified checklist of species from the area associated with a newly discovered coral reef in Iraqi waters (Pohl et al. 2014). The list is of particular importance since the records stem from an area where climate change and anthropogenic effects pose a hazard for its biodiversity, including coral bleaching and subsequent reef mortality (Maghsoudlou et al. 2008, Sheppard et al. 1992, Sheppard et al. 2010). The Gulf water turnover and flushing times have been estimated to be around 3-5 years, which makes the embayment vulnerable to human and natural alterations (Price & Sheppard 1991). The checklist includes notes on new records of specific fish species for the Arabian Gulf and Iraqi territorial waters, as well as suggestions for conservation measures to be taken for the area where the newly discovered reef resides. As a checklist of reef-associated fish species in Iraq, it is the first of its kind and provide a foundation to be built upon. In particular, the Indo-Pacific area, including the particular area of the Arabian Gulf, have been revealed to include a lot of previously unrecognized cryptic diversity among fishes, which likely means that there are still many undescribed species in the area (e.g. Zemlak et al. 2009; Asgharian et al. 2011; Puckridge et al. 2013). Recognized cryptic diversity, which can have potential influence on the species determination, has been specifically noted to facilitate future interpretation of the present list. Continued inventory and collection is of profound importance, as the Gulf waters face both anthropogenic impact and environmental change due to its geographical position (Maghsoudlou et al. 2008).

A brief history of the marine ichthyology of Iraq

The study of the fish fauna in the Mesopotamian region has ancient roots, dating back to the earliest civilizations of Sumer, Babylon, and Assyria, when several species where recorded and named (Saggs 1962; Landsberger 1962; Jawad 2012). More detailed taxonomic work was initiated by Heckel, who described some of the freshwater fish fauna of Iraq (Heckel 1843). Investigations of the Iraqi marine fish fauna were initiated by Günther, half a century later (Günther 1896; Jawad 2012). These early publications have been followed by a large number of ichthyological literature on taxonomy and distributions of both freshwater and marine species. Several checklists and guides to the marine fishes of Iraq and the surrounding areas has been previously published (for a detailed description and list of papers see Jawad 2012). However, several of

these works, particularly from 1960's and 1970's, contained many synonyms, rejected taxa, and uncertainties, making them unreliable as proper sources (see Jawad, 2012). In the following decades, the taxonomic reliability of publications is better (Jawad, 2012). However, out of the marine checklists published from the 1980's (Al-Daham 1982; Hussain, Naiama & Al-Hassan 1988; Al-Hassan & Hussain 1985), one (Al-Daham 1982) described the Iraqi marine fish fauna as being similar to that of the Arabian Gulf in general, which was a partly flawed addition of information since the Iraqi waters are more influenced by freshwater discharge than other parts of the Arabian Gulf (Carpenter et al. 1997a). Several publications in the 1980's and 1990's recognized the presence of euryhaline and diadromous species, residing in both the freshwater and marine environments in the area (Al-Hassan & Naama 1986; Al-Hassan & Al-Badri 1986; Al-Hassan & Muhsin 1986; Mohammed et al. 1993). Furthermore, the introduction of non-native and potentially invasive species by ship ballast water was also recognized at this time (Al-Hassan & Al-Badri 1986; Al-Hassan & Miller 1987). In the 1990's to 2010's there was an increase in ichthyological publications from the Arabian Gulf area, including checklists (Bishop 2003; Grandcourt 2012; Younis et al. 2016), as well as more detailed species accounts, like the first description of a novel skate species for the area (Fricke & Al-Hassan 1995), and many first records for the region (e.g. Al-Mukhtar et al. 2011; Jawad, Al-Mamry & Al-Mamary 2011; Jawad, Al-Shogeabi & Al-Mamry, 2011; Ali 2013a,b; Ali et al. 2014, Jawad 2015; Jawad & Al-Badri 2015); all of which are important for the production of a complete picture of the fish biodiversity in the area, and its need for conservation efforts (see e.g. Moore & Jawad 2008). In conclusion, the Iraqi marine fish fauna is still not complete in the published record, and substantial amounts of new information are continuously presented at the present date.

For a detailed history of the ichthyology of Iraq, refer to Jawad (2012).

The marine region of Iraq

Iraq is situated at the north-west end of the Arabian Gulf, with a coastline measuring 58 km which borders to Kuwait and Iran. The territorial waters of Iraq are important for the country's people and industry, providing food through fisheries and a major transport route for import and export of goods (Al-Hassan & Hussain 1985; Price & Sheppard 1991). The coastline is substantially influenced by the tide and is low, sandy, and irregular in shape, with many shoals and salt flats (Sabkhat).

The Iraqi marine environment is recipient of large amounts of freshwater and sediments from the Karun-, Euphrates- and Tigris Rivers which drains the Mesopotamian Valley. The three rivers merge in the Iraqi Marshes and form the Shatt al-Arab River, which transports the water through a delta, consisting of natural and man-made canals, into the Arabian Gulf. The freshwater influence extends up to 5 km off the delta. There is today substantial radiometric evidence suggesting a historically changing environment, including fluctuating sea levels and a coast-line moving forth and back through the river delta and the marshes (Aqrawi 2001).

Along with the freshwater discharge follows large amounts of nutrients, particles, pollutants, and toxic compounds from the entire drainage area. While some of it is trapped in the lakes and marshlands in the lower Mesopotamian plain, which acts as a natural filter, much also enters the marine environment (Wilson 1925; Al-Yamani 2008). Local coastal fisheries in the area depend on the flow of nutrients from the rivers, which causes particularly high primary production (Abaychi, Darmoian & Doabul 1988; Al-Saad, Shamshoom & Abaychi 1998). The delta area is also the spawning and nursery grounds for the commercially important penaeid shrimp *Metapenaeus affinis,* and a number of diadromous fish species (e.g. *Tenualosa ilisha* and *Nematalosa nasus*) (Al-Hassan et al. 1989).

The regional climate is subtropical, semi-arid, and seasonally variable, with high temperature-extremes in summer (commonly > 38°C) and lower temperatures in winter (averaging between 7 and 13°C) (Al-Yamani 2008). Sea water temperatures range from 14-34°C (Pohl et al. 2014). Evaporation and low precipitation causes high salinity in the coastal waters (Chapagain & Hoekstra, 2004), despite the substantial freshwater influence from the rivers. The weather is largely affected by the inland mountain chain along the northern borders of Iraq and Syria, the high-plains of Saudi Arabia, and the Mesopotamian Valley, which funnels strong north-western winds (Shamal) year-round towards the Gulf, carrying dust, sand, and debris (Williams 1979); some of which gets deposited in the marine environment and helps shaping the features of the coastal and the marine environment (Carpenter et al. 1997a).

River basin modifications, as well as climate change, may have considerable impacts on the marine environment in the estuarine area through changes in water discharge from rivers (Al-Yamani 2008; Bozkurt & Sen 2013). In recent history, the marine area has also been contaminated by large oil spills, but also natural oil seepage, which have had considerable negative impacts on the marine wildlife, in particular on surface dwelling animals (Price & Sheppard 1991; Gupta et al. 1993; Carpenter et al. 1997a).

Given the ecological, oceanographical, climatic, and socio-economic complexity of the Arabian Gulf, it is important to direct attention to the biodiversity that resides there (Price & Sheppard 1991).

For detailed information on the geology, climate, and oceanography of the Arabian Gulf, refer to the introduction of Carpenter *et al.* (1997a), and references therein. For a recent reference describing the general Gulf reef ichthyofauna and its exploitation, see Grandcourt (2012).

Coral reefs of the Arabian Gulf in general, and Iraq in particular

The coral reefs of the Arabian Gulf are generally of limited occurrence, which is likely due to the relatively young age of the embayment, but also due to the extreme temperatures, large temperature fluctuations, low tides, and heavy sedimentation and turbidity causing recurring mass mortalities in the coral communities (Coles & Fadlallah 1991; Sheppard & Sheppard 1991; Sheppard 1993; Riegl 1998; Maghsoudlou et al. 2008; Purkis & Riegl 2012). Large reefs are rare and many coral occurrences can more appropriately be described as coral assemblages (Burt et al. 2014). The only coral assemblages considered true reefs are found nearshore along the coasts of the northern offshore islands of Saudi Arabia and Iran, where they form fringing reefs (Coles & Tarr 1990; Sheppard, Price & Roberts 1992). In the Southern Arabian Gulf (United Arab Emirates, Bahrain, and Qatar), the coral assemblages in the form of coral carpets and biostromes dominate (Riegl 1999; Purkis & Riegl 2012).

Today, there are coral assemblages documented from the territorial waters of all nations surrounding the Arabian Gulf. The most recent major discovery was that of the first living reef in Iraqi territorial waters (Pohl et al. 2014). This coral reef is large and situated in one of the most extreme environments for coral reefs, considering salinity, sediment-load, turbidity, strong tidal currents (3-4.5 m · s-1), and the substantial variation in water temperature (14-34°C) (Sheppard et al. 1992; Carpenter et al. 1997a; Hovius 1998; Pohl et al. 2014). The ichthyofauna of this reef is the subject of the present study. For details on the study area, see Materials and Methods, and Pohl et al. (2014). For more information on the coral reefs of the Arabian Gulf and their status, refer to Carpenter et al. (1997a,b), Maghsoudlou et al. (2008), and Sheppard et al. (2010).

MATERIALS AND METHODS

Study area

The description of the newly discovered coral reef area is based on the original report announcing the existence of this important marine habitat (Pohl et al. 2014). It is located at coordinates 29°37'00"N, 48°48'00"E (Fig. 1) and covers an area of 28 km^2. It is located near the mouth of the Shatt al-Arab in a zone of low water transparency due to high nutrient and sediment loading, and highly variable conditions (temperature and salinity) caused by strong tidal currents (3-4.5 m/s). These currents are triggered by tides with a significant freshwater sediment-loaded discharge by the Shatt al-Arab during tidal ebb (Hovius 1998). The coral reef area contains a 6 by 3 km wide zone of relatively healthy reefs at water depths between 7 and 20 m (Pohl et al. 2014).

Specimens

The specimen materials used in this study originated from three sources: (1) fish specimens collected by scientists from Marine Science Centre, University of Basrah (MSC), Iraq, during two surveys in July 2012 and one survey in November 2013; (2) underwater photographs taken by the experienced scientific diving team from the Scientific Diving Centre of the Technische Universtät Bergakademie, Freiberg, Germany contracted by the Marine Science Centre (MSC), University of Basrah, Iraq; (3) fish specimens obtained from the newly discovered coral reef area of Iraq by a small commercial trawler which were made available to L. A. Jawad for taxonomic examination. The fish specimens collected by the MSC scientific staff and the underwater photographs were deposited in the fish collection and data base of MSC, University of

Basrah, Iraq. The specimens obtained by the trawler were deposited in the fish collection of the Marine and Fisheries Centre (MFC), Ministry of Agriculture and Fisheries, Muscat, Oman. In current days, both of these institutions have emerged as important depositories for fish specimens in the region, and hold a significant number of specimens from the northern Arabian Sea (MFC), Sea of Oman (MFC), and the Arabian Gulf (MFC, MSC).

Checklist organisation

In the checklist, order, family, genus, and species are listed for each species. The family classification and arrangement follows Nelson (2006), updated according to Eschmeyer, Fricke & van der Laan (2017). The genus and species classification also follows Eschmeyer, Fricke & van der Laan (2017). Species which appear to be part of cryptic species complexes, or where taxonomic status has been indicated to be uncertain have been amended with "s.l." *(sensu lato),* meaning that taxonomic designation is made in the broad sense based on presently available information. Information on the source of the fish species such as number of specimen, underwater photograph, date of collection, and locality are given.

The checklist also includes information on the known general distribution of the species, with particular notes on the distribution in the Arabian Gulf and Iraqi waters. The main reference for distribution is AquaMaps (Kesner-Reyes 2016), which is embedded in the FishBase database (Froese & Pauly 2016), and based on evaluated records registered in the Global Biodiversity Information Facility ("GBIF"; GBIF 2016). Information in these databases is not necessarily peer reviewed and vary in quality; however, omitting these records would disregard its presence. Since species accounts often remain unpublished in scientific journals today, inclusion of database information is judged to be required. Citations of GBIF (i.e. "GBIF 2016") refers to the overall collection of records available in November 2016 in this database.

Information on the habitat, the presence in

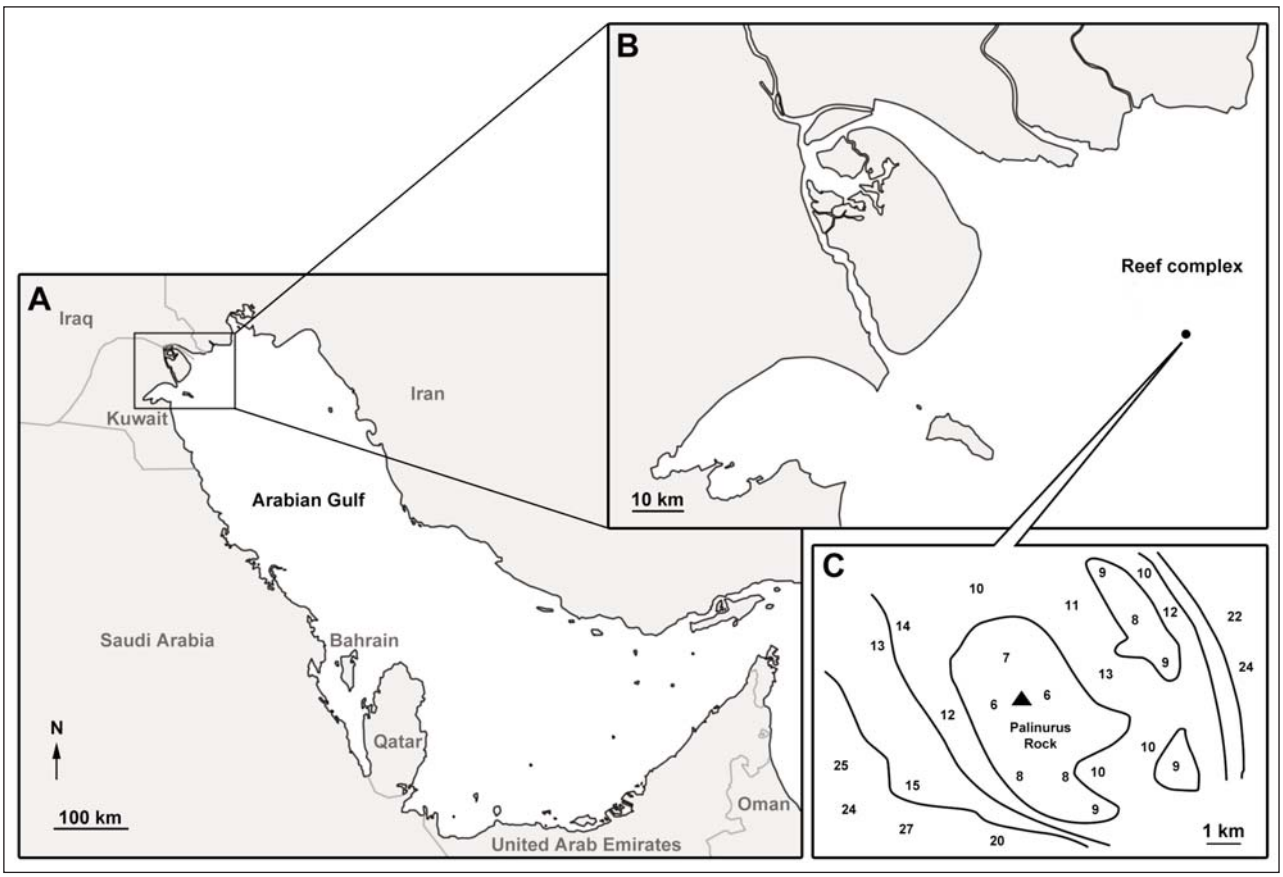

Fig. 1. Map showing the area of the newly discovered coral reef in Iraq.

Table I. List of fish species from the newly discovered coral reef area in Iraq, with new and confirmed records marked (**AG** = Arabian Gulf). Key for the IUCN Red List classification (IUCN 2018): **LC** – least concern, **NT** – near threatened, **VU** – vulnerable, **EN** – endangered, **CR** – critically endangered, **EX** – extinct, and **DD** – data deficient; when regional assessment for the Arabian Gulf exists, this is presented within parentheses.

		New records		Confirmed records	
Species	**IUCN Red List**	**AG**	**Iraq**	**AG**	**Iraq**
Rhizoprionodon oligolinx	LC				
Brevitrygon walga s.l.	NT				
Aetobatus flagellum	EN	X			
Gymnura poecilura s.l.	NT				
Gymnothorax favagineus	Not evaluated	X	X		
Gymnothorax pseudothyrsoideus	Not evaluated	X	X		
Netuma bilineata	Not evaluated				
Nematalosa nasus	LC (LC)				
Tenualosa toli	Not evaluated	X	X		
Chirocentrus dorab	LC (LC)				
Saurida tumbil	LC (LC)				
Saurida undosquamis	LC (DD)				X
Colletteichthys dussumieri	Not evaluated				
Antennarius indicus	Not evaluated				
Fistularia commersonii	LC				X
Hippocampus kuda s.l.	VU (DD)				
Monocentris japonica	Not evaluated				
Zeus faber s.l.	DD	X	X		
Platycephalus indicus s.l.	DD (LC)				
Dinoperca petersi	Not evaluated	X	X		
Epinephelus areolatus	LC (NT)				
Epinephelus bleekeri	NT (NT)				
Epinephelus coioides	NT (VU)				
Pseudochromis persicus	Not evaluated		X		
Opistognathus muscatensis	Not evaluated				
Terapon puta	Not evaluated				
Apogonichthyoides taeniatus	Not evaluated		X		
Sillago sihama s.l.	LC (LC)				
Carangoides chrysophrys	LC (LC)				
Carangoides equula	LC		X		
Carangoides gymnostethus	LC (DD)				X
Carangoides malabaricus	LC (LC)				X
Scomberoides commersonnianus	LC (LC)				
Trachinotus baillonii	LC (LC)				
Leiognathus equulus	LC (DD)		X		
Lutjanus fulviflamma	LC (LC)				
Lutjanus rivulatus	LC		X		
Lutjanus russellii	LC				
Pristipomoides multidens	LC				X
Gerres longirostris s.l.	LC (LC)				
Diagramma pictum	Not evaluated				
Plectorhinchus flavomaculatus	Not evaluated				X
Plectorhinchus gibbosus	LC		X	X	
Plectorhinchus pictus	Not evaluated		X		

		New records		Confirmed records	
Species	**IUCN Red List**	**AG**	**Iraq**	**AG**	**Iraq**
Plectorhinchus sordidus	Not evaluated				
Pomadasys commersonnii	Not evaluated		X	X	
Pomadasys olivaceus	Not evaluated				
Pomadasys stridens	Not evaluated		X		
Acanthopagrus bifasciatus	LC (LC)				
Acanthopagrus catenula	DD				
Argyrops spinifer s.l.	LC (LC)				
Crenidens indicus	LC (LC)				
Diplodus capensis	LC		X	X	
Diplodus noct	LC		X		
Rhabdosargus haffara	LC (NT)				
Rhabdosargus sarba s.l.	LC (NT)				
Gymnocranius griseus	LC	X	X		
Lethrinus borbonicus	Not evaluated				
Lethrinus lentjan	LC (LC)				
Lethrinus nebulosus s.l.	LC (LC)				
Nemipterus bipunctatus	Not evaluated				
Nemipterus randalli	Not evaluated		X		
Parascolopsis eriomma s.l.	Not evaluated				
Scolopsis taeniata	Not evaluated				
Mulloidichthys vanicolensis	LC		X	X	
Upeneus oligospilus	LC				X
Pomacanthus asfur	LC		X	X	
Pomacanthus maculosus	LC (LC)				
Pomacanthus semicirculatus	LC	X	X		
Ellochelon vaigiensis	LC				X
Moolgarda cunnesius s.l.	Not evaluated				
Dascyllus trimaculatus	Not evaluated		X		
Chromis flavaxilla	Not evaluated		X		
Neopomacentrus sindensis	Not evaluated		X		
Histiopterus typus	Not evaluated		X	X	
Bodianus macrognathos	LC				
Coris nigrotaenia	DD				
Halichoeres leptotaenia	LC		X		
Parapercis robinsoni	Not evaluated		X		
Platax teira	Not evaluated				
Siganus canaliculatus	LC (LC)				
Acanthurus mata	LC	X	X		
Zebrasoma xanthurum	LC (VU)				
Sphyraena putnamae	Not evaluated				
Triacanthus biaculeatus	Not evaluated				
Odonus niger	Not evaluated	X	X		
Aluterus monoceros	LC (DD)				
Arothron stellatus	LC (LC)				
Lagocephalus lunaris	LC (LC)				
Takifugu oblongus	LC		X		
Bothus pantherinus	LC (LC)				
Pardachirus balius	Not evaluated	X	X		
Zebrias quagga s.l.	Not evaluated		X		

brackish and freshwaters, and the depth were also included for each species, based on published records and information present in GBIF (2016).

Red List status is noted in Table I when available (as of August 16, 2018), following the international listing in the International Union for the Conservation of Nature (IUNC 2018).

RESULTS

Biodiversity and zoogeography

The coral reef fish fauna of Iraq comprises a total of 93 species in 48 families. Among these, there are 4 cartilaginous species (1 shark and 3 rays) belonging to 4 families. The 89 teleost species belonged to 44 families (Table I). The families with highest species representation in the surveys were Haemulidae and Sparidae (8 species each), followed by Carangidae (7 species). There were three families with 4 species each: Lutjanidae, Lethrinidae, and Nemipteridae; five families containing 3 species each: Serranidae, Pomacanthidae, Pomacentridae, Labridae, and Tetraodontidae; and six families with 2 species each: Acanthuridae, Clupeidae, Mugilidae, Mullidae, Syngnathidae and Synodontidae. Thirty one families were monospecific in the surveys. There were 17 euryhaline species (18.3 %) that enter brackish and freshwater habitats at sometime during their life. Other species were typical marine species, from habitats common for the Arabian Gulf.

The checklist contains 10 species recorded from the first time to the Arabian Gulf. Thirty-three species were recorded for the first time in the Iraqi marine waters. There were 6 species for which presence is confirmed for the Arabian Gulf and 8 were confirmed for the marine waters of Iraq, respectively. New records and confirmations are summarized in Table I.

Annotated checklist

Class Elasmobranchii Bonaparte 1838
Order Carcharhiniformes Compagno 1977
Family Carcharhinidae Jordan & Evermann. 1896
Rhizoprionodon Whitley 1929
Rhizoprionodon oligolinx Springer 1964 – Grey sharpnose shark

Justification: Five specimens were collected in 2012 from the surveyed coral reef area. (Fig. 2A).

Distribution and habitat: Indo-West Pacific; Arabian Sea to Southeast Asia – Northern Australia (Gallo et al. 2010; Kesner-Reyes et al. 2016); with single records from the Red Sea and Japan (Kesner-Reyes et al. 2016). Commonly reported in the Arabian Gulf (e.g. Compagno 1984; Moore et al. 2012; Jabado et al. 2015), including Iraq (Ali 2013; Ziyadi et al. 2018). A tropical neritic-pelagic marine species; depth: 0-36 m (Weigmann 2016), possibly down to 96 m (GBIF 2016), or even 145 m (Manilo & Bogorodsky 2003).

Remarks: Molecular population analyses of elasmobranch species tend to detect distinct populations in the Arabian Sea and the adjoining embayments (Henderson et al. 2016; Naylor et al. 2012). Hence, closer molecular investigations of this species may be warranted; however, only loose clustering has been found for populations in the Eastern Arabian Sea, respective the South China/Java Sea (Naylor et al. 2012).

Order Myliobatiformes Compagno 1973
Family Dasyatidae Jordan 1888
Brevitrygon Last, Naylor & Manjaji-Matsumoto 2016
Brevitrygon walga s.l. (Müller & Henle 1841) – Dwarf whipray

Justification: Underwater photo of two specimens taken on July 21, 2013, in the reef area (one specimen shown in Fig. 2B).

Distribution and habitat: Indian Ocean (Arabian Sea); Red Sea to eastern India (Last et al. 2016b). Repeatedly reported in the Arabian Gulf (particularly from Iranian waters; e.g. Vossoughi & Vosoughi 1999; Sahafi 2000; Seraj et al. 2011; Hosseini et al. 2012; Paighambari & Daliri 2012), including Iraq (Mazhar 1966; Younis et al. 2016). A small-bodied, tropical intertidal species (Last et al. 2016b).

Remarks: In the Arabian Gulf, *B. walga* has commonly been confused with *B. imbricata* (Moore 2012; Last et al. 2016b). More than one form exists of what is currently recognized as *B. walga* and taxonomic confusion across the range of *Brevitrygon* remains (Last et al. 2016b; Simpfendorfer et al. 2017). According to Last et al. (2016b), *B. imbricata* is distributed in the Indian Ocean to the east of India, while *B. walga* is present in the area investigated. Previous records of *B. imbricata* in the Arabian Gulf may therefore be *B. walga* (Hussain et al. 1988; Hussain & Nama 1989; Mohamed et al. 2001; Ziyadi et al. 2018). Recently assigned to the

genus *Brevitrygon* (previously *Himantura)* (Last et al. 2016a).

Family Myliobatidae Bonaparte 1838
Aetobatus Blainville 1816
Aetobatus flagellum (Bloch & Schneider 1801) – Longhead eagle ray

Justification: New record for Iraq based on an underwater photo taken in the coral reef area on November 2013 (Fig. 2C).

Distribution and habitat: Indo-West Pacific; Arabian Gulf to Borneo (Last et al. 2016b). Reported from two areas in the Arabian Gulf; from Iranian waters in the northern Straits of Hormuz (Vossoughi & Vosoughi 1999), and from Kuwaiti wa-

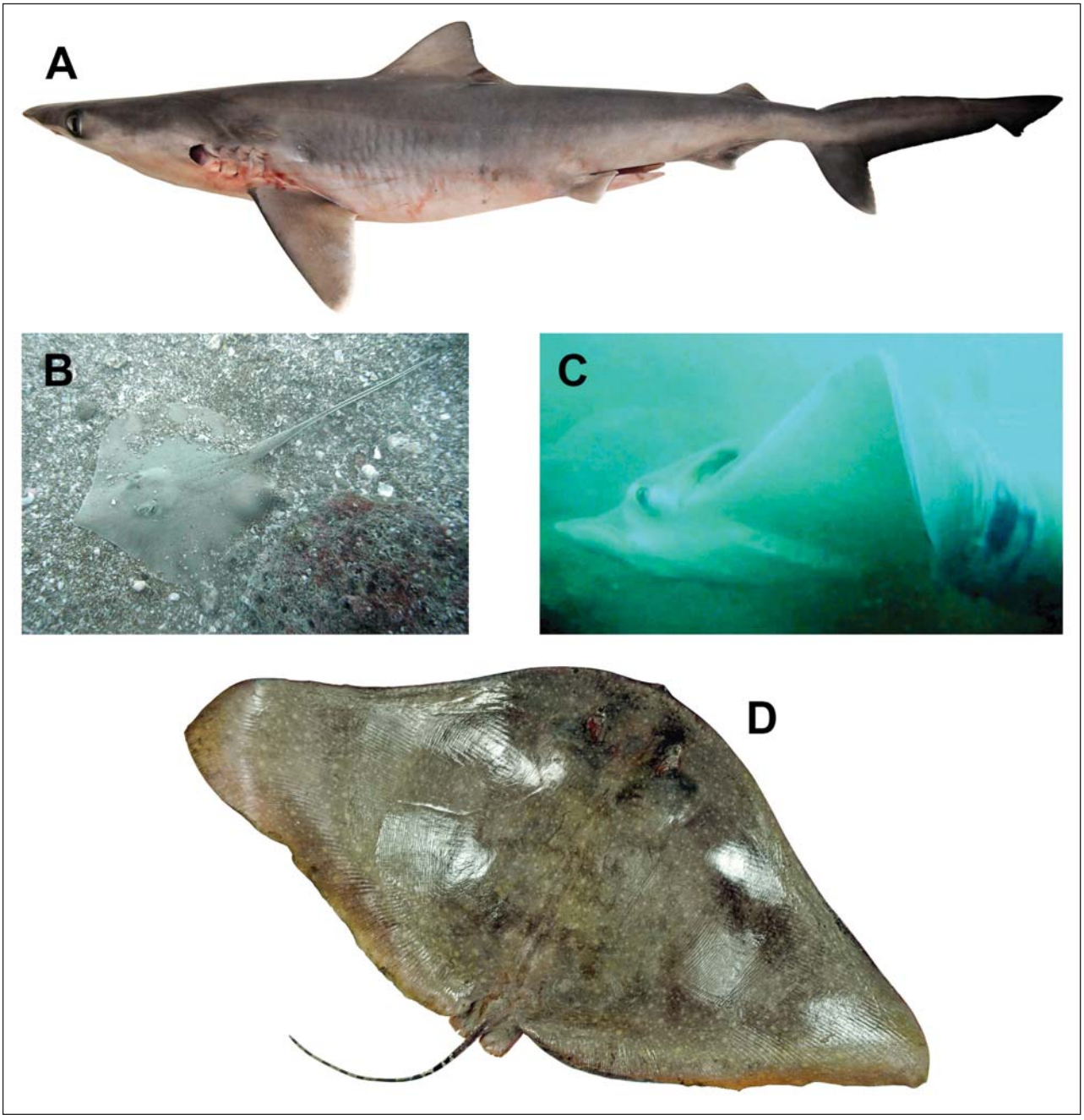

Fig. 2A-D. A, *Rhizoprionodon oligolinx*, Photo by L. A. Jawad; **B**, *Brevitrygon walga*, Photo by T. Pohl; **C**, *Aetobatus flagellum*, Photo by T. Pohl; **D**, *Gymnura poecilura,* Photo by L. A. Jawad.

ters (several specimens: e.g. Moore et al. 2012; White & Moore 2013; Bishop et al. 2016; GBIF 2016). Tropical and subtropical, mainly estuarine, in benthopelagic neritic habitats (Riede 2004; White et al. 2013).

Remarks: Species redescribed and separated from Pacific populations in White & Moore (2013).

Family Gymnuridae Fowler, 1934
Gymnura van Hasselt, 1823

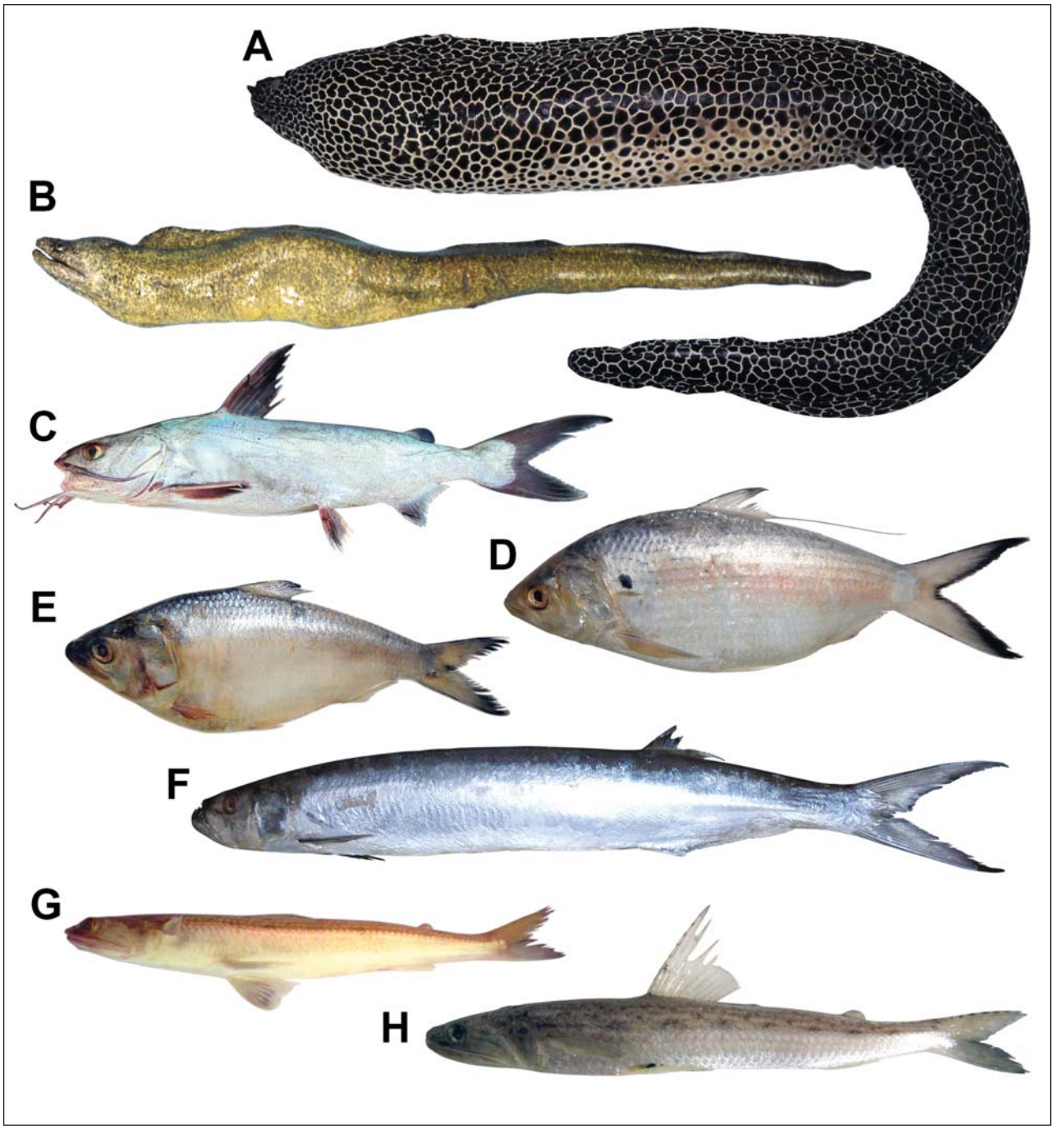

Fig. 3A-H. A, *Gymnothorax favagineus*, Photo by L. A. Jawad; **B**, *Gymnothorax pseudothyrsoideus*, Pho by L. A. Jawad; **C**, *Netuma bilineata*, Photo by L. A. Jawad; **D**, *Nematalosa nasus*, Photo by L. A. Jawad; **E**, *Tenualosa toli*, Photo by L. A. Jawad; **F**, *Chirocentrus dorab*, Photo by L. A. Jawad; **G**, *Saurida tumbil*, Photo by M. Al-Mukhtar; **H**, *Saurida undosquamis*, Photo by Mustafa Al-Mukhtar.

Gymnura poecilura s.l. (Shaw 1804) – Long-tailed butterfly ray

Justification: Four specimens were collected in 2012 from the reef area (Figure 2D)

Distribution and habitat: Indo-West Pacific; Red Sea to Shanghai – Indonesia (Last et al. 2016b). Reported from several locations in the Arabian Gulf, including Iraq (e.g. Carpenter et al. 1997a,b; Vossoughi & Vosoughi 1999; Ziyadi et al. 2018). A tropical neritic demersal-pelagic species, commonly found inshore on sandy and muddy substrates down to at least 30 m (Last et al. 2016b), recorded down to 320 m in GBIF (2016).

Remarks: Species designation may be subject to change due to apparent cryptic diversity. Molecular analyses suggest two sub-clusters within the previously recognized species: *G.* cf. *poecilura* 1 (Indonesian-Malaysian specimens), and *G.* cf. *poecilura* 2 (Iranian specimens) (Naylor et al. 2012). It is possible that even more division is warranted within this species cluster (Henderson et al. 2016: Mukhta et al. 2016). The name *G. hormosensis* is suggested for specimens obtained from the Arabian Gulf and Sea of Oman (Almojil et al. 2015), but is assigned without a nominated type specimen.

Class Actinopterygii Klein 1885
Order Anguilliformes Berg 1943
Family Muraenidae Rafinesque 1810
Gymnothorax Bloch 1795
Gymnothorax favagineus Bloch & Schneider 1801 – Laced moray

Justification: New record for Iraq and the Arabian Gulf based on two specimens collected in 2012 (Fig. 3A).

Distribution and habitat: Indo-West Pacific; Red Sea and East Africa to Taiwan and north-eastern Australia (Lieske & Myers 1994; Randall & Golani 1995; GBIF 2016). Previously reported from the Gulf of Oman and the Arabian Sea coasts of Oman (Randall 1995a; GBIF 2016). No previous reports of this species from the Arabian Gulf were found. A tropical marine or brackish-water species; reef-associated down to 50 m (Allen & Erdmann 2012).

Gymnothorax pseudothyrsoideus (Bleeker 1853) – Highfin moray

Justification: New record for Iraq and the Arabian Gulf based on three specimens collected in 2012 (Fig. 3B).

Distribution and habitat: Indo-Pacific; southern Oman – Seychelles to Japan – eastern Australia (Kesner-Reyes et al. 2016). Marine and reef-associated down to 46 m (Fricke et al. 2011; GBIF 2016).

Order Siluriformes Cuvier 1817
Family Ariidae Berg 1958
Netuma Bleeker 1858
Netuma bilineata (Valenciennes, 1840) – Bronze catfish

Justification: Three specimens were collected in 2012 from the reef area (Figure 3C).

Distribution and habitat: Indo-West Pacific; Arabian Gulf to AJpan – north-eastern Australia (Randall 1995a, Kesner-Reyes et al. 2016). Reported as abundant in Iraqi waters in Ziyadi et al. (2018). Demersal, mainly in tropical marine, but also fresh- and brackish, waters between 0.5-75 m (Froese & Pauly 2016; GBIF 2016).

Remarks: Previously regarded as junior synonym to *N. thalassina*, but Kailola (1986) reassigned it as a valid species. Differs from *N. thalassina* in having a narrow occipital process with gently concave sides (vs. broad occipital process with convex sides *in N. thalassina)* and rounded, blunt snout (vs. prominent and broadly pointed snout in *N. thalassina*) (Ng 2012).

Order Clupeiformes Bleeker 1859
Family Clupeidae Cuvier 1817
Nematalosa Regan 1917
Nematalosa nasus (Bloch 1759) – Bloch's gizzard shad

Justification: Ten specimens were collected in 2012 from the reef area (Figure 3D)

Distribution and habitat: Indo-West Pacific; Gulf of Aden to Korea – Philippines (Kesner-Reyes et al. 2016). Common in the Arabian Gulf (Ali & Hussain 1990; Abou-Seedo 1992; Whitehead 1956; Carpenter et al., 1997a; GBIF, 2016), with reports from Iraq (Al-Hassan 1987; Hussain et al. 1988; Ali & Hussain 1990; Ziyadi et al. 2018). Anadromous tropical species, living in estuarine pelagic-neritic habitats down to 30 m (Shao & Lim 1991; Riede 2004; Munroe & Priede 2010).

Remarks: Older keys may not distinguish this species from *N. resticularia* or *N. persara* (Al-Has-

san 1987; Nelson & McCarthy 1995). Common in the Arabian Gulf (Al-Khalaf et al. 2015).

Tenualosa Fowler 1934
Tenualosa toli (Valenciennes 1847) – Toli shad

Justification: New record for Iraq and the Arabian Gulf based on ten specimens collected in 2012 (Fig. 3E).
Distribution and habitat: Indo-West Pacific; India to the Java- and South China Sea, with additional records from eastern Australia (GBIF 2016). Whitehead (1985) suggested that the distribution of this species did not reach the Oman Sea or the Arabian Gulf; the first well documented record from the former area was reported in 2011 (Jawad et al. 2011a), although it was reported (Fouda 1995) and listed as a part of the Omani fish checklist (Al-Jufaili et al. 2010) prior to this date. A tropical euryhaline species; largely estuarine and pelagic-neritic (Blaber et al. 1996; Riede 2004).

Family Chirocentridae Cuvier & Valenciennes 1846
Chirocentrus Cuvier 1816
Chirocentrus dorab (Forsskål 1775) – Dorab wolf-herring

Justification: Ten specimens were collected in 2012 from the reef area (Figure 3F).
Distribution and habitat: Indo-Pacific; Red Sea – East Africa to Japan – Solomon Islands – Australia (Kesner-Reyes et al. 2016). Reported from several countries around the Arabian Gulf (Whitehead, 1985; Carpenter, et al. 1997a; Grandcourt 2012), including Iraq (Hussain et al. 1988; Khamees et al. 2015; Ziyadi et al. 2018); a common and commercially valuable species in the area (Jawad 2006). A tropical amphidromous species; often inshore and reef-associated, down to 120 m (Riede 2004; Sommer et al. 1996).
Remarks: Distinguished from *C. nudus* in having the major portion of the dorsal fin dark dorsally (Luther 1966).

Order Aulopiformes Rosen 1973
Family Synodontidae Gill 1862
Saurida Valenciennes 1850
Saurida tumbil (Bloch, 1795) – Greater lizardfish

Justification: Ten specimens were collected in 2012 from the reef area (Fig. 3G).
Distribution and habitat: Indo-Pacific; Red Sea – Mozambique to the eastern coasts of tropical and subtropical Asia and Australia (Kesner-Reyes et al. 2016). Reported from several Arabian Gulf localities, including Iraq (e.g. Cressey & Waples 1984; GBIF 2016); a common and commercially valuable species in the area (Valinassab et al. 2006). Tropical marine and amphidromous (Reide 2004), commonly on soft bottoms between 20-60 m depth (Sommer et al. 1996; FAO-FIGIS 2005), but also found reef-associated down to 700 m (Goldschmidt et al. 1996).

Saurida undosquamis (Richardson 1848) – Brushtooth lizardfish

Justification: Confirmed record for Iraqi waters based on three specimens collected in November 2012 from the reef area (Fig. 3H).
Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to the western coasts of the Pacific Ocean (Kesner-Reyes et al. 2016). Widespread in the Arabian Gulf (Carpenter et al. 1997a; Bishop, 2003; Kaymaram et al. 2015; GBIF 2016). Iraqi waters were included in the distribution given by Fischer & Bianchi (1984). Not recorded in recent surveys in Iraq or Kuwait (Kaymaram et al. 2015). Subtropical and amphidromous (but primarily marine); found on coastal muddy and sandy bottoms between 1-350 m (commonly below 20 m); sometimes found reef-associated (Russell 1999; Riede 2004; Kaymaram et al. 2015).
Remarks: All records from the western Indian Ocean, and adjacent embayments, have been considered of low reliability, partly due to lacking descriptions of the specimens reported (Inoue & Nakabo 2006; Kesner-Reyes et al. 2016). A photograph from Oman (Randall 1995a) has been considered a correct identification, but the description of the species included characters overlapping those of related species (Inoue & Nakabo 2006).

Order Batrachoidiformes Nelson 1994
Family Batrachoididae Collette & MacPhee 2002
Colletteichthys (Valenciennes 1837)
Colletteichthys dussumieri (Valenciennes 1837) – Flat toadfish

Justification: One specimens were collected in 2012 from the reef area (Fig. 4A).
Distribution and habitat: North-west Indian

ocean; listed (as *Austrobatrachus dussumieri)* as native to the western Arabian Gulf in Carpenter et al. (1997a) and Bishop (2003); Randall (1995a) notes its presence in the Gulf waters of Oman. Furthermore, the species is recorded from Iranian waters close to the Straits of Hormuz (Sahafi 2000; Zare et al. 2013). Marine demersal species, preferring muddy bottoms (Carpenter et al. 1997a).

Remarks: Greenfield (2012) specifies the distribution of *C. dussumieri* to be restricted between the western coast of India to the Malabar area. Records from the Arabian Gulf are considered reliable in AquaMaps (Kesner-Reyes et al. 2016), but Greenfield (2012) re-described collected specimens from this area as *C. occidentalis* based on consistently different counts of tentacles above the eye (1 tentacle; which is consistent with the drawn picture in Carpenter et al. 1997a), as compared with Indian

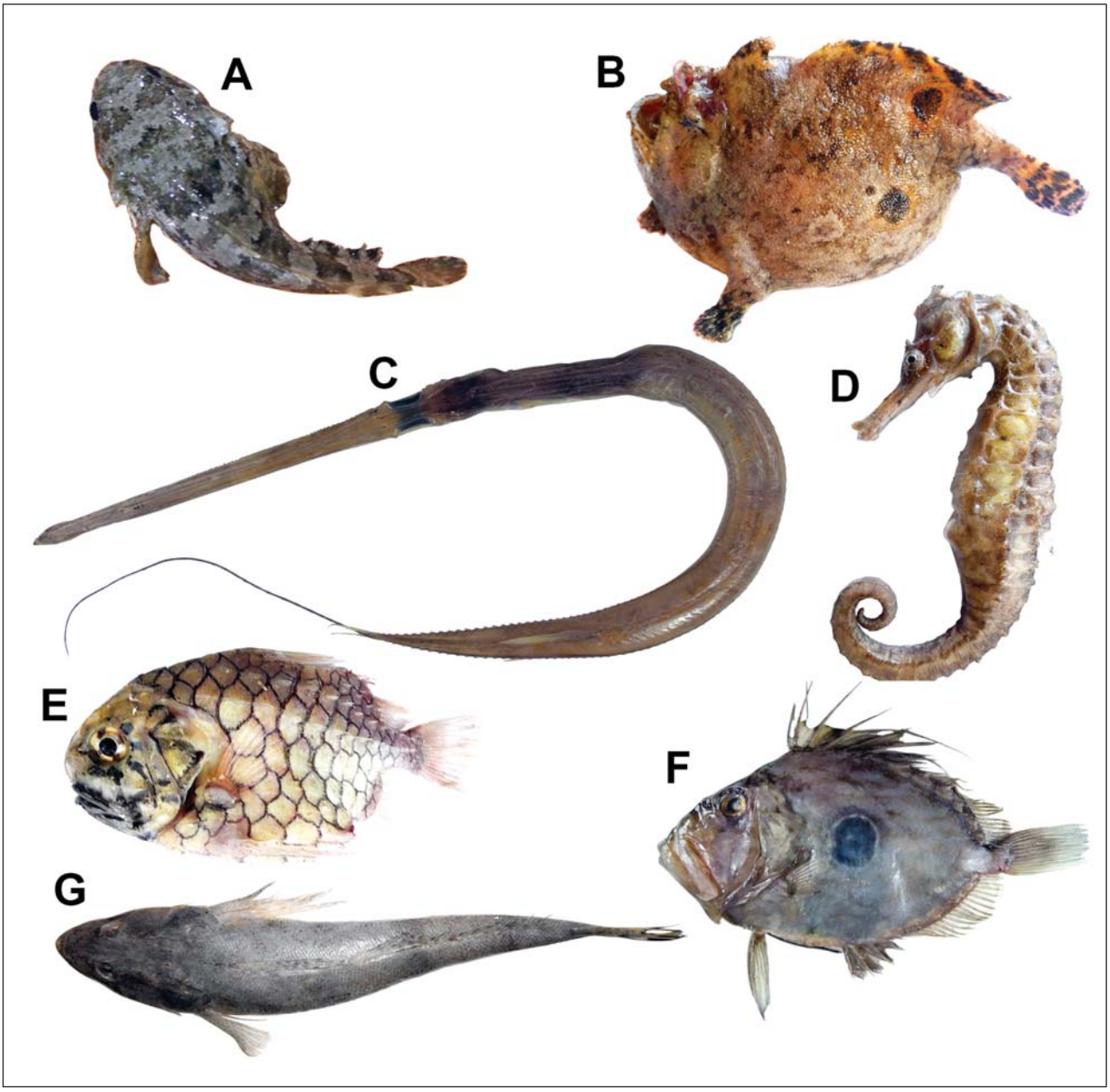

Fig. 4A-G. A, *Colletteichthys dussumieri*, Photo by M. Al-Mukhtar; **B**, *Antennarius indicus* , Photo by L. A. Jawad; **C**, *Fistularia commersonii*, Photo by L. A. Jawad; **D**, *Hippocampus kuda*, Photo by L. A. Jawad; **E**, *Monocentris japonica*, Photo by L. A. Jawad; **F**, *Zeus faber*, Photo by L. A. Jawad; **G**, *Platycephalus indicus*, Photo by L. A. Jawad.

records (3 tentacles). For want of molecular evidence of species determination, the species is here listed as *C. dussumieri* based on morphology.

Order Lophiiformes Garman, 1899
Family Antennaridae Gill 1863
Antennarius Daudin 1816
Antennarius indicus Schultz, 1964 – Indian frogfish

Justification: Two specimens were collected in 2012 from the reef area (Fig. 4B).
Distribution and habitat: Western Indian Ocean; Arabian Gulf – Mozambique to Sri Lanka (Pietsch & Grobecker 1987; Kesner-Reyes et al. 2016). Recorded from Iraq for the first time by Jawad & Hussain (2014). Uncommon, tropical marine, living reef-associated down to 29 m (Pietsch & Grobecker 1987).

Order Syngnathiformes Nelson 1994
Family Fistulariidae Blainville 1818
Fistularia Rüppell 1838
Fistularia commersonii Rüppell 1838 – Bluespotted cornetfish

Justification: Three specimens were collected in 2012 from the reef area (Fig. 3C).
Distribution and habitat: Indo-Pacific; Red Sea – East Africa to Easter Island (Fritzsche & Schneider 1995; Kesner-Reyes et al. 2016). Reported from the Arabian Gulf (e.g. Krupp & Müller 1994), including Iraq (Ziyadi et al. 2018). A benthopelagic tropical marine species; reef-associated down to 130 m (Watson & Sandknop 1996).

Family Syngnathidae Rafinesque 1810
Hippocampus Rafinesque 1810
Hippocampus kuda s.l. Bleeker 1852 – Spotted seahorse

Justification: Five specimens were collected in 2012 from the reef area (Fig. 3D).
Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to the Hawaiian Islands (Lourie et al. 2016; Kesner-Reyes et al. 2016). Reported from several areas in the Arabian Gulf (e.g. Krupp & Müller 1994; Bishop 2003; Al-Lamy, Taher & Al-Ali 2012), including Khor Abdullah (Al-Hassan & Al-Badri 1986) and Khor al-Zubair in Iraqi waters (Hussain et al. 1988). Tropical marine and brackish-water species; found in seagrass- and algae areas of estuaries and reefs, typically at 0-8 m; but records to at least 76 m exist (Allen & Erdmann 2012; GBIF 2016).
Remarks: Taxonomy of the specimens from the Arabian Gulf should be investigated in closer detail, to ascertain the validity of the taxonomical classification (Aylesworth 2014). Most smooth seahorse specimens from the Indo-Pacific has been assigned to *H. kuda*, which is likely a species-complex with much localized morphological and genetic variation (Lourie et al. 2016). Threathened by high exploitation and habitat destruction (Aylesworth 2014). All *Hippocampus* spp. are listed in CITES Appendix II, which means that trade is regulated.

Order Beryciformes Regan 1909
Family Monocentridae Gill 1859
Monocentris Bloch & Schneider 1801
Monocentris japonica (Houttuyn 1782) – Pinecone fish

Justification: Two specimens were collected in 2012 from the reef area (Fig. 4E).
Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to southern Japan – New Zealand (Masuda et al. 1984; Smith 1986; Paulin et al. 1989). Previously reported from western Arabian Gulf (Bushehr Province, Iran) (IFRTO 1997), and marine waters of Iraq (Jawad et al. 2014b). A tropical marine species; reef-associated at depths between 20-200 m (Froese & Pauly 2016), with additional records down to 773 m (GBIF 2016).

Order Zeiformes Latreille 1825
Family Zeidae Latreille 1825
Zeus Linnaeus 1758
Zeus faber s.l. Linnaeus 1758 – John Dory

Justification: New record for Iraq and the Arabian Gulf, based on two specimens collected in 2012 (Fig. 4F).
Distribution and habitat: East-Atlantic, Mediterranean, and Indo-West Pacific (Kesner-Reyes et al. 2016). Recently reported from the Arabian Sea coasts of Oman (Jawad et al. 2011b). A temperate marine species; neritic, found between 5-400 m (most commonly between 50-150 m) (May & Maxwell 1986; Lloris 2005).
Remarks: DNA barcoding showed that northern and southern hemisphere specimens cluster into separate groups, which are also separated from *Z. capensis*, suggesting two cryptic species within the currently recognized *Z. faber* (Ward et al. 2008).

Order Scorpaeniformes Greenwood et al. 1966
Family Platycephalidae Gill 1872
Platycephalus Bloch 1795
Platycephalus indicus s.l. (Linnaeus 1758) – Bartail flathead

Justification: Three specimens were collected in 2012 from the reef area (Fig. 4G).
Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Korea – Australia (Kesner-Reyes et al. 2016). Reported from Iraq, where it is common (Hussain et al. 1988; Ziyadi et al. 2018), with several other records from the Arabian Gulf, where it is of commercial importance (e.g. Valinassab et al. 2006; Mousavi-Sabet et al. 2015; GBIF 2016). Subtropical oceanodromous; commonly found on coastal sandy and muddy bottoms between 0.5-25 m (but recorded down to 375 m) (Riede 2004; GBIF 2016).
Remarks: Substantial genetic divergence has been detected between different Indo-Pacific populations, suggesting a species complex with cryptic species (Zemlak et al. 2009; Puckridge et al. 2013). Eight separate lineages were found, with the Arabian Gulf populations being closest related to East African populations (Puckridge et al. 2013). The name *P. indicus* is not associated with any type locality.

Order Perciformes Bleeker 1859
Family Dinopercidae Heemstra & Hecht 1986
Dinoperca Boulenger 1895
Dinoperca petersi (Day 1875) – Lampfish

Justification: New record for Iraq and the Arabian Gulf from the coral reef area, Iraq based on three specimens collected in 2012 (Fig. 5A).
Distribution and habitat: West Indian Ocean; East Africa to western India (Kesner-Reyes et al. 2016). Described from the Makran coast (Day 1875) and further reported from the Arabian Sea several times (Randall 1995; Manilo & Bogorodsky 2003). A tropical and sub-tropical marine species; reef-associated down to 50 m (van der Elst & Adkin 1991).

Family Epinephelidae Smith & Craig 2007
Epinephelus Bloch 1793
Epinephelus areolatus (Forsskål 1775) – Areolate grouper

Justification: Four specimens were collected in 2012 from the reef area (Fig. 5B)
Distribution and habitat: Indo-Pacific; East Africa to Fiji, with records from the embayments around the Arabian Peninsula (e.g. Smith et al. 1987; Carpenter et al. 1997a; Craig et al. 2011; Kesner-Reyes et al. 2016), including Iraq (e.g. Ali & Hussein 1990; Heemstra & Randall 1993; Ziyadi et al. 2018). A tropical marine species; associated with sea grass or sediment bottoms close to rocks and rocky reefs, between 6-200 m (Randall et al. 1990).

Epinephelus bleekeri (Vaillant 1878) – Duskytail grouper

Justification: Two specimens were collected in 2012 from the reef area (Fig. 5C)
Distribution and habitat: Indo-Pacific; Arabian Gulf – Madagascar to Japan – northern Australia (Craig et al. 2011; Kesner-Reyes et al. 2016). Reported from Iraq (Heemstra & Randall 1993) and several other localities in the Arabian Gulf (e.g. Krupp & Müller 1994; Sahafi 2000; Valinassab et al. 2006; GBIF 2016). A tropical marine species; associated to rocky reefs, silty coastal reefs, and the surrounding soft bottoms at depths of 30-105 m (Carpenter et al. 1997a; Craig et al. 2011; Froese & Pauly 2016).
Remarks: Populations decline due to fisheries (Choat 2015).

Epinephelus coioides (Hamilton 1822) – Orange-spotted grouper

Justification: Two specimens were collected in 2012 from the reef area (Fig. 5D).
Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Japan – Fiji (Heemstra & Randall, 1993; Craig et al. 2011). Reported from Iraq (Heemstra & Randall 1993) and several other locations in the Arabian Gulf area (e.g. Grandcourt et al. 2005; GBIF 2016). Occurs in a variety of marine habitats, often in turbid waters, including shallow reefs and lagoons down to 100 m (Carpenter et al. 1997a; Craig et al. 2011).
Remarks: Populations in decline, as overfishing occurs in the Arabian Gulf (Grandcourt et al. 2005).

Family Pseudochromidae Troschel 1849
Pseudochromis Rüppell 1835
Pseudochromis persicus Murray 1887 – Bluespotted dottyback

Justification: New record for Iraq, from the coral reef area, based on two specimens collected in 2012 (Fig. 5E).

Distribution and habitat: Likely endemic to the Arabian Gulf, with only a few records from outside of this embayment (Smith & Saleh 1987; Kesner-Reyes et al. 2016). Reported from the Arabian Gulf coasts of Kuwait, Iran, Qatar, UAE, Bahrain,

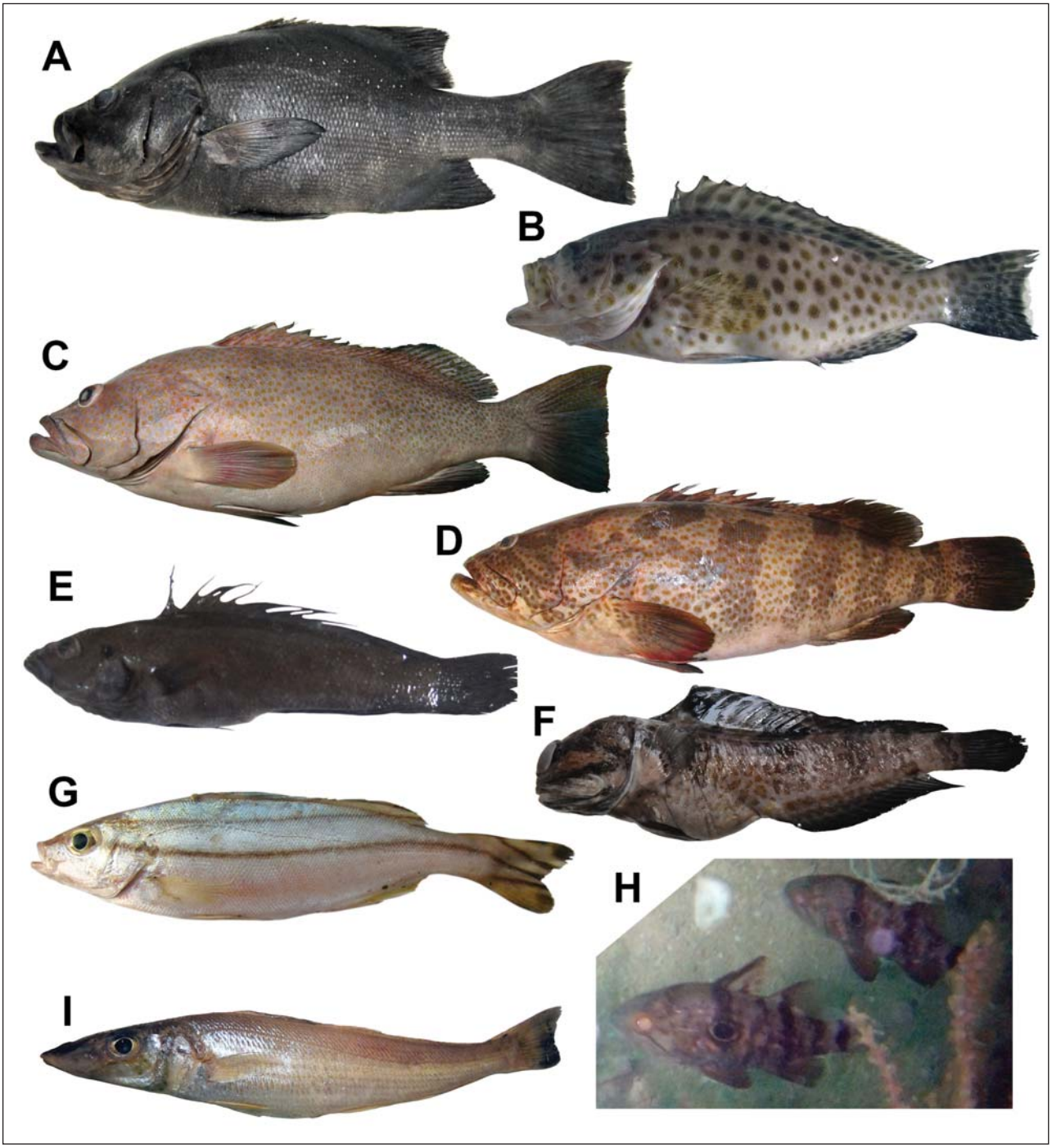

Fig. 5A-I. A, *Dinoperca petersi*, Photo by L. A. Jawad; **B**, *Epinephelus areolatus*, Photo by M. Al-Mukhtar; **C**, *Epinephelus bleekeri*, Photo by L. A. Jawad; **D**, *Epinephelus coioides*, Photo by M. Al-Mukhtar; **E**, *Pseudochromis persicus*, Photo by M. Al-Mukhtar; **F**, *Opistognathus muscatensis*, Photo by L. A. Jawad; **G**, *Terapon puta*, Photo by L. A. Jawad; **H**, *Apogonichthyoides taeniatus*, Photo by T. Pohl; **I**, *Sillago sihama*, Photo by L. A. Jawad.

Oman, and Saudi Arabia (Smith et al. 1987; Carpenter et al. 1997a,b; Rezai & Savari 2004; Grandcourt 2012; Burt et al. 2013; GBIF 2016). Very common in some shallow reef areas in the Arabian Gulf (Smith & Saleh 1987; Coles & Tarr 1990). A tropical marine species, typically reef-associated and found between 1-25 m (Lieske & Myers 1994).

Family Opistognathidae Bonaparte 1835
Opistognathus Cuvier 1816
Opistognathus muscatensis Boulenger 1888 – Robust jawfish

Justification: Two specimens were collected in 2012 from the reef area (Fig. 5F).
Distribution and habitat: West Indian Ocean; Arabian Gulf to Durban, South Africa (Smith-Vaniz 1986). In the Arabian Gulf reported from Iraq (Hussain & Jawad 2014), and Iran, east of the Lavan Island (GBIF 2016). A tropical marine reef-associated species. Depth range: 15-50 m (Lieske & Myers 1994); usually found between 30-50 m (Baensch & Debelius 1997).

Family Teraponidae Richardson 1842
Terapon Cuvier 1816
Terapon puta Cuvier 1829 – Small-scaled terapon

Justification: Five specimens were collected in 2012 from the reef area (Fig. 5G).
Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to the Philippines – eastern Australia (Kesner-Reyes et al. 2016). Repeatedly reported from the Arabian Gulf (e.g. Coles & Tarr 1990; Abou-Seedo 1992; Carpenter et al. 1997a; GBIF 2016), including Iraq (Hussain et al. 1988; Ziyadi et al. 2018). A tropical marine amphidromous species (Riede, 2004), commonly found inshore down to 30 m (Golani & Bogorodsky 2010), with additional records down to 200 m (GBIF 2016).

Family Apogonidae Günther 1859
Apogonichthyoides Smith 1949
Apogonichthyoides taeniatus (Cuvier 1828) – Twobelt cardinal

Justification: New record for Iraq from the coral reef area, based on an underwater photograph of two specimens. Photo taken in July 2013 (Fig. 5H).
Distribution and habitat: Indian Ocean; Red Sea – Mozambique to western India (Kesner-Reyes et al. 2016). Recorded from the western coasts of the Arabian Gulf (Smith et al. 1987; Carpenter et al. 1997a,b; Bishop 2003; GBIF 2016). A tropical and subtropical marine species; associated with coastal reefs and mangroves at depths of 0.5-125m (GBIF 2016).
Remarks: *Apogonichthyoides taeniatus* is a valid name following Eschmeyer et al. (2017) and is morphologically distinguishable from other congeners (Fraser & Allen 2011), but has been suggested to be part of the *A. nigripinnis* species complex (Fraser & Allen 2010).

Family Sillaginidae Richardson 1846
Sillago Cuvier 1817
Sillago sihama s.l. (Forsskål 1775) – Silver sillago

Justification: Six specimens were collected in 2012 from the reef area (Fig. 5I)
Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to Japan – Australia (Kesner-Reyes et al. 2016). Commonly reported from the Arabian Gulf, including Iraqi waters (e.g. Ali & Hussein 1990; Abou-Seedo 1992; McKay 1992; Paighambari & Daliri 2012; GBIF 2016). A tropical marine species; amphidromous and commonly associated with sandy bottoms, mangroves and reefs down to 60 m (McKay 1992; Allen & Erdmann, 2012).
Remarks: New species have recently been found from waters close to the Arabian Gulf; the Red Sea (Golani et al. 2014) and the Arabian Sea (Panwhar et al. 2017), and *S. sihama* has been suggested to be endemic to the Red Sea (e.g. Golani et al. 2014). Most recent key available in Panhwar et al. (2017).

Family Carangidae Rafinesque 1815
Carangoides Bleeker 1851
Carangoides chrysophrys (Cuvier 1833) – Longnose trevally

Justification: Two specimens were collected in 2012 from the reef area (Fig. 6A)
Distribution and habitat: Indo-Pacific; East Africa to Japan – Melanesia – New Zealand (Smith-Vaniz 1984; Kesner-Reyes et al. 2016). Repeatedly recorded in the Arabian Gulf area, including Iraq (e.g. Smith-Vaniz 1984; Al-Jufaili et al. 2010; Grandcourt 2012; Paighambari & Daliri 2012; GBIF 2016). A tropical marine species;

pelagic in reef areas, commonly at depths of 30-60 m (Randall 1995a), but recorded between 10 and 100 m (GBIF 2016).

Carangoides equula (Temminck & Schlegel 1844) – Whitefin trevally

Justification: New record from Iraq, based on seven specimens collected in 2012 from the coral reef area (Fig. 6B).
Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Easter Island (Baranes & Golani 1993; Golani & Bogorodsky 2010; Kesner-Reyes et al. 2016; Smith-Vaniz & Williams 2016a). A single previous record from the United Arab Emirates in the Arabian Gulf (Randall 1995a). A tropical marine species; benthopelagic, often reef-associated, commonly between 60-226 m (Randall & Cea 2011), but recorded between 10-365m (GBIF 2016).

Carangoides gymnostethus (Cuvier 1833) – Bludger

Justification: Confirmation of occurrence in Iraqi waters, based on six specimens collected in 2012 from the reef area (Fig. 6C).
Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – Tonga – eastern Australia (Kesner-Reyes et al. 2016). Presence in Iraqi marine waters unclear. Smith-Vaniz (1984) covered all the Gulf states, including Iraq, in its distribution; but no explicit data were provided. Randall (1995a) noted a general distribution in the Arabian Gulf without specifying the countries, and Grandcourt (2012) lists it simply as present in the Arabian Gulf; Bishop (2003) lists it as native to Kuwaiti waters. Two specimens from United Arab Emirates are found in GBIF (2016). A tropical marine species, associated to offshore reefs at depths between 13-151 m (GBIF 2016).

Carangoides malabaricus (Bloch & Schneider 1801) – Malabar trevally

Justification: Confirmation of occurrence in Iraqi waters, based on nine specimens collected in 2012 from the reef area (Fig. 6D).
Distribution and habitat: Indo-West Pacific; East Africa to Gulf of Thailand – Japan – Australia (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (Abou-Seedo 1992; Hosseini et al. 2012; GBIF 2016), but presece in Iraqi waters (as suggested in Fischer & Bianchi 1984) previously unconfirmed. A tropical marine species; amphidromous and reef-associated down to 185 m (Carpenter et al. 1997a; Riede 2004; GBIF 2016).

Scomberoides Lacépède 1801
Scomberoides commersonnianus Lacepède 1801 – Talang queenfish

Justification: Five specimens were collected in 2012 from the reef area (Fig. 6E).
Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – New Zealand (Kesner-Reyes et al. 2016). Reported from several localities in the Arabian Gulf (e.g. Abou-Seedo 1992; Grandcourt 2012; Parsa et al. 2014; GBIF 2016). Also reported from Iraq (Mohamed et al. 2012; Nasir & Khalid 2013; Ziyadi et al. 2018). Parasitological literature describes parasites from this species, captured in Iraqi waters (e.g. Mhaisen et al. 2013). A tropical marine and brackish-water species; amphidromous and associated to reefs and offshore islands at depths down to 86 m (Riede 2004; Fricke et al. 2011; GBIF 2016).
Remarks: Distinguished from other *Scomberoides* spp. *(S. lysan*, *S. tala*, and *S. tol)* based on the protrusion of the upper jaw beyond the eye, colour pattern, and meristic characters (Smith-Vaniz & Staiger 1973).

Trachinotus Lacépède 1801
Trachinotus baillonii (Lacépède 1801) – Small spotted dart

Justification: Seven specimens were collected in 2012 from the reef area (Fig. 6F).
Distribution and habitat: Indo-West Pacific; Red Sea – Mangaréva Island to Japan – French Polynesia (Kesner-Reyes et al. 2016). Reported from the Arabian Gulf (Blegvad & Løppenthin 1944; Carpenter et al. 1997a), including recent records from Iraq (Hussain & Jawad 2014; Ziyadi et al. 2018). A tropical marine species; commonly associated to reefs, lagoons and sandy beaches down to 10 m, but recorded down to 36 m (Kemp 2000; Bacchet et al. 2006; GBIF 2016).

Family Leiognathidae Gill 1893
Leiognathus Lacépède 1802
Leiognathus equulus (Forsskål 1775) – Common ponyfish

Justification: New record for Iraq from the coral reef area, based on ten specimens collected in 2012 (Fig. 6G).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – Samoa – Australia (Kesner-Reyes et al. 2016). Recorded from Bahrain, Kuwait and Iran in the Arabian Gulf (Bishop 2003; Paighambari & Daliri 2012; GBIF 2016), but no specific previous records from Iraq. A tropical amphidromous species; demersal and commonly associated to estuaries, mangroves, and muddy bottoms (Larson 2012a; Alam et al. 2015). Recorded down to 330 m (Pauly et al. 1996; GBIF 2016).

Family Lutjanidae Gill 1861

Lutjanus Bloch 1790

Lutjanus fulviflamma (Forsskål 1775) – Dory snapper

Justification: Seven specimens were collected in 2012 from the reef area (Figure 7A).

Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to Japan – Samoa – Australia (Allen 1986; Kesner-Reyes et al. 2016). Several records from the Arabian Gulf, where it is among the more common species at some reefs (e.g. Sivasubramaniam & Ibrahim 1982; Coles & Tarr 1990; Krupp & Müller 1994; Grandcourt et al.

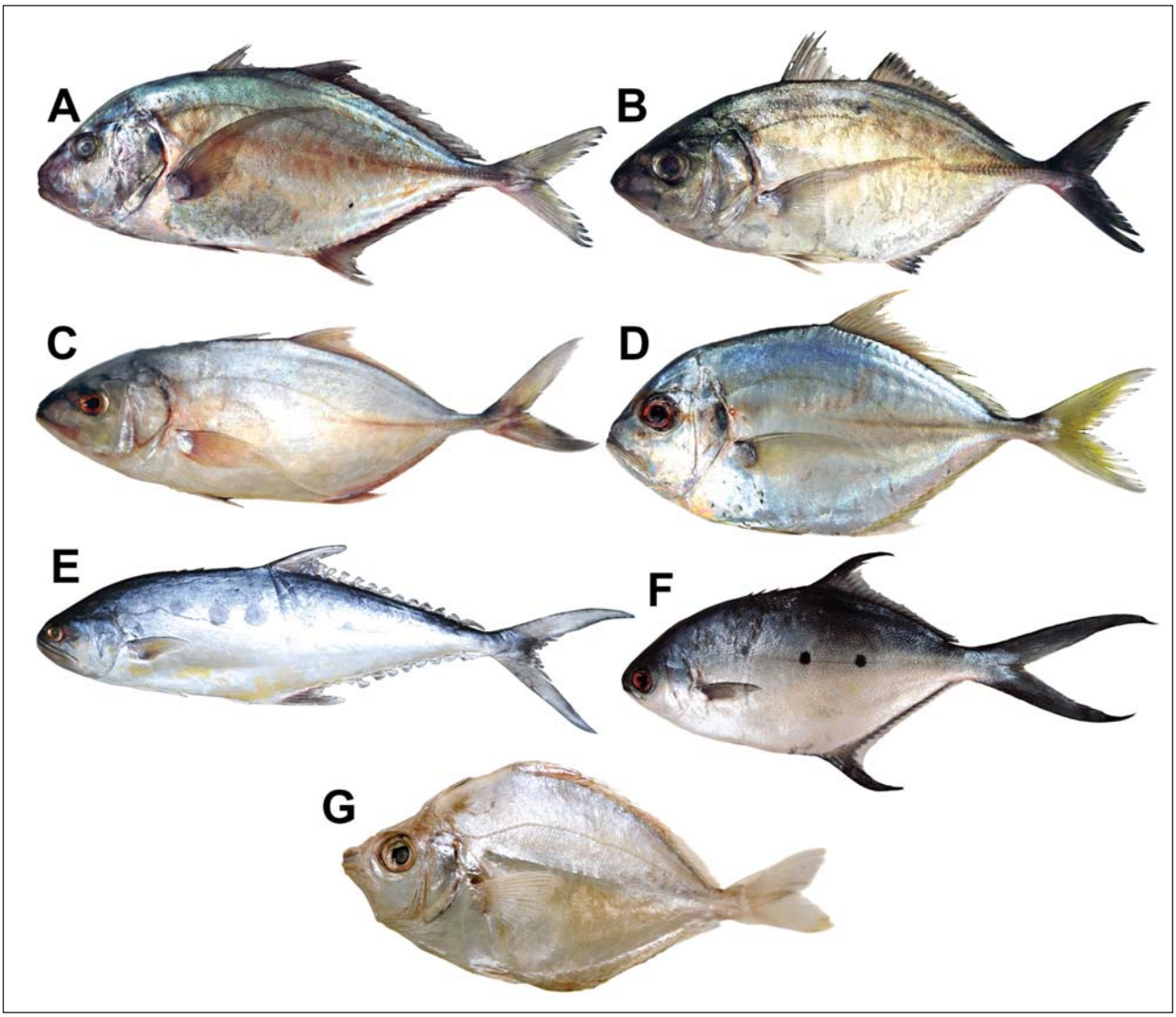

Fig. 6A-G. A, *Carangoides chrysophrys*, Photo by L. A. Jawad; **B**, *Carangoides equula*, Photo by L. A. Jawad; **C**, *Carangoides gymnostethus*, Photo by L. A. Jawad; **D**, *Carangoides malabaricus*, Photo by L. A. Jawad; **E**, *Scomberoides commersonnianus*, Photo by L. A. Jawad; **F**, *Trachinotus baillonii*, Photo by L. A. Jawad; **G**, *Leiognathus equulus*, Photo by L. A. Jawad.

2006b; Sadighzadeh et al. 2012). Specifically reported from Iraqi marine waters (Allen 1985; Ziyadi et al. 2018). A tropical marine species; reef- and lagoon-associated at depths between 3-35 m (Lieske & Myers 1994).

Remarks: Populations in the western Indian Ocean appers to be genetically connected (but Arabian Gulf populations were not included in the analysis) (Dorenbosch et al. 2006).

Lutjanus rivulatus (Cuvier 1828) – Blubberlip snapper

Justification: New record for Iraq based on five specimens collected from the coral reef area in 2012 (Fig. 7B).

Distribution and habitat: Indo-West Pacific; East Africa to Japan – French Polynesia – Australia (Allen 1985; Kesner-Reyes et al. 2016). Recorded from the Straits of Hormuz area in the eastern-most parts of the Arabian Gulf (Sadighzadeh et al. 2012; GBIF 2016; Ibáñez et al. 2016); additionally, reported from the Sea of Oman (Randall 1995a). A tropical marine species; reef-associated, often near freshwater run-offs, at least at the juvenile stage, down to 100 m (Lieske & Myers 1994; GBIF 2016).

Lutjanus russellii (Bleeker 1849) – Russell's snapper

Justification: Two specimens from the coral reef area photographed underwater in July 2013 (Fig. 7C).

Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to Japan – Melanesia – Australia (Kesner-Reyes et al. 2016). Reported from several localities in the Arabian Gulf (e.g. Sivasubramaniam & Ibrahim, 1982; Allen, 1985; Sahafi 2000; Sadighzadeh et al. 2012; GBIF 2016), including Iraq (Allen 1985). A tropical marine species; reef-associated at depths of 3-124 m (most often between 20-50 m) (Lieske & Myers 1994; Kuiter & Tonozuka 2001; GBIF 2016).

Pristipomoides Bleeker 1852
Pristipomoides multidens (Day 1871) – Goldbanded jobfish

Justification: Confirmation of presence in Iraqi waters, based on three specimens collected from the coral reef area in 2012 (Fig. 7D).

Distribution and habitat: Indo-Pacific; Red Sea – East Africa to Japan – Samoa – South Australia (Kesner-Reyes et al. 2016; GBIF 2016). Reported as present in Kuwait in the Arabian Gulf (Carpenter et al. 1997b); also noted from the Gulf of Oman (McIlwain et al. 2011). A tropical marine species; demersal at depths of 40-350 m (Anderson & Allen 2001; Fry, Brewer & Venables 2006).

Family Gerreidae Bleeker 1859
Gerres Quoy & Gaimard 1824
Gerres longirostris s.l. (Lacépède 1801) – Strongspine silver-biddy

Justification: Fifteen specimens were collected in 2012 from the reef area (Fig. 7E).

Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Japan – Samoa – South Australia (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (e.g. Grandcourt et al. 2006c; GBIF 2016). Recently reported for the first time in Iraq, from the area near Khor Al-Ummiah (Ali 2013). A tropical amphidromous marine and estuarine species; found over sandy bottoms, often reef- and lagoon-associated (Iwatsuki, Kimura & Yoshino 2001). Typically found at depths between 0-50 m (Riede 2004; Fricke et al. 2011).

Remarks: *Gerres longirostris* was considered to be of uncertain taxonomic status (Iwatsuki et al. 1999), but Iwatsuki et al. (2001) considers it part of a *G. longirostris* species complex, with designation of neotype from Madagascar, Indian Ocean.

Family Haemulidae Gill 1885
Diagramma Oken 1817
Diagramma pictum (Thunberg 1792) – Painted sweetlips

Justification: Five specimens were collected in 2012 from the reef area (Fig. 7F).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – New Caledonia (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (e.g. Smith & Saleh 1987; Grandcourt et al. 2006a; Paighambari & Daliri 2012; GBIF 2016), including Iraq (McKay 1984; Ziyadi et al. 2018). A tropical marine species; non-migratory, living in coastal and reef areas at depths of 1-170 m (Pauly, Cabanban & Torres 1996), but usually between 1-50 m (Myers 1999).

Remarks: Genetic studies suggest that *D. pictum* may belong within the *Plectorhinchus* genus (Sanciangcoet al. 2011; Liang et al. 2013).

Plectorhinchus Lacépède 1801
Plectorhinchus flavomaculatus (Cuvier 1830) – Lemonfish

Justification: Confirmed record for Iraq, based on two specimens collected in 2012 (Fig. 7G).
Distribution and habitat: Indo-West Pacific; Red Sea – south-east Africa to southern Japan – eastern Australia (Kesner-Reyes et al. 2016). Recorded from Iranian waters in the Arabian Gulf (Assadi & Dhegani 1997; Paighambari & Daliri 2012; GBIF 2016). The present record is considered the first confirmed record of this species from the Iraqi waters. Marine and reef-associated, commonly at

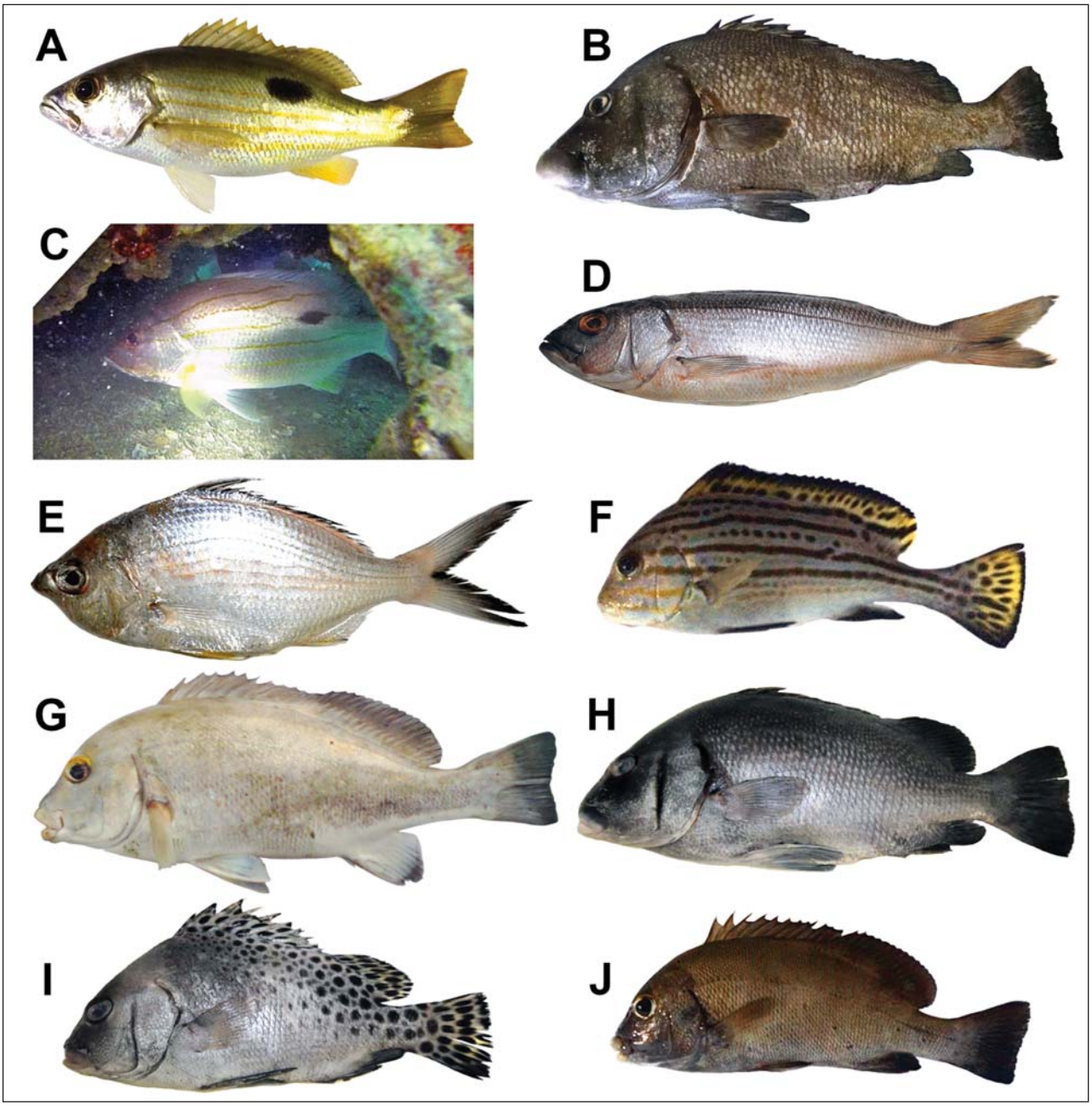

Fig. 7A-J. A, *Lutjanus fulviflamma*, Photo by L. A. Jawad; **B**, *Lutjanus rivulatus*, Photo by L. A. Jawad; **C**, *Lutjanus russellii*, Photo by T. Pohl; **D**, *Pristipomoides multidens*, Photo by L. A. Jawad; **E**, *Gerres longirostris*, Photo by L. A. Jawad; **F**, *Diagramma pictum*, Photo by L. A. Jawad; **G**, *Plectorhinchus flavomaculatus*, Photo by L. A. Jawad; **H**, *Plectorhinchus gibbosus*, Photo by L. A. Jawad; **I**, *Plectorhinchus pictus*, Photo by L. A. Jawad; **J**, *Plectorhinchus sordidus*, Photo by L. A. Jawad.

depths of 2-25 m, but recorded down to 100 m (Allen & Erdmann 2012; GBIF 2016).

Plectorhinchus gibbosus (Lacépède 1802) – Brown sweetlips

Justification: New record for Iraq, and a confirmation for the Arabian Gulf, based on three specimens collected in 2012 from the coral reef area (Fig. 7H).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – Samoa –Australia (Kesner-Reyes et al. 2016). Noted as native for Kuwait, but without reference, by Larson (2012b). Otherwise, no reports of this species are found from the Arabian Gulf area (e.g. Fischer & Bianchi 1984; Carpenter et al. 1997a, b; GBIF 2016). A tropical marine and estuarine species, which may enter freshwater (Kottelat et al. 1993). Reef-associated at depths down to 52 m (GBIF 2016).

Plectorhinchus pictus (Tortonese 1936) – Trout sweetlips

Justification: New record for Iraq, based on three specimens collected in 2012 (Fig. 7I).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Pacific China – western Australia (McKay 1984; Randall 1995a; Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf, including waters of Kuwait which are adjacent to the Iraqi territorial waters (e.g. Smith & Saleh 1987; Paighambari & Daliri 2012; Al-Husaini et al. 2015; GBIF 2016). A tropical marine species which lives in coastal waters in association with reefs at depths of 10-200 m (Smith & Saleh 1987; Al Sakaff & Esseen 1999; GBIF 2016).

Remarks: Some authors have synonymized *P. pictus* with *P. cinctus* (e.g. Randall 1995a). Distinguished from all other *Plectorhinchus* species in the area by the combination of characters: 12 spines and 15 or 16 soft rays on the dorsal fin and black spots on the back and flanks.

Plectorhinchus sordidus (Klunzinger 1870) – Sordid rubberlip

Justification: Four specimens were collected in 2012 from the reef area (Fig. 7J).

Distribution and habitat: Western Indian Ocean; Red Sea – South Africa to Seychelles – Mauritius (Lieske & Myers 1994; Kesner-Reyes et al. 2016). Noted to be very common in the western Arabian Gulf by Carpenter et al. (1997a) and has been reported from this area by several other authors (e.g. Smith & Saleh 1987; Riegl, 1998; Tharwat & Al-Gaber 2006; Grandcourt et al. 2011; GBIF 2016). Reported from the Iraqi waters (Jawad et al. 2014a; Ziyadi et al. 2018). A tropical marine species; associated to shallow vegetated areas, as well as reefs, at depths of 2-25 m (Lieske & Myers 1994).

Remarks: Distinguished from other *Plectorhincus* species based on meristic characters and colour patterns. *Plectorhincus schotaf* and *P. sordidus* share many overlapping characters, but *P. schotaf* has a diagnostic red opercular membrane and is red at the base of the pectoral fin (Jawad et al. 2014a).

Pomadasys Lacépède 1801

Pomadasys commersonnii (Lacépède 1801) – Smallspotted grunter

Justification: New record for Iraq, and a confirmation of presence in the Arabian Gulf, based on three specimens collected in 2012 from the coral reef area (Fig. 8A).

Distribution and habitat: Western Indian Ocean; south Oman – Seychelles – Madagascar to northwestern India (Kesner-Reyes et al. 2016). Carpenter et al. (1997a) listed this species as present in the Arabian Gulf (UAE to Kuwait). The present record is considered the first reliable record for Iraq. A marine and brackish-water species; associated to sand and mud bottoms (Carpenter et al. 1997a), as well as reefs (Riede, 2004). Recorded depth range is 0-49 m (GBIF 2016).

Pomadasys olivaceus (Day 1875) – Olive grunt

Justification: Eight specimens were collected in 2012 from the reef area (Fig. 8B).

Distribution and habitat: Southeast Atlantic, Indian Ocean; Arabian peninsula – Namibia to the Malay Peninsula (Heemstra 1995; Kesner-Reyes et al. 2016). Arabian Gulf records stem from Iraq (Jawad et al. 2014a; Ziyadi et al. 2018) and Dubai, United Arab Emirates (GBIF 2016). A tropical marine and estuarine species living in coastal areas, often in tidal estuaries, but also in association to reef areas, at depths of 1-116 m (Jawad et al. 2014a; GBIF 2016).

Remarks: Differs from *P. commersonnii* in having 11–13 rays in the anal fin and body not covered

with numerous dark brown spots. It also differs from other species of *Pomadasys* in the area in having 2 pores and a median pit on chin (Fischer & Bianchi 1984).

Pomadasys stridens (Forsskål 1775) – Striped piggy

Justification: New record for Iraq, based on two specimens collected in 2012 from the coral reef area (Fig. 8C).

Distribution and habitat: Indian Ocean; Red Sea – East Africa to western India (Kesner-Reyes et al. 2016). Very common in the Arabian Gulf (Carpenter et al. 1997a), with many records from several countries (e.g. Wright 1988; Abou-Seedo 1992; Al-Ghais 1995; Randall 1995a, 1997; Assadi & Dhegani 1997; GBIF 2016). No previous records have been found from Iraq. Tropical marine species; coastal and reef-associated down to 121 m (Carpenter et al. 1997a; GBIF 2016).

Remarks: *Pomadasys stridens* was previously merged together with *P. striatum* and *P. quadrilineatus*, but split up by Iwatsuki et al. (1995) due to differences in colouration, meristic, morphometrics, and geographic distribution.

Family Sparidae Rafinesque 1810
Acanthopagrus Peters 1855
Acanthopagrus bifasciatus (Forsskål 1775) – Twobar seabream

Justification: An underwater photograph of two specimens. Photo taken in July 2013 (Fig. 8D).

Distribution and habitat: Western Indian Ocean; around the Arabian Peninsula (Kesner-Reyes et al. 2016). Reported from several countries in the Arabian Gulf (e.g. Smith et al. 1987; Sahafi 2000; Grandcourt et al., 2004; Iwatsuki & Heemstra 2011; GBIF 2016), including Iraq (Bauchot & Smith 1984; Ziyadi et al. 2018). A tropical marine and brackish-water species, reef-associated at depths of 2-33 m (Lieske & Myers 1994; GBIF 2016).

Remarks: *Acanthopagrus bifasciatus* was recently split into two separate species, one southern (*A. catenula*; marine waters of Eastern Africa) and one northern *(A. bifasciatus;* see above), with overlapping distributions in the Gulf of Aden area (Iwatsuki & Heemstra 2011; but see below for Arabian Gulf records of the former species). The presently recorded specimens fit with the description of the northern species, as the dorsal and caudal fins are immaculate yellow (Iwatsuki & Heemstra 2011).

Acanthopagrus catenula (Lacépède 1801) – Bridled seabream

Justification: Seven specimens were collected in 2012 from the reef area (Fig. 8E).

Distribution and habitat: Indian Ocean; East Africa to islands in the eastern Indian Ocean (Iwatsuki & Heemstra 2011; Kesner-Reyes et al. 2016): also found along the coast of Pakistan (Siddiqui et al. 2014) and the Gulf of Oman (Jawad et al. 2012). The first record from the Arabian Gulf was from the Iraqi marine waters (Al-Badri & Jawad 2014). A tropical marine species; associated to shallow coastal reefs and estuaries (2-50 m) (Sommer et al. 1996).

Remarks: Previously regarded as a colour morph of *A. bifasciatus*, but resurrected as a separate species by Iwatsuki & Heemstra (2011). The most distinguished features separating it from other species of *Acanthopagrus* are the presence of two conspicuous vertical black bars across the head along with a dorsal fin with wide black margin, a yellow proximal part of the dorsal fin, and a third outer molar teeth row extending to the rear end of both jaws (Iwatsuki & Heemstra 2011). Species specific population trends and life-history characteristics are largely unknown for this recently resurrected species (Russel & Carpenter 2014).

Argyrops Swainson, 1839
Argyrops spinifer s.l. (Forsskål 1775) – King soldier bream

Justification: Twelve specimens were collected in 2012 from the reef area (Fig. 8F).

Distribution and habitat: Indian Ocean; East Africa to the Malayan peninsula (Iwatsuki & Heemstra 2018). Widespread in the Arabian Gulf (e.g. Eggleston 1974; Grandcourt et al. 2004; Valinassab et al. 2006; Iwatsuki et al. 2014b; GBIF 2016). From Iraqi waters, reported by Fischer & Bianchi (1984) and Ziyadi et al. (2018). A marine species, living in various subtidal benthic habitats, between 5-200 m (Iwatsuki & Heemstra 2018).

Remarks: Revieweing the genus, Iwatsuki & Heemstra (2018) concluded that *A. spinifer sensu lato* is a species complex containing two species. The newly described *A. flavops* can be confused with *A. spinifer*, but it diverges in having a yellow snout and cheek, with head and body reddish orange with yellow reflections at center of each scale, iris golden, and fins reddish orange (Iwatsuki &

Heemstra 2018). *Argyrops spinifer sensu stricto* is dispersed throughout the Indian Ocean, including the Red Sea and the Arabian Gulf. *Argyrops flavops* is limited to the Arabian Sea, and has not yet been explicitly reported from either the Red Sea or the Arabian Gulf, although Kuronuma & Abe (1972) published a photo of the species (as *A. filamentosus)* from the Kuwait City Fish Market, exact locality unknown).

Crenidens Valenciennes, 1830
Crenidens indicus (Forsskål 1775) – Karanteen seabream

Justification: Ten specimens were collected in 2012 from the reef area (Fig. 8G).

Distribution and habitat: North-west Indian Ocean; Arabian Gulf to Pakistan (Kesner-Reyes et al. 2016; Iwatsuki et al. 2014a). Reported in the

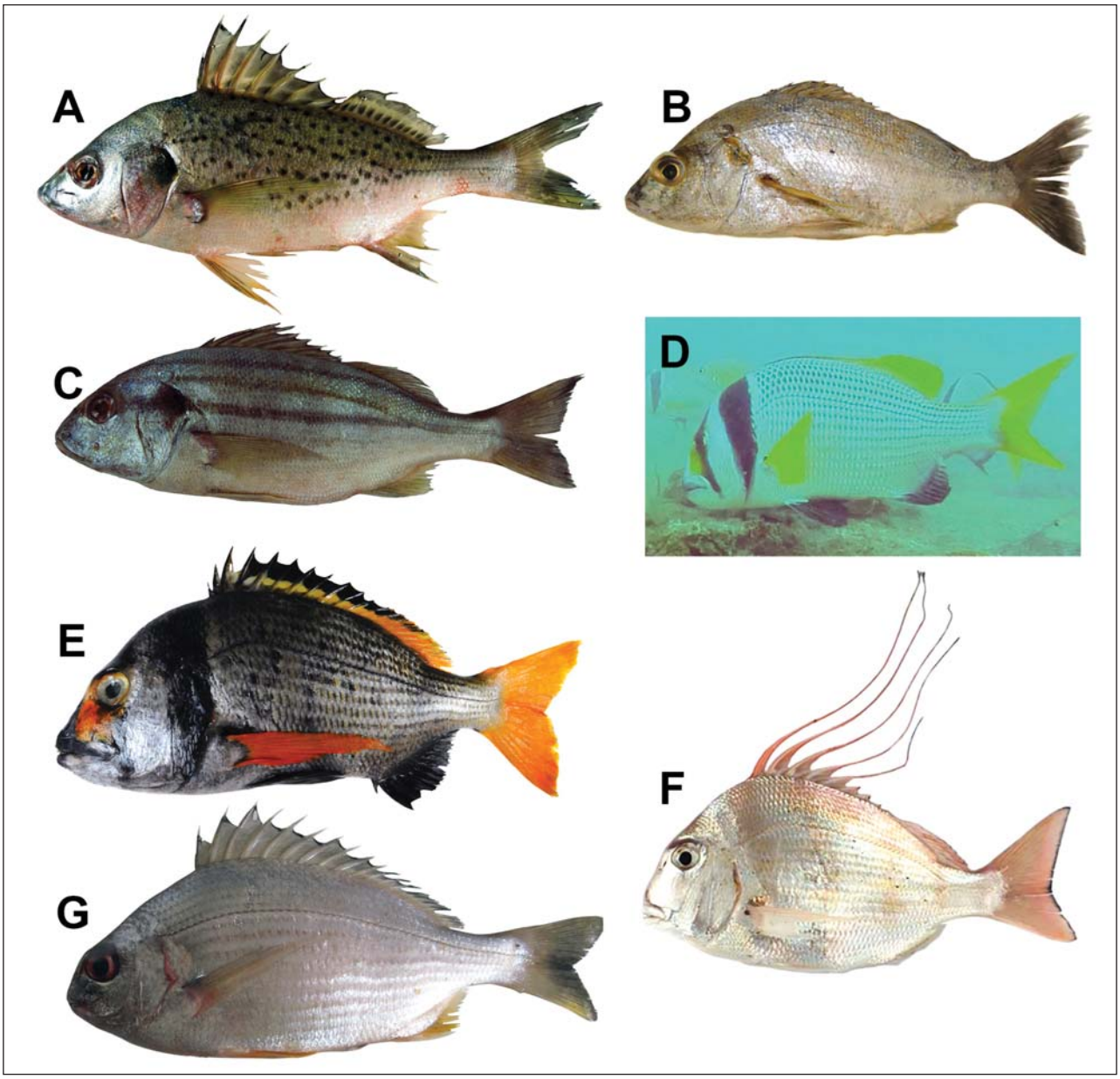

Fig. 8A-G. A, *Pomadasys commersonnii*, Photo by L. A. Jawad; **B**, *Pomadasys olivaceus*, Photo by L. A. Jawad; **C**, *Pomadasys stridens*, Photo by L. A. Jawad; **D**, *Acanthopagrus bifasciatus*, Photograph by Thomas Pohl; **E**, *Acanthopagrus catenula*, Photo by L. A. Jawad; **F**, *Argyrops spinifer*, Photo by M. Al-Mukhtar; **G**, *Crenidens indicus*, Photo by M.Al-Mukhtar.

Arabian Gulf, including Iraq (Smith & Smith 1986; GBIF 2016). Subtropical marine species; in coastal shallow and muddy demersal habitats.

Remarks: *Crenidens indicus* differs from the closely related *C. crenidens* by having 5.5-6.5 scale rows between the 10th dorsal-fin spine base and the lateral line (vs. 4.5 scale rows in *C. crenidens).* The two were raised from subspecies to species by Iwatsuki & MacLaine (2013).

Diplodus Rafinesque 1810
Diplodus capensis (Smith 1844) – Cape white seabream

Justification: New record for Iraq, and a confirmation of presence in the Arabian Gulf, following current species definitions, based on three specimens collected in 2012 from the coral reef area (Fig. 9A).

Distribution and habitat: Southeast Atlantic and western Indian Ocean; Angola to Mozambique (Smith & Smith 1986; Kesner-Reyes et al. 2016). Also recorded from Omani waters (Randall 1995). One additional record from the Arabian Gulf in GBIF (2016) (as *D. sargus* ssp. *capensis* in 1999 from the United Arab Emirates). A tropical marine species; commonly in the surf-zone in rocky areas, but also in estuaries or reef-associated down to 50 m (Bianchi et al. 1999; Mann et al. 2014b).

Remarks: Belongs to the *D. sargus* species complex (Fricke et al. 2016), which contain several very closely related species (Karahan et al. 2017).

Diplodus noct (Valenciennes 1830) – Red Sea seabream

Justification: New record for Iraq, based on three specimens collected in 2012 (Fig. 9B).

Distribution and habitat: Considered endemic to the Red Sea (Iwatsuki et al. 2014c; DiBattista et al. 2016). Five previous records exist in the GBIF database, from two locations in Kuwait, and one location in Bahrain (GBIF 2016). A tropical marine species; associated with sandy bottoms and reefs at shallow depths of 1-8 m (Lieske & Myers 1994; GBIF 2016).

Remarks: Closely related to several other *Diplodus* species according to recent barcoding analyses (Karahan et al. 2017), which suggests it belongs to the *D. sargus* complex (Fricke et al. 2016). Common in the Red Sea.

Rhabdosargus Fowler 1933
Rhabdosargus haffara (Forsskål 1775) – Haffara seabream

Justification: Six specimens were collected in 2012 from the reef area (Fig. 9C).

Distribution and habitat: North-western Indian Ocean; Red Sea to the north Arabian (Bauchot & Smith 1984; Grandcourt 2012; Kesner-Reyes et al. 2016). Noted in a checklist for Kuwait (Bishop 2003), as well as in a checklist of marine fish parasites from the Basrah province in Iraq (Khamees et al. 2015). Iraqi waters are included in the distribution map in Bauchot & Smith (1984) and capture record is presented in Ziyadi et al. (2018). A tropical marine species; over sandy and muddy bottoms or reef-associated, typically down to 10 m (Bauchot & Smith 1984), but recorded down to 61 m (GBIF 2016).

Remarks: Well distinguished from the other five currently recognized *Rhabdosargus* species (Tanaka & Iwatsuki 2013). Overexploited in the Arabian Gulf (Abdulqader et al. 2015c).

Rhabdosargus sarba s.l. (Forsskål 1775) – Goldlined seabream

Justification: Seven specimens were collected in 2012 from the reef area (Fig. 9D).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – eastern China – eastern Australia (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf, where it is common (Sivasubramaniam & Ibrahim 1982; Bauchot & Smith 1984; Grandcourt et al. 2011; Grandcourt 2012). Iraqi waters included in the distribution map in Bauchot & Smith (1984). A tropical marine and brackish-water species; lives in shallow waters, often in estuaries, but also in reef-associated at depths down to 60 m (Riede 2004), with additional records from 118 m (GBIF 2016).

Remarks: Genetically well distinguished from the other recognized *Rhabdosargus* species (Tanaka & Iwatsuki 2013), but may constitute a species complex, as indicated by large intraspecific genetical divergence across its range (Zemlak et al. 2009; Mann et al. 2014a). Currently it is morphologically distinguished based on colouration (notably brown-yellowish pelvic and anal fins), body proportions, and scale-row number between lateral line and dorsal fin (Tanaka & Iwatsuki 2013). Overexploited in the Arabian Gulf (Grandcourt et al. 2011).

Family Lethrinidae Bonaparte 1831
Gymnocranius Klunzinger 1870
Gymnocranius griseus s.l. (Temminck & Schlegel 1843) – Grey large-eye bream

Justification: New record for Iraq and the Arabian Gulf, based on four specimens collected in 2012 (Fig. 9E).

Distribution and habitat: Indo-Pacific; southern Japan to the Indo-Malaysian region, with additional records outside of this area being regarded as non-good records in AquaMaps (Kesner-Reyes et al. 2016), due to possible mix-up with young *G. grandoculis* (Froese & Pauly 2016; Carpenter et al. 2016). Recorded from waters of Oman in Jawad et al. (2011a).

Remarks: Species determination is based on the lack of blue lines on the snout, which should be present in *G. grandoculis*, but not in *G. griseus* (Carpenter & Allen 1989). This is also in line with the record from Omani waters (Jawad et al. 2011a). Notably, there are indications of yet unde-

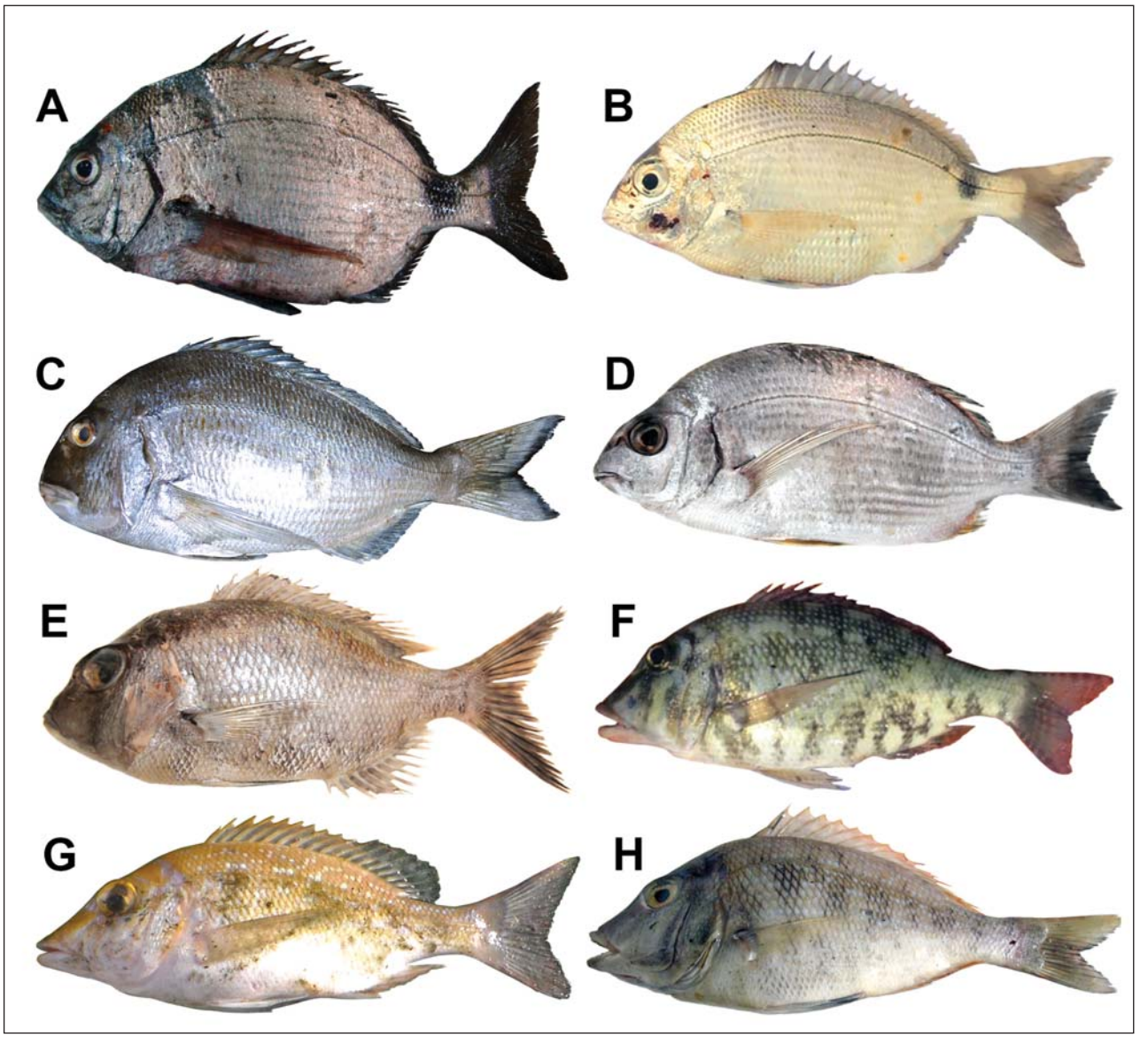

Fig. 9A-H. A, *Diplodus capensis*, Photo by L. A. Jawad; **B**, *Diplodus noct*, Photo by M. Al-Mukhtar; **C**, *Rhabdosargus haffara*, Photo by L. A. Jawad; **D**, *Rhabdosargus sarba*, Photo by L. A. Jawad; **E**, *Gymnocranius grandoculis*, Photo by L. A. Jawad; **F**, *Lethrinus borbonicus*, Photo by M. Al-Mukhtar; **G**, *Lethrinus lentjan*, Photo by M. Al-Mukhtar; **H**, *Lethrinus nebulosus*, Photo by M. Al-Mukhtar.

termined species of *Gymnocranius* (Chen et al. 2016), which may have potential implications for current determination.

Lethrinus Cuvier 1829
Lethrinus borbonicus Valenciennes 1830 – Snubnose emperor

Justification: Four specimens were collected in 2012 from the reef area (Fig. 9F).
Distribution and habitat: West Indian ocean; Red Sea – South Africa to western India –Réunion (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (e.g. Carpenter & Allen 1989; Krupp & Müller 1994; Carpenter et al. 1997a; Grandcourt et al. 2010a; Grandcourt 2012; GBIF 2016), including Iraq (Carpenter & Allen 1989; Ziyadi et al. 2018). A tropical marine, non-migratory species living over sandy bottoms near reefs, at depths down to 40 m (Lieske & Myers 1994).

Lethrinus lentjan (Lacépède 1802) – Pink-ear emperor

Justification: Nine specimens were collected in 2012 from the reef area (Fig. 9G).
Distribution and habitat: Indo-West Pacific; Red Sea – Africa to Tonga – Ryukyu Islands (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (Sivasubramaniam & Ibrahim 1982; Smith & Saleh 1987; Carpenter & Allen 1989; Grandcourt et al. 2011; Grandcourt 2012; Paighambari et al. 2012; GBIF 2016), including Iraq (Carpenter & Allen 1989; Ziyadi et al. 2018). A species found in coastal marine and brackish waters; non-migratory, living over sandy bottoms close to reefs and lagoons at depths down to 100 m (Kailola et al. 1993; GBIF 2016).

Lethrinus nebulosus s.l. (Forsskål 1775) – Spangled emperor

Justification: Six specimens were collected in 2012 from the reef area (Fig. 9H).
Distribution and habitat: Distributed from the Red Sea and the Arabian Gulf and southward to East Africa, and further to the east to Japan and Samoa (Kesner-Reyes et al. 2016). It is found in several locations in the Arabian Gulf area (e.g. Sivasubramaniam & Ibrahim 1982; Grandcourt et al. 2006a, 2010; Grandcourt 2012; GBIF 2016), including Iraq (e.g. Carpenter & Allen 1989; Ali & Hussain 1990; Khamees et al. 2015). A tropical marine and brackish-water species, which lives in various habitats, including coral reefs, at depths down to 93 m (Carpenter & Allen 1989; GBIF 2016), with an additional record from 290 m (GBIF 2016).
Remarks: The currently recognized species may represent a complex of cryptic species (Zemlak et al. 2009).

Family Nemipteridae Regan 1913
Nemipterus Swainson 1839
Nemipterus bipunctatus (Valenciennes 1830) – Delagoa threadfin bream

Justification: Six specimens were collected in 2012 from the reef area (Fig. 10A).
Distribution and habitat: Indian Ocean; Red Sea – East African coast to the Strait of Malacca (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (Krupp & Müller 1994; Carpenter et al. 1997a; Bishop 2003; Asgharian et al. 2011; GBIF 2016). Also recorded from Iraq (Russell, 1990; Ziyadi et al. 2018). Marine, demersal, and non-migratory; found over sandy and muddy bottoms at depth of 18-100 m (Sommer et al. 1996).
Remarks: Distinguished from closely related *Nemipterus* on the basis of fresh colour (Russell 1993; Russell & Tweddle 2013). Specifically distinguished from the recently described *N. flavomandibularis* (W. Indian Ocean) based on the lack of the yellow patterns on the head (Russell & Tweddle 2013).

Nemipterus randalli Russell 1986 – Randall's threadfin bream

Justification: New record for Iraq, based on ten specimens collected in 2012 (Fig. 10B).
Distribution and habitat: Western Indian Ocean; Arabian Gulf – Madagascar to Eastern Coast of India (Kesner-Reyes et al. 2016). Originally described from Bahrain, Arabian Gulf (Russell 1986). A tropical marine demersal species; sandy and muddy bottoms at depths down to more than 200 m (Goldschmidt et al. 1996).
Remarks: Distinguished from other *Nemipterus* by having a long pelvic fin extending to or beyond the origin of anal fin, a shallow suborbital, and pale blueish dorsal and anal fins, the latter with a yellow medial stripe (Russell & Tweddle 2013).

Parascolopsis Boulenger 1901
Parascolopsis eriomma s.l. (Jordan & Richardson 1909) – Rosy dwarf monocle bream

Justification: Ten specimens were collected from the coral reef area in 2012 (Fig. 10C).
Distribution and habitat: Indo-West Pacific; Red Sea – East African coasts to Japan – Indonesia (Russell & Golani 1993; Kesner-Reyes et al. 2016). Recorded from the Arabian Gulf (Russell, 1990; GBIF, 2016), and from Iraqi waters (Jawad & Al-Badri 2014). A tropical marine demersal species; recorded between 25-264 m (Russell & Golani 1993; Sommer et al. 1996).
Remarks: Distinguished from other *Parascolopsis* by the count of gill rakers on the first arch (17 to 19) (Russell & Chin 1996). However, the taxon may include more than one species as indicated by recent genetic analyses (Hung et al. 2017).

Scolopsis Cuvier 1814
Scolopsis taeniata (Cuvier 1830) – Black-streaked monocle bream

Justification: Ten specimens were collected in 2012 from the reef area (Fig. 10D).
Distribution and habitat: North-western Indian Ocean, Red Sea – Gulf of Aden to the Indian west coast – Sri Lanka (Kesner-Reyes et al. 2016). Reported from several places in the Arabian Gulf [e.g. Smith et al. 1987; Russell 1990; Carpenter et al. 1997a (as *S. taeniatus*); Grandcourt 2012 (as *S. taeniatus*); Paighambari & Daliri 2012; GBIF 2016]; Iraqi waters are in the distribution range in Russell (1990). Marine and reef-associated at depths of 20-50 m (Al-Sakaff & Esseen 1999).

Family Mullidae Rafinesque 1815
Mulloidichthys Whitley 1929
Mulloidichthys vanicolensis (Valenciennes 1831) – Yellowfin goatfish

Justification: New record for Iraq, and a confirmation for the Arabian Gulf, based on five specimens collected in 2012 from the coral reef area (Fig. 10E).
Distribution and habitat: Indo-Pacific; Red Sea – East Africa to the Polynesian region of the Pacific Ocean, with additional records from the west coasts of North and Central America (Uiblein 2011; Kesner-Reyes et al. 2016). Two records (9 specimens, year 1956), from the Saudi Arabian coasts of the Arabian Gulf, and two diving observations from Oman at the mouth of the Gulf (2013), are recorded in GBIF (GBIF 2016). The species was also recorded in a water-quality study from Saudi Arabia (Jubail area) in 2015 (Siddiqui et al. 2016). A tropical marine species; sandy bottoms in association with reefs at depths of 1-113 m (Uiblein 2011; Allen & Erdmann 2012).
Remarks: Allozyme data have suggested that widely separated populations of *M. vanicolensis* do not diverge much genetically (Stepien et al. 1994; Uiblein 2011).

Upeneus Cuvier 1829
Upeneus oligospilus Lachner 1954 – Short-fin goatfish

Justification: Confirmation for the presence of this species in the Iraqi marine waters, based on one specimens collected in 2013 from the reef area (Fig. 10F).
Distribution and habitat: Known distribution is restricted to the Arabian Gulf (Uiblein & Gouws 2014). Has likely been recorded previously from this area as *U. tragula* (e.g. Sivasubramaniam & Ibrahim 1982; Downing *et al.* 1985; Smith, Saleh & Sangoor 1987; Abou-Seedo 1992; Krupp & Müller 1994; Bishop 2003; Randall & Kulbicki 2006). A tropical marine species; on sandy bottoms in coastal areas, sometimes reef-associated, at depths down to 13 m (Uiblein & Gouws 2014).
Remarks: A recently resurrected species, split from *U. tragula* (Uiblein & Heemstra 2010). The taxonomic revison suggested that *U. tragula* is distributed from the Malayian Archipelago and eastward to the east coasts of the Pacific Ocean, and that the species found in Arabian Gulf is *U. oligospilus* (Uiblein & Gouws 2014). Overall, *U. tragula* and its closest relatives in the Indo-Pacific are considered a species complex (the dark-freckled *tragula* group; Uiblein & Gouws 2014). The specimen obtained from the Iraqi reef area had a caudal fin/standard length ratio of 0.267, which fits the characteristics that separate *U. oligospilus* from *U. tragula* (Uiblein & Gouws 2014). Given previous records of *U. tragula* likely being *U. oligospilus*, the present record is a confirmation of this species from Iraqi waters.

Family Pomacanthidae Jordan & Rutter 1898
Pomacanthus Lacepéde 1802
Pomacanthus asfur (Forsskål 1775) – Arabian angelfish.

Justification: New record for Iraq, and a confirmation for the Arabian Gulf, based on underwater image taken at the coral reef area in 2013 (Fig. 10G).

Distribution and habitat: Western Indian Ocean; Red Sea to Zanzibar. One unconfirmed scuba observation is recorded from Kuwait (Maradim Island) in 2002 (GBIF 2016). It is also listed as sometimes occurring in the Arabian Gulf by Roberts et al. (1992). A tropical marine and non-

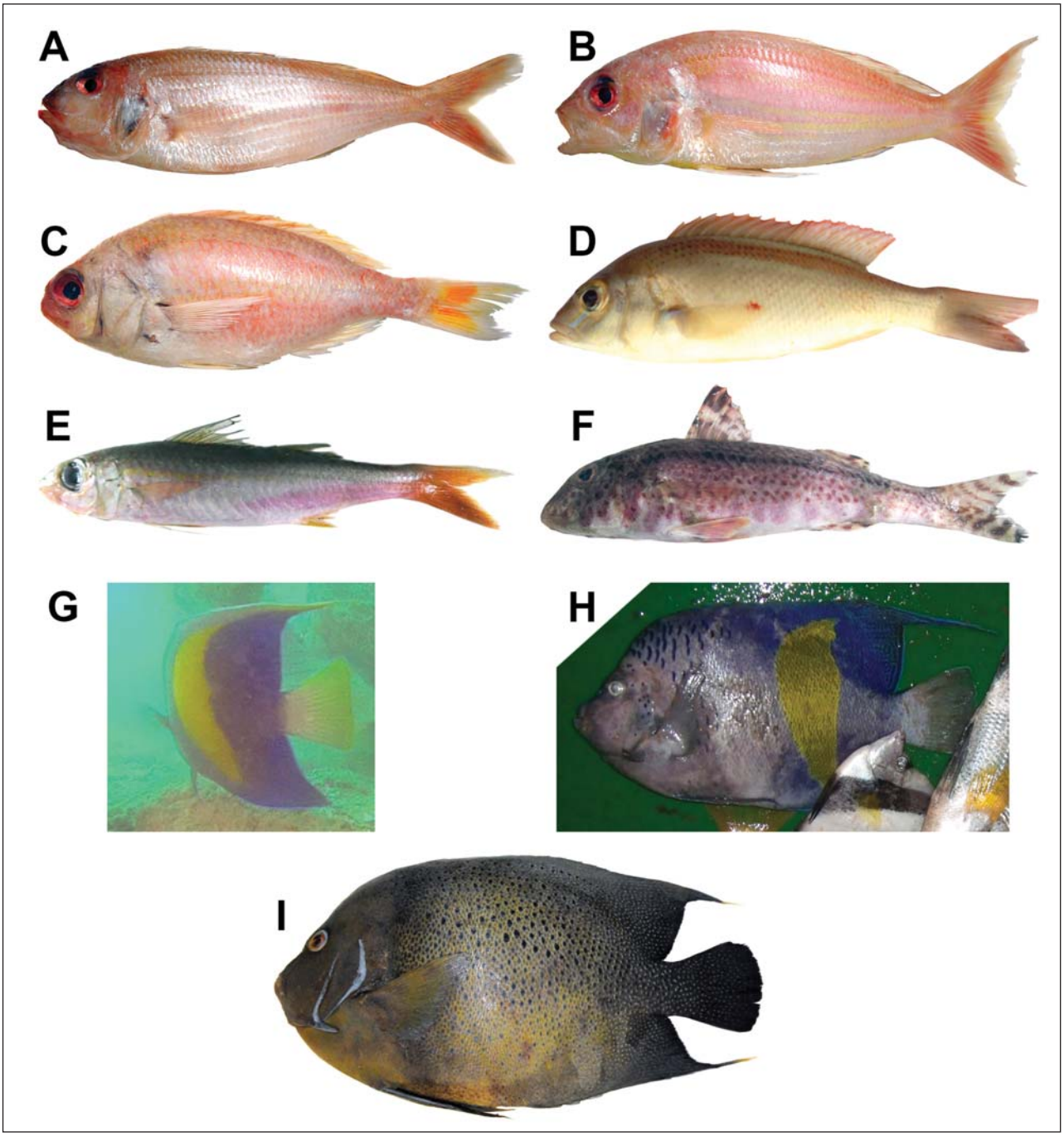

Fig. 10A-H. A, *Nemipterus bipunctatus*, Photo by L. A. Jawad; **B**, *Nemipterus randalli*, Photo by L. A. Jawad; **C**, *Parascolopsis eriomma*, Photo by L. A. Jawad; **D**, *Scolopsis taeniata*, Photo by L. A. Jawad; **E**, *Mulloidichthys vanicolensis*, Photo by M. Al-Mukhtar; **F**, *Upeneus tragula*, Photo by M. Al-Mukhtar; **G**, *Pomacanthus asfur*, Photo by T. Pohl; **H**, *Pomacanthus maculosus*, Photo by M. Al-Mukhtar; **I**, *Pomacanthus semicirculatus*, Photo by M. Al-Mukhtar.

migratory species; reef-associated at depths of 3-30 m (Lieske & Myers 1994; Sommer et al. 1996).

Pomacanthus maculosus (Forsskål 1775) – Yellowbar angelfish

Justification: Seven specimens were collected in 2012 from the reef area (Fig. 10H).

Distribution and habitat: North-west Indian Ocean; Red Sea to Arabian Gulf and Sea of Oman (e.g. Sivasubramaniam & Ibrahim 1982; Randall 1988; Grandcourt et al. 2010; Zafarghandi et al. 2013; Eskandari et al. 2014; Kesner-Reyes et al. 2016). Jawad et al. (2014) and Ziyadi et al. (2018) noted the presence of this species for Iraqi marine water. A tropical marine species, typically associated with shallow coral reefs, but recorded down to 55 m (Lieske & Myers 1994; Sommer et al. 1996; Zafarghandi et al. 2013; GBIF 2016).

Remarks: Body coloration of young specimens (less than 10 cm TL) differs from that of adults, with a dark blue to almost black body with many thin light blue and white vertical lines (Salameh et al. 2012). Arabian Gulf populations are genetically similar (Zafarghandi et al. 2013).

Pomacanthus semicirculatus (Cuvier 1831) – Semicircle angelfish

Justification: New record for Iraq and for the Arabian Gulf, based on five specimens collected from the coral reef area in 2012 (Fig. 10I).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – Samoa – southern Australia (Myers 1991; Kesner-Reyes et al. 2016). No previous records from the Arabian Gulf area were found (e.g. GBIF 2016). A tropical marine species; reef-associated at depths of 1-96 m (Allen & Erdmann 2012; GBIF 2016).

Family Mugilidae Jarocki 1822
Ellochelon Whitley 1930
Ellochelon vaigiensis (Quoy & Gaimard 1825) – Squaretail mullet

Justification: Confirmation of the presence of this species for Iraq based on ten specimens were collected in 2012 from the reef area (Fig. 11A)

Distribution and habitat: Indo-Pacific; Red Sea – East Africa to Polynesia (Harrison & Senou 1997; Kesner-Reyes et al. 2016). Fischer & Bianchi (1984) and Carpenter et al. (1997) include the whole Gulf area in its distribution. The species is also reported from coastal freshwaters by the Gulf in Iran (Hashemi et al. 2014; Esmaeili et al. 2015), as well as from marine environments in the area of the Strait of Hormuz (Hesni & Teimori 2016). A tropical marine-, brackish- and freshwater (catadromous) species; often in estuarine and coastal areas, at shallow depths of 0-5 m (Luther 1973; Bacchet et al. 2006).

Remarks: Cryptic diversity in the genus has been suggested (Durand 2015).

Moolgarda Whitley 1945
Moolgarda (Osteomugil) cunnesius s.l. (Valenciennes 1836) – Longarm mullet

Justification: Seven specimens collected from the coral reef area, in 15 July, 2012 (Fig. 11B).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to western coasts of the Pacific Ocean (Randall, 1995a; Durand et al. 2012). Noted as present in the Arabian Gulf in Carpenter et al. (1997a), but without specific geographic information. Two records are found in GBIF (2016) from the Arabian Gulf, one from Kuwait in 1995 and one from Iran in 2014 (both recorded as *Valamugil cunnesius*). Two more specimens are recorded from Iraqi waters (Jawad 2015). A marine-, brackish- and freshwater species with catadromous habit; coastal at shallow depths of 0-3 m (McDowall 1988; Fricke et al. 2011), but recorded down to 42 m (GBIF 2016).

Remarks: The taxonomy of Mugilidae is complex and debated, and is under revision (Durand 2015). The species discussed here has been renamed as *Osteomugil cunnesius* in Durand et al. (2012a,b), but it is still listed as *M. cunnesius* in Eschmeyer et al. (2017). Recently constructed phylogenies suggest paraphyly, as well as substantial cryptic diversity within this species (Durand et al. 2012a,b; Durand & Borsa 2015; Xia et al. 2016).

Family Pomacentridae Bonaparte 1832
Dascyllus Cuvier 1829
Dascyllus trimaculatus (Rüppell 1829) – Threespot dascyllus

Justification: New record for Iraq based on six specimens collected from the coral reef area on 15 July, 2012 (Fig. 11C).

Distribution and habitat: Indo-Pacific; Red Sea – East Africa to the Line and Pitcairn Islands (Kesner-Reyes et al. 2016). Reported from Kuwait (Carpenter et al. 1997b; Bishop 2003), and UAE

(GBIF 2016) within the Arabian Gulf, as well as in Omani and Iranian waters of the Strait of Hormuz (Sahafi 2000; Khatami et al. 2014; GBIF 2016). A tropical marine species; reef-associated at depth of 1-55 m (Allen 1991), but recorded deeper than 100 m on a few occasions (GBIF 2016).

Remarks: The closely related *D. albisella*, *D. strasburgi*, *D. trimaculatus* and *D. auripinnis* have been grouped together in a *Dascyllus trimaculatus* species complex by Bernardi et al. (2002), due to paraphyly of the latter two species. Colouration was found not to be a good indicator of species within the complex (Bernardi et al. 2002).

Chromis Cuvier 1829
Chromis flavaxilla Randall 1994 – Arabian chromis

Justification: New record for Iraq based on underwater photo taken in the coral reef area on 15 July, 2012 (Fig. 11D).

Distribution and habitat: Western Indian Ocean in the waters surrounding the Arabian Peninsula (Kesner-Reyes et al. 2016). Native to the western coastline of the Arabian Gulf (Kuwait to UAE) (Randall 1994; Krupp & Almarri 1996; Carpenter et al. 1997a; Bishop 2003); the present records are the first from Iraqi marine water. A tropical marine species; reef-associated at depths down to 18 m (Randall 1995a).

Neopomacentrus Allen 1975
Neopomacentrus sindensis (Day 1873) – Arabian demoiselle

Justification: New record for Iraq based on underwater photo taken in the coral reef area on 15 July, 2012 (Fig. 11E).

Distribution and habitat: Red Sea – Arabian Sea – Arabian Gulf (Grandcourt 2012; Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf, including areas neighbouring Iraqi waters (Kuwait and Khuzestan in Iran) (Downing et al. 1985; Smith et al. 1987; Coles & Tarr 1990; Randall 1995a, 2005; Eskandari et al. 2014; GBIF 2016). A tropical marine species; reef-associated down to 30 m (Allen 1991; GBIF 2016).

Family Pentacerotidae Bleeker 1859
Histiopterus Temminck & Schlegel 1844
Histiopterus typus Temminck & Schlegel 1844 – Sailfin armourhead

Justification: New record for Iraq and a confirmation for the Arabian Gulf, based on six specimens collected from the coral reef area in July 15, 2012 (Fig. 11F).

Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Japan – eastern Australia (Kesner-Reyes et al. 2016). Listed as present in the western parts of the Arabian Gulf in Carpenter et al. (1997a), and Fischer & Bianchi (1984) include the Arabian Gulf in its distribution, but no details about its actual presence was given in the texts. The present record is the first to Iraqi marine waters and considered a confirmation for the Arabian Gulf. A marine species; reef-associated at depths of 40-421 m (Randall 1995a).

Family Labridae Cuvier 1816
Bodianus Bloch 1790
Bodianus macrognathos (Morris 1974) – Giant hogfish

Justification: Three specimens collected in 2012 from the reef area (Fig. 11G).

Distribution and habitat: Western Indian Ocean; Arabian Peninsula to Kenya (Parenti & Randall 2010; Sommer et al. 1996; Kesner-Reyes et al. 2016), but considered rare in the northern range (Oman) (Russel & Choat 2010). The first record for the Arabian Gulf was reported from Iraqi marine waters (Jawad & Al-Badri 2015). A tropical marine species; living over rocky bottoms and reef-associated at depths of 25-65 m, with juveniles occurring at shallower depths (Gomon & Randall 1984; Gomon 2006).

Coris Lacépède 1801
Coris nigrotaenia Mee & Hare 1995 – Blackbar coris

Justification: Five specimens were collected in 2012 from the reef area (Fig. 11H).

Distribution and habitat: Mainly found at the Arabian Sea coast of Oman (Randall 1995a; Parenti & Randall 2010; Kesner-Reyes et al. 2016: GBIF 2016), with one additional specimen recorded from Gulf of Oman (GBIF 2016), and five specimens recorded in the Iraqi waters of the Arabian Gulf (Jawad & Al-Badri 2015). A tropical marine species, living in association with exposed rocky shores and reefs at depths of 2-20 m (Randall 1995a).

Remarks: A central vertical elongate black band,

extending between the base of the dorsal fin and the mid-portion of the pectoral fin, distinguishes it from other *Coris* spp. (Mee & Hare 1995).

Halichoeres Rüppell 1835
Halichoeres leptotaenia Randall & Earle 1994 – Thinstripe wrasse

Justification: New record for Iraq based on two

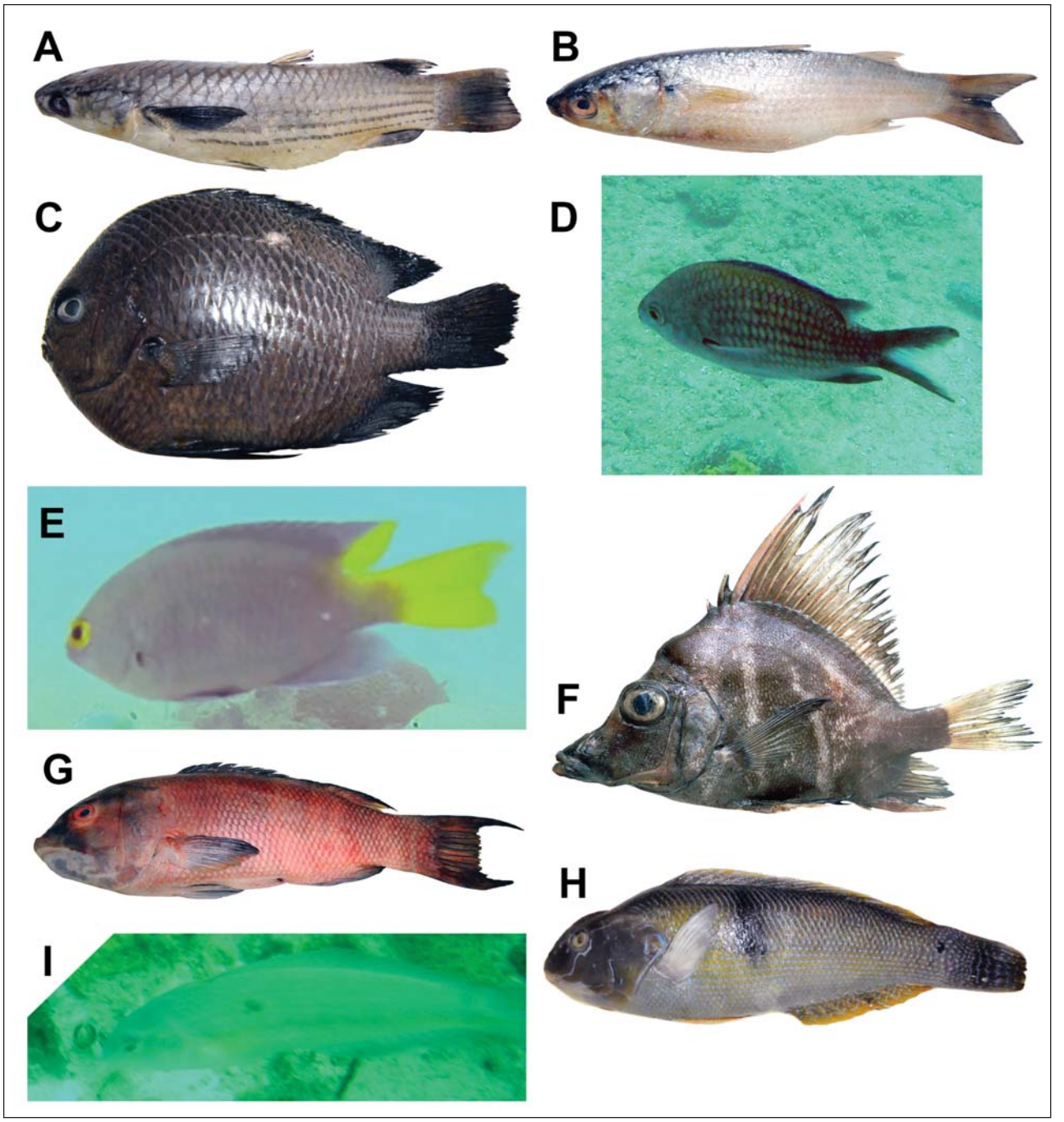

Fig. 11A-I. A, *Ellochelon vaigiensis*, Photo by L. A. Jawad; **B**, *Moolgarda cunnesius*, Photo by L. A. Jawad; **C**, *Dascyllus trimaculatus*, Photo by L. A. Jawad; **D**, *Chromis flavaxilla*, Photo by Thomas Pohl; **E**, *Neopomacentrus sindensis*, Photo by T. Pohl; **F**, *Histiopterus typus*, Photograph by L. A. Jawad; **G**, *Bodianus macrognathos*, Photo by Laith A. Jawad; **H**, *Coris nigrotaenia*, Photo by L. A. Jawad; **I**, *Halichoeres leptotaenia*, Photo by L. A. Jawad.

underwater photos taken in the coral reef area on July 15, 2012 (Fig. 11I).

Distribution and habitat: Seemingly endemic to the Arabian Gulf (Parenti & Randall 2010). It has been reported from Jana Island, Saudi Arabia and from Khasab, Oman (Randall & Earle 1994), and is listed in a Kuwaiti checklist of marine fish species (Bishop 2003). In Carpenter et al. 1997a, the distribution covers the southern and western coasts of the Arabian Gulf, which is repeated in Choat & Alam (2015). One specimen outside of the Arabian Gulf is recorded from Mozambique (GBIF 2016). A tropical marine species; lives demersally in association to rocks and coral patches on sand bottoms at depths of 2-15 m (Randall & Earle 1994; Choat & Alam 2015).

Family Pinguipedidae Bleeker 1863
Parapercis Bleeker 1863
Parapercis robinsoni Fowler 1929 – Smallscale grubfish

Justification: New record for Iraq based on six specimens collected from the coral reef area on July 15, 2012 (Fig. 12A).

Distribution and habitat: Western Indian Ocean; Red Sea – South Africa to Pakistan – Seychelles – Réunion (Kesner-Reyes et al. 2016). Reported from the western Arabian Gulf (Bahrain, Kuwait, and Saudi Arabia) (Randall & Stroud 1985; Krupp & Müller 1994; Carpenter et al. 1997a; Bishop 2003; GBIF 2016). A tropical marine species; demersal over sandy substrate near coral reefs, at depths of 6-73 m, commonly in the deeper part of the depth range (Sommer et al. 1996; Carpenter et al. 1997a; GBIF 2016).

Remarks: Distinguished from *P. nebulosa* based on meristic characters and colouration (see Randall & Stroud 1985).

Family Ephippidae Bleeker 1859
Platax Cuvier 1816
Platax teira (Forsskål 1775) – Teira

Justification: Six specimens were collected in 2012 from the reef area (Fig. 12B).

Distribution and habitat: Indo-West Pacific; Red Sea – East Africa to Japan – New Zealand (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (e.g. Krupp & Müller 1994; Carpenter et al. 1997a,b; Rezai & Savari 2004; Grandcourt 2012; Eskandari et al. 2014; GBIF 2016), including Iraq (Jawad & Al-Bannai 2014; Ziyadi et al. 2018). A tropical marine amphidromous species; found in a variety of habitats (Riede 2004) at depths of 3-97 m (Allen & Erdmann 2012; GBIF 2016).

Remarks: A relatively high number of *Platax orbicularis* has been reported from Iraqi waters, close to the coral reef area, in Resen (2016). No details on the determination of the species was provided in Resen (2016), and it is possible that both *P. teira* and *P. orbicularis* are present at the reef.

Family Siganidae Richardson 1837
SIGANUS Forsskål 1775
Siganus canaliculatus (Park 1797) – White-spotted spinefoot

Justification: Ten specimens were collected in 2012 from the reef area (Fig. 12C).

Distribution and habitat: Indo-West Pacific; north-western Indian Ocean to south-western Pacific Ocean (Myers 1999; Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (e.g. Smith et al. 1987; Woodland 1990, Al-Ghais 1993; Carpenter et al. 1997a,b; Wassef & Hady 1997; Grandcourt 2012; GBIF 2016), including Iraq (Hussain et al. 1988; Khamees et al. 2015; Ziyadi et al. 2018). A tropical marine and brackish-water species; common in lagoons and estuaries in association with reefs, mangroves and seagrass beds; recorded at depths down to 108 m (Woodland 1997; Abdulqader et al. 2015e; GBIF 2016).

Remarks: *Siganus canaliculatus* can be confused with *S. fuscescens*, and may also hybridize with this species (Ravago-Gotanco & Juinio- Meñez 2010). The latter species is mainly found in the Western pacific (Kesner-Reyes et al. 2016).

Family Acanthuridae Bonaparte, 1832
Acanthurus Forsskål 1775
Acanthurus mata (Cuvier 1829) – Elongate surgeonfish

Justification: New record for Iraq and the Arabian Gulf based on five specimens collected from the coral reef area on July 15, 2012 (Fig. 12D).

Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Polynesia (Kesner-Reyes et al. 2016). No reports from the Arabian Gulf have been found (e.g. Randall 1995a; Grandcourt 2012; GBIF 2016). A tropical marine species; pelagic or in association with rocky substrate and reefs at

depths of 5-100 m (Al Sakaff & Esseen 1999; Abesamis et al. 2012), but it is usually found at 5-45 m (Baensch & Debelius 1997).

Zebrasoma Swainson 1839
Zebrasoma xanthurum (Blyth 1852) – Yellowtail tang

Justification: Two specimens were collected in 2012 from the reef area (Fig. 12E).
Distribution and habitat: Arabian Sea; Red Sea to the Arabian Gulf (Kesner-Reyes et al. 2016), with additional records from North and Central America where it is non-native (GBIF 2016). Reported from several localities in the Arabian Gulf (e.g. Smith & Saleh 1987; Carpenter et al. 1997a, b; Rezai & Savari 2004; Grandcourt 2012; GBIF 2016). Recorded for the first time from the Iraqi marine waters by Al-Badri and Jawad (2014). A tropical marine species; associated with coral- and rocky reefs down to 20 m (Lieske & Myers 1994; Baensch & Debelius 1997).
Remarks: Other than based on coloration, this species cannot be visually separated from *Z. seopas* and *Z. flavescens* (Randall 1995).

Family Sphyraenidae Rafinesque 1815
Sphyraena Klein 1778
Sphyraena putnamae Jordan & Seale 1905 – Sawtooth barracuda

Justification: Three specimens were collected in 2012 from the reef area (Fig. 12F).
Distribution and habitat: Indo-Pacific; Red Sea – South Africa to Japan – New Caledonia – Vanuatu (Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf (Carpenter et al. 1997a,b, Krupp et al. 2000; Mohammadizadeh et al. 2010; Asgharian et al. 2011; GBIF 2016), including Iraq (Ziyadi et al. 2018). A tropical marine species; associated to lagoons and reefs at depths of 3-20 m (Allen & Erdmann 2012), but found down to 115 m (GBIF 2016).
Remarks: Commonly confused with *S. jello* and *S. qenie* (Senou 2001). Based on single-gene (COI) analysis, the species *S. putnamae* and *S. jello* are not separated into different lineages (Milana et al. 2014; *S. qenie* not included in the analysis). However, trees based on other genes suggest other possible tree topographies, with stronger support for genetic divergence (Santini et al. 2015). Colour patterns and the morphology of the caudal- and second dorsal fin distinguishes *S. putnamae* from its closest relatives (Senou 2001).

Order Tetraodontiformes Berg 1940
Family Triacanthidae Bleeker 1859
Triacanthus Oken 1817
Triacanthus biaculeatus (Bloch 1786) – Short-nosed tripodfish

Justification: Ten specimens were collected in 2012 from the reef area (Fig. 12G).
Distribution and habitat: Indo-West Pacific; Arabian Gulf – Mauritius to Japan –Australia (Santini & Tyler 2002; Kesner-Reyes et al. 2016). Reported from several locations in the Arabian Gulf, including Iraq (e.g. Fischer & Bianchi 1984; Ali & Hussain 1990; Grandcourt 2012; Paighambari & Daliri 2012; GBIF 2012). A tropical marine and estuarine species; found demersally in shallow coastal muddy and sandy areas (< 22 m; Santini & Tyler 2002), but recorded down to 119 m (GBIF 2016).
Remarks: Related and morphologically similar to *T. nieuhofii* (Matsuura 2001; Santini & Tyler 2002). Distinguished based on dorsal fin colouration and head shape (Matsuura 2001). Furthermore, *T. nieuhofii* is only recorded from the East Indian Ocean (Santini & Tyler 2002).

Family Balistidae Rafinesque 1810
Odonus Gistel, 1848
Odonus niger (Rüppell 1836) – Red-toothed triggerfish

Justification: New record for Iraq and the Arabian Gulf based on four specimens collected in 2012 (Fig. 12H).
Distribution and habitat: Western Indian Ocean; Red Sea to Polynesia (Kesner-Reyes et al. 2016). No reports have been found from the Arabian Gulf (e.g. Randall, 1995a; GBIF 2016), but recorded from the Gulf of Oman (GBIF 2016). A tropical benthopelagic marine species; reef-associated at 3-77 m (Riede 2004; GBIF 2016).

Family Monocanthidae Nardo 1843
Aluterus Cloquet 1816
Aluterus monoceros (Linnaeus 1758) – Unicorn leatherjacket filefish

Justification: An underwater photo of one specimens was obtained in December 2012 from the reef area (Fig. 12I).

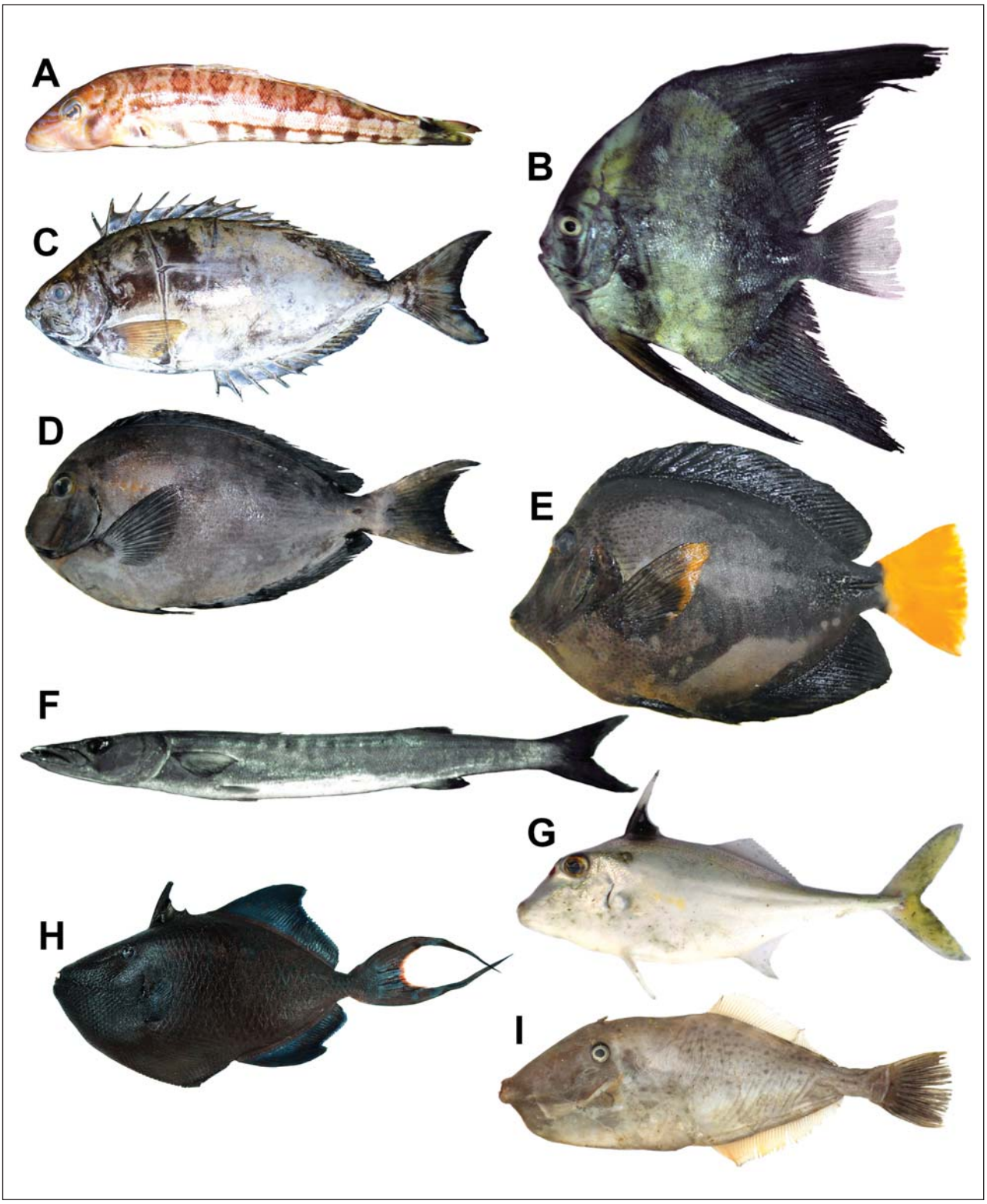

Fig. 12A-I. A, *Parapercis robinsoni*, Photo by M. Al-Mukhtar; **B**, *Platax teira*, Photo by L. A. Jawad; **C**, *Siganus canaliculatus*, Photo by Laith A. Jawad; **D**, *Acanthurus mata*, Photo by Laith A. Jawad; **E**, *Zebrasoma xanthurum*, Photo by L. A. Jawad; **F**, *Sphyraena putnamae*, Photo by M. Al-Mukhtar; **G**, *Triacanthus biaculeatus*, Photo by M. Al-Mukhtar; **H**, *Odonus niger*, Photo by L. A. Jawad; **I**, *Aluterus monoceros*, Photo by L. A. Jawad.

Distribution and habitat: Circumglobal in tropical and subtropical areas. Reported from several locations in the Arabian Gulf, including Iraq (e.g. Fischer & Bianchi 1984, Carpenter et al. 1997 a, b; Bishop 2003; Grandcourt 2012; GBIF 2016). Marine; reef-associated at depths of 1-120 m, possibly even at substantially larger depths (Allen & Erdmann 2012; GBIF 2016).

Remarks: The species has been suggested to constitute two separate lineages, one Indopacific *(A. monoceros)* and one Atlantic *(A. guntherianus),* but no distinct morphological characters have been found between specimens from these areas (Berry & Vogele 1961).

Family Tetraodontidae Bonaparte 1832
Arothron Müller 1841
Arothron stellatus (Anonymous 1798) – Stellate puffer

Justification: Four specimens were collected in 2012 from the reef area (Fig. 13A).

Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to Japan – Lord Howe Island – Polynesia (Smith & Heemstra 1986; GBIF 2016). Recorded from several locations In the Arabian Gulf (e.g. Downing et al. 1985; Smith & Saleh 1987; Krupp & Müller 1994; Carpenter et al. 1997a,b; Rezai & Savari 2004; Grandcourt 2012; GBIF 2016), including Iraq (Abed et al. 2013; Ziyadi et al. 2018). A tropical marine and brackish-water species associated with reefs and lagoons at depths down to 100 m (Myers 1991; GBIF 2016).

Lagocephalus Swainson 1839
Lagocephalus lunaris (Bloch & Schneider 1801) Lunartail puffer.

Justification: Thirteen specimens were collected in 2012 from the reef area (Fig. 13B).

Distribution and habitat: Indo-West Pacific; Red Sea – South Africa to Japan – Australia (Randall 1995a). Reported from several locations in the Arabian Gulf, including Iraq (e.g. Abou-Seedo 1992; Carpenter et al. 1997a,b; Zare, Naderi & Azvar 2013; GBIF 2016). A tropical marine and occasionally brackish-water species; demersal over sandy substrates close to reefs at depths down to 151 m (Riede 2004; GBIF, 2016).

Takifugu Abe 1949
Takifugu oblongus (Bloch 1786) – Lattice blaasop

Justification: New record for Iraq based on four specimens collected in 2012 (Fig. 13C).

Distribution and habitat: Indo-West Pacific; western India – South Africa to Japan – Australia (Kesner-Reyes et al. 2016). One previous report from the Arabian Gulf area (Naderi et al. 2013), and another record from the Sea of Oman (Jawad & Pitassy 2015). A tropical marine and estuarine species; shallow demersal habitats at depths of 3-131 m (Talwar & Jhingran 1991; GBIF 2016).

Order Pleuronectiformes Regan 1910
Family Bothidae Regan 1910
Bothus Rafinesque 1810
Bothus pantherinus (Rüppell 1830) – Leopard flounder

Justification: Six specimens were collected in 2012 from the reef area (Fig. 13D).

Distribution and habitat: Indo-Pacific; Red Sea – East Africa to Japan – Lord Howe Island – Polynesia, with a few additional records from the west coast of North America (Kesner-Reyes et al. 2016; GBIF 2016). Reported from several locations in the Arabian Gulf (e.g. Sivasubramaniam & Ibrahim 1982; Krupp & Almarri 1996; Carpenter et al. 1997a,b; Grandcourt 2012), including Iraq (Jawad & Al-Badri 2015; Ziyadi et al. 2018). A tropical marine species; benthic on sandy and silty substrates, sometimes reef-associated, at depths between 3 - 150m (recorded down to 400 m) (Hensley & Amaoka 2001; GBIF 2016).

Remarks: *Bothus pantherinus* differs from *B. mancus* in number of gillrakers on the lower limb of the first gill arch (6-8 vs. 9-11, respectively), and its upper head profile is convex, rather than concave as in *B. mancus*. Compared to *B. myriaster*, which has cycloid scales on the eyed side, all scales are ctenoid on the eyed side in *B. pantherinus* (Nielsen 1984).

Family Soleidae Bonaparte 1832
Pardachirus Günther 1862
Pardachirus balius Randall & Mee 1994

Justification: New record for Iraq and the Arabian Gulf from the coral reef area based on four specimens collected in 2012 (Fig. 13E).

Distribution and habitat: North-western Indian

Ocean; distribution previously limited to the southern coasts of Oman (Randall 1995a). The present record represents a northward range extension. A tropical, marine species; benthic at depths of 6-47 m (Randall 1995a).

Zebrias Jordan & Snyder 1900
Zebrias quagga s.l. (Kaup 1858) – Fringefin zebra sole

Justification: New record for Iraq based on three specimens collected from the coral reef area, Iraq in 15 July, 2013 (Fig. 13F).

Distribution and habitat: North-west Indian Ocean; Red Sea to the Arabian Gulf. Fischer & Bianchi (1984) consider this species as native to the Arabian Gulf, but see 'Remarks' below. A tropical marine species; benthic on sandy and muddy bottoms (Reide 2004).

Remarks: A recent revision of the *Zebrias* genus only report *Z. quagga* from the eastern part of the Indian Ocean, with *Z. captivus* being the species present in the Arabian Gulf (Stephens 2010). However, compared to the specimens in the present study, *Z. captivus* should have more darkly demarcated bands, which also should be of equal breadth to the inter-band spaces, and the meristic characters (e.g. anal-fin rays) do not match *Z. captivus* (Stephens 2010). For *Z. captivus*, a total of only two specimens are recorded, from Bahrain in 1983 (Randall 1995b; Munroe et al. 2015b), and thus the full morphological variation in this species is likely not known. Based on presently available information about the *Zebrias* species (Stephens 2010), the present specimens are evaluated to belong to *Z. quagga*. The present records, thus, represent a further north extension in the distribution of this species. However, more detailed information about *Zebrias* spp. in the Arabian Gulf needs to be collected to resolve the species distribution pattern (Munroe et al. 2015b).

DISCUSSION

The general goal of biodiversity check-lists is to

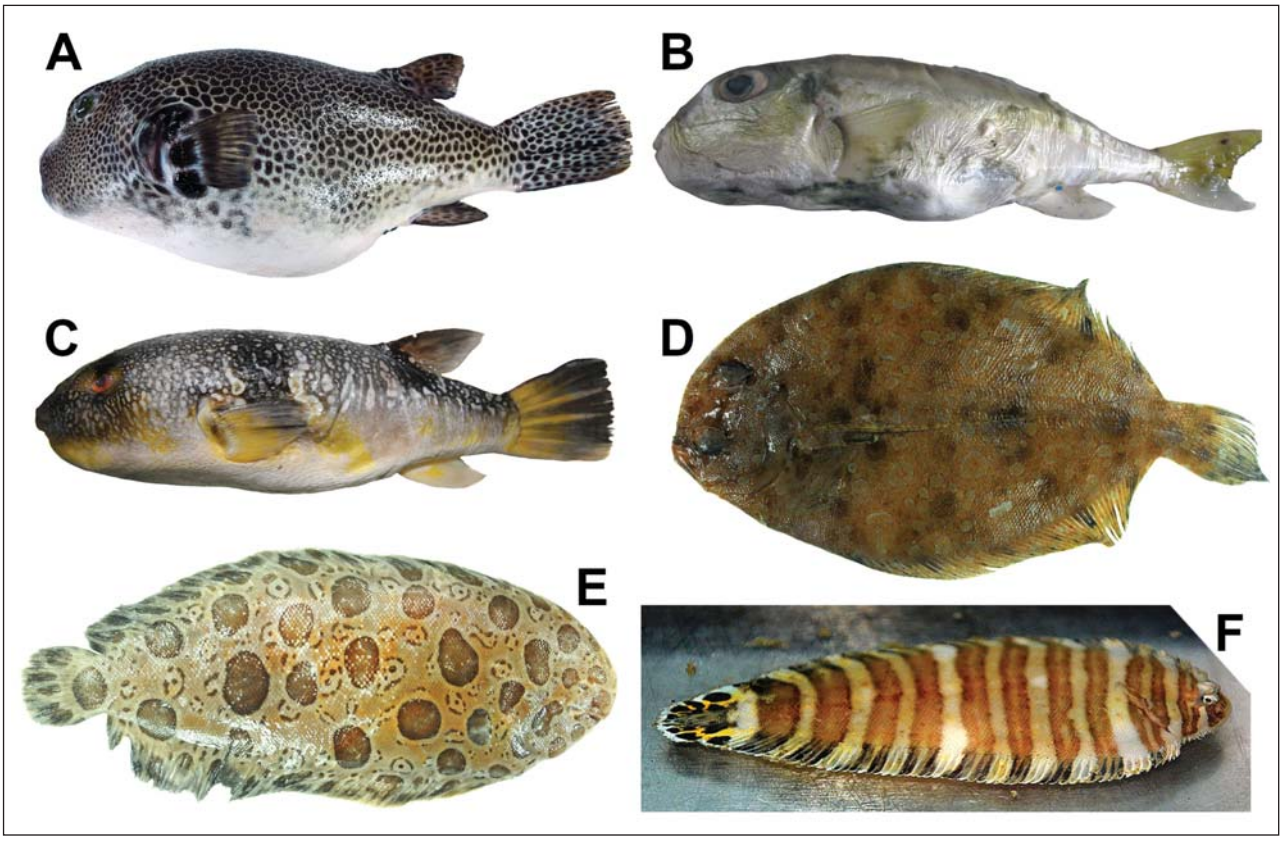

Fig. 13A-F. A, *Arothron stellatus*, Photo by L.A. Jawad; **B**, *Lagocephalus lunaris*, Photo by M. Al-Mukhtar; **C**, *Takifugu oblongus*, Photo by L. A. Jawad; **D**, *Bothus pantherinus*, Photo by L. A. Jawad; **E**, *Pardachirus balius*, Photo by L. A. Jawad; **F**, *Zebrias quagga*, Photo by M. Al-Mukhtar.

summarize the complete species record from a given geographical area. The present list should be regarded as an initial foundation for a check-list for the Iraqi coral reef area. There are likely more species associated to the reef area in question, than recorded here; both stationary and transient species. For instance, there are several more elasmobranch species in recorded in nearby areas, which are likely to be occasional guests at the reef (Moore 2012; Jabado et al. 2015; Almoji et al. 2015; Ziyadi et al. 2018). There is also a general lack of cryptic and/or small bodied demersal species in the list, e.g. eels (Anguillidae), blennies (Blenniidae), triplefins (Tripterygidae) and gobies (Gobiidae), which likely stems both from the survey methods, which have low efficiencies of capturing/recording these species, and from the nocturnal or cryptic behaviour seen in some species. The collection methodology used, i.e. commercial fishing methods and underwater photography, is biased in the sense that medium-and larger-sized species are more likely recorded. Furthermore, high turbidity limited the detection efficiency of divers at the reef during the underwater survey. A complete record of small and cryptic species, which likely constitute a substantial part of the biodiversity, may require application of ichthyocides or small-meshed traps (Myers & Donaldson 2003). Similar patterns in the fish assemblage, with an underrepresentation of small-bodied, cryptic and nocturnal species, were also observed by Zajonz et al. (2000) in the Socotra Archipelago. In addition, both species constitution and the total number of species are likely varying seasonally due to climatic factors, and over shorter time-scales due to the highly variable environment, as is the case in the western reefs in the Arabian Gulf (Coles & Tarr 1990). Hence, further surveys will probably extend the list.

The recorded fish fauna from the area of the recently discovered Iraqi coral reef comprises a total of 93 species (71 genera; 48 families; 15 orders). Among these, there are four cartilaginous species (1 and 3 sharks and rays, respectively) from four different families, and 89 teleost species from 44 families. The largest families, in terms of recorded species number, are Haemulidae and Sparidae (8 species, 8.6 % each), followed by Carangidae (7 species, 7.5 %). There are three families with four species, Lutjanidae, Lethrinidae and Nemipteridae (4.3 % each). There are 31 monospecific families representing 33.3 % of all species, and 70.5 % of the total number of the families studied. The checklist contains 10 species recorded for the first time to the Arabian Gulf area, and 23 additional species recorded for the first time in the Iraqi marine waters. Some range extensions of fish are hypothesized to be due to increased salinities in the northern Arabian Gulf, which is a consequence of reduced discharge from the Shatt Al-Arab (Al-Husaini et al. 2015). There may also be a substantial transport of species to the area by ship ballast water (Nadim et al. 2008). However, at least some of the new national records are likely a consequence of the fact that a new, previously unknown, habitat has been sampled.

Judging from records available so far, the fish species richness of the newly discovered coral reef area is relatively high in comparison to its size. Such richness could be due to counter clockwise current running through the Arabian Gulf and reaching the Iraqi marine waters with influx of pelagic eggs and larvae from Iranian waters (Carpenter et al. 1997a), which could be continuously enriching the fish communities at the reef. Fish could also potentially move between Kuwaiti reefs and the Iraqi reef (Carpenter et al. 1997b). Durville (2002) and Durville et al. (2002) showed that there is a low larval flux onto the coral reef flats of Reunion Island, but a recent study from the Great Barrier Reef suggest that dispersal ranges of some coral reef fish species, like groupers, can actually be very large (Williamson et al. 2016). Other than the estarine and anadromous species, the fish fauna of the Iraqi reef resembles the fauna of neighbouring Kuwaiti coral reefs (Carpenter et al. 1997b), and includes many species found on other Arabian Gulf coral reefs (Smith et al. 1987; Carpenter et al. 1997a; Grandcourt 2012). The estuarine and anadromous species present in the area adds to the overall fish biodiversity. The presence of these species, which is undoubtedly a consequence of the proximity to the Shatt-al-Arab estuary (e.g. Younis et al. 2016), leads to the reef having a somewhat uncharacteristic faunal constitution for a coral reef. It is not known how important the reef area is for these species' general subsistence in the area.

Some details regarding the sampling effort in the present study require particular discussion. It was initially not realized that the fish samples collected by the small trawler originated from a coral reef area. The longitudes and the latitudes given for the sampling area were checked after the announce-

ment of the discovery of the Iraqi coral reef area by Pohl et al. (2014). Field notes from the trawler collection trip in this area revealed that pieces of stone corals *Platygyra pini* (Chevalier 1975), *Turbinaria stellata* (Lamark 1816) and some ophiuroids were alive when they were collected in 2012. A living filter-feeding bivalve, *Lithophaga robusta*, which possess a high bio-eroding activity within stony corals, was also found among the fish specimens in the trawl catch. Thus, the catch from the trawler is considered to be consisting of, at least temporally, coral reef associated species.

Despite the environmental conditions in the area, with high turbidity, and temperature and salinity fluctuations, the coral reef ichthyofauna is relatively rich. The geographic location in the north-western Arabian Gulf, with counter-clockwise currents transporting water from the south, makes the reef a potentially important refuge for fish eggs, larvae, and adults following with the currents (Carpenter et al. 1997a). Furthermore, several species being red-listed by IUCN (IUCN 2018) are present in the reef area (Table I), as evidenced by the present study. In addition, several of the recorded species are included among the most vulnerable species to climate change (e.g. *Tenualosa toli* and *Pomacanthus maculosus)* (Jones & Cheung 2017). Despite the Iraqi jurisdiction being relatively small in comparison to other states with coastlines in the Arabian Gulf, the discovery of the reef will likely have some implications for the Iraqi responsibility for conserving red-listed coral-dependent fishes, see e.g. Buchanan et al. (2015). Unlike other coral reef areas (e.g. Letourneur et al. 1993; Naïm et al. 2004), the Iraqi reef and its fauna today lack official protection and no protective measures are yet put in place. Thus, the imminent impact of coastal-zone urbanisation and exploitation, as well as impact of natural disasters and climate change, mean that this unique biotope will be under increasing pressure in the future (Cuet et al. 1988; Cuet & Naïm 1992; Ahamada et al. 2002; Chabanet et al. 2002). Management plans for this reef area and its ecosystem are therefore needed, especially since there are plenty of threats to the ecosystems in the Arabian Gulf in general in the present day (Feary et al. 2013). Neighbouring habitats may need some consideration from a conservation perspective as well, since neighboring areas are important for the functioning of coral reefs (Palumbi 2004).

To assist in the forthcoming management of this coral reef area, four species of potential suitability for future monitoring are suggested as a basis for a future final selection decision. They are considered because of their wide range of distribution, potential value in fisheries, abundance and/or their potential as indicators for changes in community structure. These species are: *Epinephelus bleekeri*, *Lutjanus fulviflamma*, *Lethrinus nebulosus*, *Diagramma pictum*.

Knowledge of the local biodiversity, of which checklists are a first step, is required for management to become efficient. It is also important to note that the impact and responsibility is not only a matter for the coastal area of Iraq, but also belongs to areas upstream the major rivers and other coastal states. While the regional interest in management of coral reefs has increased over the last decades, increased managemental efforts and resources has been called for (Maghsoudlou et al. 2008). There are many problem areas for the marine nature conservation in the Arabian Gulf (Maghsoudlou et al. 2008; Sheppard et al. 2010; Feary et al. 2013; Burt 2014; Al-Abdulrazzak et al. 2015), and solving these problems will likely require continued cross-boundary collaboration among neighbouring Gulf States (Burt, 2014; Burt et al. 2012; Krupp 2002; Sheppard et al. 2012).

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