

Checklists of Protozoans and Myxozoans of Freshwater and Marine Fishes of Basrah Province, Iraq

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(Received: 30 March 2016 - Accepted: 20 April 2016)

Abstract- Reviewing the literature on all the protozoans and myxozoans parasitizing freshwater and marine fishes of Basrah Province, Iraq indicated the presence of 25 protozoans (one sarcodinid, six mastigophorans, one opalinid, four epicomplexans and 13 ciliophorans) as well as ten myxozoans. Some of these parasites infect skin, fins and gills of their hosts while others are internal parasites of fish muscles, body cavity and different body viscera. Apart from one taxon which was recorded from a marine locality, the remaining taxa were recorded from freshwater localities. The total number of protozoan and myxozoan species recorded for each fish host species fluctuated from a minimum of one parasite species in 11 fish hosts to a maximum of 15 parasite species in *Silurus triostegus*. Number of fish hosts reported for these parasites fluctuated from one host in case of 21 parasite species to a maximum of 19 host species in case of the ciliophoran *Trichodina domerguei*.

Keywords: Sarcodina, Mastigophora, Opalinata, Apicomplexa, Ciliophora, Myxozoa, freshwater fishes, marine fishes, Basrah Province, Iraq.

Introduction

Protozoan ectoparasites are the most common parasites encountered in cultured fishes and they are also frequently found on wild fishes (Noga, 2010). Under natural water conditions or fish farms, fishes are vulnerable to infection with varieties of external and internal parasites. Among these parasites, ciliophorans infect fish skin, fins and gills (Basson and Van As, 2006; Dickerson, 2006), apicomplexans and mastigophorans are generally found in the digestive tract and blood/body fluids of fishes but some mastigophorans are ectoparasites which are found on the body surface and/or gills of fishes (Woo, 2006), opalines infect the intestinal wall (Aquarium, 2010) and the myxozoans infect fins, skin, operculum, buccal cavity, nasal chamber, eye ball, gall bladder and wall of the alimentary canal (Kaur, 2014).

Protozoan infections may occur as spots, bumps or boils on different infected fish organs (Amlacher, 1970). Epithelial erosion and ulceration may result from the parasite's entrance into and exit from the host (Rogers and Gaines, 1975; Hoffman, 1999). Lesions produced by the parasites may also lead to secondary microbial infections (Noga, 2010). On the other hand, some amoeba species can cause disease as secondary pathogens, following a primary gill infection that is caused by bacteria (Bullock *et al.*, 1994). Ichthyophthiriasis (caused by *Ichthyophthirius multifiliis*) and cryptocaryoniasis (caused by *Cryptocaryon irritans*) are significant diseases in fish culturing systems. Outbreaks of these

diseases produced financial losses, resulting not only from fish mortalities, but also from the cost of control measures and treatments (Dickerson, 2006). The majority of fish apicomplexans have relatively low pathogenicity (Molnár, 2006). Although most myxozoans cause little harm, a few have become recognized as serious pathogens, especially in aquaculture situations (Feist and Longshaw, 2006).

Information concerning protozoans and myxozoans parasitic on fishes of Basrah Province are scattered in different local scientific references. Some of such parasites as well as some fishes have been misidentified, misspelled or quoted with their synonyms or with wrong authorities. For these reasons, it was decided to review these data; revise names of both parasites and fishes in accordance with updated references and electronic sites and to provide an updated fish-parasite checklist in addition to the protozoan and myxozoan lists. This review is a continuation of series of literature reviews on major groups of parasites of fishes in Basrah Province of Iraq (Mhaisen *et al.*, 1993; 2013a, b, c; Ali *et al.*, 2014; Mhaisen *et al.*, 2014; Khamees *et al.*, 2015). Finally, it was also planned to compare the richness of infected fishes of this province with protozoans and myxozoans with those of the whole country of Iraq based on data extracted from the index-catalogue of parasites and disease agents of fishes of Iraq (Mhaisen, 2016).

Sources and Methods

A total of 41 references (24 research papers, ten M. Sc. theses, three Ph. D. theses and four conference abstracts) dealing with protozoan and myxozoan parasites of fishes of Basrah Province were used to prepare the present review. Data from such references were gathered to provide parasite list and fish-parasite list. Notes on parasite misidentification as well as misspelling in names of such parasites, their authorities and synonyms were corrected in accordance with information from some electronic sites (EOL, 2016; ITIS, 2016; WoRMS, 2016), relevant literature and correspondence with some experts. For fishes, the scientific names were reported as they appeared in their original references but they were then checked with a recent account on freshwater fishes of Iraq (Coad, 2010). However, fish valid names used here were based on the widely used electronic site, the FishBase (Froese and Pauly, 2016) as well as the Catalog of Fishes (Eschmeyer, 2016), but Durand (2016) was followed for the recent valid names of members of fish family Mugilidae.

The index-catalogue of parasites and disease agents of fishes of Iraq (Mhaisen, 2016) was used to show number of protozoans and myxozoans reported for each infected fish species in Basrah Province in comparison with that of the whole country of Iraq as well as the richness of fishes of Basrah Province with these parasites in comparison with such richness in fishes of the whole country of Iraq.

Results and Discussion

Surveys Achieved on Fish Protozoans and Myxozoans in Basrah Province:

Surveying of available literature showed the presence of 41 references on protozoans and myxozoans of fishes of Basrah Province. From these references, five major categories of fish habitats can be recognized. These are:

- 1- The marshy area (Al-Hammar Marsh), north of Basrah.
- 2- Shatt Al-Arab River and its creeks and canals.
- 3- Fish farms and aquaria in Basrah Province.

4- Marine waters of the northwest of the Arab Gulf.

5- Tigris River, north of Qurna City, north of Basrah.

Reports on fish protozoans and myxozoans from the marshy area of Basrah Province were achieved in Al-Hammar Marsh, north of Basrah (Al-Daraji, 1986; Mohamad, 1989; Al-Daraji and Al-Salim, 1990; Al-Salim and Al-Daraji, 1990, 1992; Al-Salim and Mohamad, 1995; Bannai *et al.*, 2005; Jori, 2006, 2007; Abbas, 2007). Results of an abstract provided by Ali *et al.* (1990) cannot be taken in consideration as no host-parasite account was given for the studied fishes from Al-Hammar Marsh.

Some reports on fish protozoans and myxozoans were done on Shatt Al-Arab River (Sharma, 1977; Al-Salim, 1985, 1986, 1989a, b, 1992a, 1993; Eassa *et al.*, 2014) and its creeks and canals which included those from Al-Ashar Canal (Bhatti, 1979), Mehajjeran Creek, south of Basrah City (Khamees, 1983; Mhaisen *et al.*, 1986), Garmat Ali River, north of Basrah City (Jori, 1998; Abdul-Rahman, 1999; Al-Dosary, 1999; Adday, 2001; Al-Niaeem, 2002, 2006a, b; Kadhim, 2009; Al-Janae'e, 2010) and Al-Salihiya Canal, east of Basrah City (Al-Janae'e, 2010).

Some reports were done on protozoans and myxozoans from some farm fishes, cage fishes and aquarium fishes of Basrah Province (Al-Salim, 1992b; Al-Daraji *et al.*, 1999, 2002, 2006; Salih, 2005; Jassim, 2007; Ahmed and Ali, 2013; Al-Ali *et al.*, 2013; Eassa *et al.*, 2014).

Only one report on a myxozoan parasite of one marine fish species of Iraq from Khor Al-Zubair Estuary (Mhaisen and Al-Maliki, 1996) is so far existed.

Only one report on unidentified protozoan cyst was reported from the intestine of a single species of fishes from Tigris River, north of Qurna City (Al-Maliki *et al.*, 2015).

Protozoans and Myxozoans Recorded from Fishes of Basrah Province:

Reviewing existing literature on protozoan and myxozoan parasites of fishes collected from Basrah Province indicated the existing of 35 taxa belonging to six phyla, eight classes, 12 orders, 13 families and 15 genera (Table 1). Two FAO Fisheries Technical Papers (Arthur and Te, 2006; Kirjušina and Vismanis, 2007) were followed to arrange the major taxonomic groups down to the scientific names of such parasites. These parasites are alphabetically presented under their taxonomical groups. Notes on parasite misidentification and misspelling in names of such protozoans, their authorities and synonyms are corrected in accordance with the information from some electronic sites, relevant literature and correspondence with some experts. Names of fish hosts are quoted as they appeared in the reviewed literature but the valid names have been updated according to Durand (2016), Eschmeyer (2016) and Froese and Pauly (2016). The full authority of each valid fish host species is shown in Table (2).

Major Groups of Parasitic Fauna: Parasite-Host List

Apart from one group (Sarcodina), the parasite-host list is arranged in the major groups of parasitic fauna according to Arthur and Te (2006) and Kirjušina and Vismanis (2007). For each major group, a list of species together with their hosts and concerned references is given. Also, the systematic account of all major groups is given down to the specific name of all parasites (Table 1). For each parasite species, all records from fishes of Basrah Province are given together with the first record of each concerned parasite in Iraq, as well as the present number of

all hosts so far known in Iraq for each concerned species based on the index-catalogue of parasites and disease agents of fishes of Iraq (Mhaisen, 2016).

Phylum Sarcodina

The phylum Sarcodina was recognized as Sarcodina by Shul'man (1984), Rhizopoda by Hoole *et al.* (2001), Sarcomastigophora by EOL (2016), Protozoa by ITIS (2016) and Amoebozoa by Zilberg and Munday (2006) and WoRMS (2016). This phylum is represented in fishes of Basrah Province with one species of the genus *Entamoeba* (Table 1).

Entamoeba histolytica Schaudinn, 1903 was reported from the intestinal lumen of *Cyprinus carpio* by Al-Daraji *et al.* (1999), who erroneously stated the authority as Schandinn, 1903, from the fish ponds of Marine Science Centre. They described the nature of trophozoite in the text and cyst with chloroplast, glycogen vacuole and two nuclei in the figures. According to a correspondence between one of us (F.T.M.) and Dr. Omar M. Amin on 29 Jan. 2015, this was a misdiagnosis as the occurrence of both cysts and trophozoites suggests a complete cycle of the parasite in the fish which is a physical impossibility. *E. histolytica* is well known to infect the primates (Roberts and Janovy, 1996). Although some *Entamoeba* spp. infect fishes (Imam *et al.*, 1987; Bullock *et al.*, 1994; Guz and Szczepaniak, 2009) but no reports were found on the infection of fishes with *E. histolytica*. So, the sarcodine species reported by Al-Daraji *et al.* (1999) should be designated as *Entamoeba* sp.

Phylum Mastigophora

The phylum Mastigophora was recognized as Euglenozoa by Woo (2006), EOL (2016) and WoRMS (2016) but as Sarcomastigophora by ITIS (2016). It is represented in fishes of Basrah Province with four species of the genus *Trypanosoma* and one species of *Ichthyobodo* in addition to some unidentified species of the genus *Trypanosoma* (Table 1).

Trypanosoma arabica Al-Salim & Al-Daraji, 1990 was described as a new species from the blood plasma of *Silurus triostegus* from Al-Hammar Marsh (Al-Salim and Al-Daraji, 1990; Jori, 2006). No type material of such new species was preserved in any museum. It is appropriate to mention here that this species was reported earlier as *Trypanosoma* sp. from the same fish (which was reported by its synonym *Parasilurus triostegus*) and from the same locality by Al-Daraji (1986). No more records of such parasite are so far known from fishes of Iraq (Mhaisen, 2016).

Trypanosoma basrensis Al-Salim & Al-Daraji, 1992 was described as a new species from the blood of *Leuciscus vorax* (reported as *Aspius vorax*) from Al-Hammar Marsh (Al-Salim and Al-Daraji, 1992). No type material of such new species was preserved in any museum. The specific name was derived from Basrah and hence it should be spelled as *basransis* not *basrensis*. It is appropriate to mention here that this species was reported earlier as *Trypanosoma* sp. from the same fish and the same locality by Al-Daraji (1986). No more records of such parasite are so far known from fishes of Iraq (Mhaisen, 2016).

Trypanosoma carasobarbi Al-Salim, 1985 was described as a new species from the heart blood of *Carasobarbus luteus* from Shatt Al-Arab River (Al-Salim, 1985). Again, no type material of such new species was preserved in any museum. *T. carasobarbi* was reported later from the same fish (as well as its synonym *Barbus luteus*) from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990)

and from Mehaijeran Creek (Mhaisen *et al.*, 1986). It is appropriate to mention here that *Trypanosoma* sp. reported from the same fish from Mehaijeran Creek (Khamees, 1983) is conspecific with *T. carasobarbi* of Al-Salim (1985). So far, *C. luteus* is the only host for *T. carasobarbi* in Iraq (Mhaisen, 2016).

Trypanosoma mystuii Al-Jafery & Rahemo, 1982 was reported from the blood of *Mystus pelusius* from Garmat Ali River (Al-Dosary, 1999). Its first description as a new species (again with no specimen deposition in any museum) was from the same fish from Tigris River at Baghdad by Al-Jafery and Rahemo (1982). No more hosts for *T. mystuii* are so far known from Iraq (Mhaisen, 2016).

Few unidentified *Trypanosoma* species were reported from four fish species in Basrah Province. These included *C. luteus* from Mehaijeran Creek (Khamees, 1983), *L. vorax* (reported as *A. vorax*) from Al-Hammar Marsh (Al-Daraji, 1986), *Planiliza abu* (reported as *Liza abu*) from Garmat Ali River (Al-Dosary, 1999) and *S. triostegus* (also reported as *P. triostegus*) from both Al-Hammar Marsh (Al-Daraji, 1986; Jori, 2006) and from Garmat Ali River (Al-Dosary, 1999). It is appropriate to mention here that *Trypanosoma* sp. reported by Khamees (1983) and Mhaisen *et al.* (1986) was considered as conspecific with *T. carasobarbi* while *Trypanosoma* sp. reported from *A. vorax* (synonym of *L. vorax*) by Al-Daraji (1986) was considered as conspecific with *T. basrensis* and *Trypanosoma* sp. reported from *P. triostegus* (synonym of *S. triostegus*) by Al-Daraji (1986) was considered conspecific with *T. arabica*. Twelve fish species are so far reported as hosts for *Trypanosoma* spp. in Iraq (Mhaisen, 2016).

Against the rules of the International Commission of Zoological Nomenclature (I.C.Z.N.), authors of all the nine *Trypanosoma* species so far reported as new species in Iraq (Mhaisen, 2016) failed to deposit any trypanosome materials in any museum or research institution. Only syntype of *T. acanthobramae* was deposited in the Department of Biology, College of Science, University of Mosul (Warsi and Fattohy, 1976). The conclusion of naming new trypanosome species in Iraq was based on the assumption that a new host and a new geographical area for a trypanosome mean a new trypanosomal species (Fattohy, 1975). This is untrue as *T. danilewskyi*, for example, was first described from the blood of *C. carpio* in Europe and has since been found in goldfish (*Carassius auratus*), tench (*Tinca tinca*) and eel (*Anguilla* sp.) in Europe and in *Saccobranchus* (= *Heteropneustes*) *fossilis* in India (Woo, 2006).

Ichthyobodo necator (Henneguy, 1883) Pinto, 1928 was reported as trophozoite and cyst from the skin of *Heteropneustes fossilis* from Al-Ashar Canal (Bhatti, 1979) under the name of *Costia necatrix* (Henneguy, 1883). According to Mhaisen (1980), this parasite was not ascertained by an expert as Dr. M. N. Bhatti himself was a fish physiologist. According to Woo (2006), EOL (2016) and WoRMS (2016), *C. necatrix* is a previous name of *Ichthyobodo necator*. So far, *I. necator* has seven fish host species in Iraq but for all these hosts, it was reported as *C. necatrix* (Mhaisen, 2016).

Phylum Opalinata

The phylum Opalinata is recognized as Sarcocystidophora by ITIS (2016) and as Bigyra by WoRMS (2016). It is represented in fishes of Basrah Province with one species of the genus *Opalina* (Table 1).

Opalina ranarum Ehrenberg, 1831 was reported from the intestine of *C. carpio* and *P. abu* (reported as *L. abu*) from the Experimental Station of the Marine

Science Centre (Al-Daraji *et al.*, 1999). In page 84 of Al-Daraji *et al.* (1999), the generic name was spelled as *Opalinia*, the authority was given as Metcalf and the year of authority was erroneously given as 1932. Name parser according to Global Names Index (2010) indicated the presence of *Opalina ranarum* Ehrenberg, 1831 as well as three subspecies (*O. r. arvalis*, *O. r. late* and *O. r. smithi*) by Metcalf, 1923 and one subspecies (*O. r. orbicularia*) by Metcalf, 1940. So, as no subspecies was given by Al-Daraji *et al.* (1999), their record should be considered as *O. ranarum* Ehrenberg, 1831. No more hosts are so far known for this parasite in Iraq (Mhaisen, 2016).

Phylum Apicomplexa

The phylum Apicomplexa is known as Myzozoa by EOL (2016) and WoRMS (2016). It is represented in fishes of Basrah Province with three species of the genus *Haemogregarina* in addition to unidentified specimen of this genus (Table 1).

Haemogregarina cyprini Smirnova, 1971 was recorded from the blood of *C. carpio* from Basrah University Fish Farm (Al-Salim, 1992b). No more records of such parasite are so far known in fishes of Iraq (Mhaisen, 2016).

Haemogregarina majeedi Al-Salim, 1993 was described as a new species from erythrocytes, erythroblasts and blood plasma of *Mesopotamichthys sharpeyi* (reported as *Barbus sharpeyi*) from Shatt Al-Arab River by Al-Salim (1993). No materials were deposited in any museum but the author stated that one slide was with Dr. C. D. Becker of Pacific Northwest Richland, Washington. In a conference abstract, Al-Salim (1989a) mentioned its first occurrence from the same fish. No more records of such *H. majeedi* are so far known in fishes of Iraq (Mhaisen, 2016).

Haemogregarina meridianus Al-Salim, 1989 was described as a new species from erythrocytes, erythroblasts and blood plasma of *P. abu* (reported as *L. abu*) from Shatt Al-Arab River (Al-Salim, 1989b). No materials were deposited in any museum. No more records of such *H. meridianus* are so far known in fishes of Iraq (Mhaisen, 2016).

Unidentified *Haemogregarina* species was mentioned, in an abstract, from the blood of *Planiliza subviridis* (reported as *Liza subviridis*) from Shatt Al-Arab River by Al-Salim (1992a). In Iraq, Hussain *et al.* (2013) recorded another unidentified *Haemogregarina* sp. from gills of *C. carpio* from Al-Shark Al-Awsat Fish Farm, Babylon Province with neither description nor a good illustration. No more records of unspecified *Haemogregarina* are so far known in fishes of Iraq (Mhaisen, 2016).

Phylum Ciliophora

This phylum is recognized by the three electronic cites (EOL, 2016; ITIS, 2016; WoRMS, 2016). This phylum is represented in fishes of Basrah Province with one species each of the genera *Balantidium*, *Chilodonella*, *Ichthyophthirius*, *Apiosoma*, *Tetrahymena* and *Nyctotheroides* and four species of the genus *Trichodina* in addition to some unidentified species of the genera *Ichthyophthirius* and *Apiosoma* (Table 1).

Balantidium coli (Malmsten, 1857) Stein, 1863 was reported as trophozoite from the intestine of *C. carpio*, *P. abu* (reported as *L. abu*) and *Planiliza carinata* (reported as *Liza carinata*) from fish ponds and fibreglass tanks at Marine Science

Centre (Al-Daraji *et al.*, 1999). As some *Balantidium* species, such as *Balantidium ctenopharyngodoni* Chen, 1955, *Balantidium spinibarbichthys* Ky, 1971, *Balantidium polyvacuolum* Li, 1963, *Balantidium barbi* (Dogiel & Bykhovski, 1934) Jankovski, 1982 and *Balantidium sigani* Diamant & Wilbert, 1985 infect fishes (Arthur and Te, 2006; Basson and Van As, 2006; Al-Salmany, 2015) and as *B. coli* infects the mammals (Roberts and Janovy, 1996), we consider *B. coli* reported by Al-Daraji *et al.* (1999) as representing *Balantidium* sp. In fishes of Iraq, only two species of *Balantidium* are so far known (Mhaisen, 2016).

Chilodonella hexasticha (Kiernik, 1909) Kahl, 1931 was reported from gills of *S. triostegus* from Al-Hammar Marsh (Abbas, 2007). That was the first record of *C. hexasticha* in Iraq which has so far two host species in Iraq (Mhaisen, 2016).

Ichthyophthirius multifiliis Fouquet, 1876 was reported from ten fish species in Basrah Province. These were *C. luteus* from three satations viz., Mehajeran Creek (Khamees, 1983; Mhaisen *et al.*, 1986), Al-Ashar Fish Market (Mhaisen, 1986) and Al-Hammar Marsh (Al-Daraji, 1986), *Carassius auratus* from Al-Salihiya Canal (Al-Janae'e, 2010), *Ctenopharyngodon idella* from Basrah University Experimental Aquaculture Station (Jassim, 2007), *C. carpio* from Basrah University Experimental Aquaculture Station (Al-Daraji *et al.*, 2002a; Jassim, 2007; Ahmed and Ali, 2013), from Al-Salihiya Canal (Al-Janae'e, 2010) and from fish cages at Al-Qurnah City and Al-Dayr Town as well as from the river at Al-Qurna City, Al-Dayr Town and Abul-Khaseeb City (Eassa *et al.*, 2014), *Gambusia holbrooki* from Garmat Ali River (Kadhim, 2009), *Garra rufa* from Shatt Al-Arab River (Mhaisen, 1986), *L. vorax* (reported as *A. vorax*) from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990) and from Basrah Fish Market (Mhaisen, 1986), *P. abu* (reported as *L. abu*) from Garmat Ali River (Jori, 1998; Al-Dosary, 1999), *Poecilia latipinna* from Garmat Ali River (Kadhim, 2009) and *S. triostegus* from Al-Hammar Marsh (Jori, 2006; Abbas, 2007). *I. multifiliis* was recorded for the first time in Iraq from *P. subviridis* (reported as *Mugil dussumieri*) from Tigris River at Baghdad by Herzog (1969). So far, 35 fish hosts are known for *I. multifiliis* in Iraq (Mhaisen, 2016).

I. multifiliis appears to parasitize all freshwater fishes. There are suggestions of variation in the degree of susceptibility between fishes. These variations may depend on such factors as genetic background, physiological status of the fishes, parasite strains and environmental conditions (Dickerson, 2006). Unidentified *Ichthyophthirius* species were reported from skin and fins of *P. abu* (reported as *L. abu*) from Shatt Al-Arab River (Sharma, 1977) and from gills of *M. pelusius* from Garmat Ali River (Al-Dosary, 1999). Unidentified *Ichthyophthirius* sp. was reported for the first time in Iraq by Shamsuddin *et al.* (1971) from both *M. sharpeyi* (reported as *B. sharpeyi*) and *S. triostegus*. Unidentified *Ichthyophthirius* species are so far known from four fish species in Iraq (Mhaisen, 2016).

Apiosoma amoeba (Grenfell, 1887) Lom, 1966 was recorded in Basrah Province from skin and gills of *P. latipinna* from Garmat Ali River by Kadhim (2009), who misspelled the specific name as *amoebae*. Li *et al.* (2008) in their consideration of the genus *Apiosoma* showed that *A. amoeba* has four synonyms. The first record of *A. amoeba* from Iraq was by Ali *et al.* (1989) from *C. carpio*. So far, five fish host species are known for this parasite in Iraq (Mhaisen, 2016).

Unidentified *Apiosoma* species were reported from gills of both *M. pelusius* and *S. triostegus* from Garmat Ali River (Adday, 2001). So far, no any more records of

unidentified *Apiosoma* sp. are known from fishes of Iraq (Mhaisen, 2016).

Trichodina domerguei (Wallengren, 1897) Haider, 1964 was reported from skin and gills of 19 fish species from Basrah Province. These hosts included *Acanthobrama marmid* from Garmat Ali River and Al-Salihiya Canal (Al-Janae'e, 2010), *Acanthopagrus arabicus* (reported as *A. latus*) from Garmat Ali River (Al-Janae'e, 2010), *Alburnus mossulensis* from Garmat Ali River and Al-Salihiya Canal (Al-Janae'e, 2010), *Arabibarbus grypus* (reported as *B. grypus*) from Al-Salihiya Canal (Al-Janae'e, 2010), *C. luteus* (reported as *B. luteus*) from Garmat Ali River (Al-Janae'e, 2010), *Carassius auratus* from Garmat Ali River and Al-Salihiya Canal (Al-Janae'e, 2010), *C. idella* from Basrah University Experimental Aquaculture Station and Fry Caring Ponds (Jassim, 2007), *C. carpio* from Basrah University Fish Farm at Al-Tanuma town (Mhaisen, 1986), from Basrah University Experimental Aquaculture Station and Fry Caring Ponds (Jassim, 2007), from Al-Salihiya Canal (Al-Janae'e, 2010) and from fish cages at Al-Qurnah City, Al-Dayr Town and Abu Al-Khaseeb City as well as from rivers at Al-Qurnah City, Al-Dayr Town and Abu Al-Khaseeb City (Eassa *et al.*, 2014), *G. holbrooki* from Garmat Ali River (Kadhim, 2009), *H. fossilis* from Al-Hammar Marsh (Mohamad, 1989; Al-Salim and Mohamad, 1995), *Hypophthalmichthys molitrix* from Basrah University Experimental Aquaculture Station and Fry Caring Ponds (Jassim, 2007), *Luciobarbus xanthopterus* (reported as *B. xanthopterus*) from Garmat Ali River (Al-Janae'e, 2010), *Mastacembelus mastacembelus* from Garmat Ali River (Adday, 2001), *M. pelusius* from Garmat Ali River (Adday, 2001), *P. abu* (reported as *L. abu*) from Garmat Ali River (Jori, 1998; Al-Janae'e, 2010) and from Al-Salihiya Canal (Al-Janae'e, 2010), *P. subviridis* (reported as *L. subviridis*) from Shatt Al-Arab River (Al-Salim, 1992a) and from Garmat Ali River (Al-Janae'e, 2010), *P. latipinna* from Garmat Ali River (Al-Janae'e, 2010), *S. triostegus* from Garmat Ali River (Adday, 2001; Al-Janae'e, 2010) and from Al-Hammar Marsh (Jori, 2006) and *Sparidentex hasta* from Garmat Ali River (Al-Janae'e, 2010). Al-Salim (1992a) claimed that *T. domerguei* was detected from the blood of *P. subviridis* (reported as *L. subviridis*). According to Hoffman (1999), trichodinids usually live on fish gills but in weakened fishes they possibly cover the entire surface of the fish. So, occurrence of this parasite in the blood is doubtful. The first record of *T. domerguei* in Iraq was from eight freshwater fish species from Tigris River, Al-Tharthar Lake and fish markets in Baghdad City (Shamsuddin *et al.*, 1971). So far, 39 fish host species are known for *T. domerguei* in Iraq (Mhaisen, 2016) which makes it the most distributed ciliophoran species in fishes of Iraq.

Trichodina nigra Lom, 1961 was reported from Basrah Province from gills of *S. triostegus* from Al-Hammar Marsh (Jori, 2006). Its first record in Iraq was from both *C. carpio* and *H. molitrix* from Al-Furat Fish Farm (Al-Zubaidy, 1998). Nine fish host species are so far known for *T. nigra* in Iraq (Mhaisen, 2016).

Trichodina prowazeki Grupcheva & Lom, 1980 was reported from Basrah Province from blood and heart muscle of *S. triostegus* from Al-Hammar Marsh (Jori, 2006) which was its first report in Iraq as well. The occurrence of this parasite in the blood and heart muscle is doubtful. No more records are so far known for *T. prowazeki* in fishes of Iraq (Mhaisen, 2016).

Trichodina reticulata Hirschmann & Partsch, 1955 was reported from Basrah Province from skin, gills and blood of *S. triostegus* from Al-Hammar Marsh (Jori, 2006) which was its first report in Iraq as well. Such occurrence in fish blood is doubtful. Four fish host species are so far known for *T. reticulata* in Iraq (Mhaisen,

2016).

Unidentified *Trichodina* species were so far reported from five fish species in Basrah Province. These were *Aphanius dispar* from Garmat Ali River (Kadhim, 2009), *C. carpio* from Garmat Ali River (Al-Dosary, 1999) as well as from University of Basrah Fish Farm (Ahmed and Ali, 2013), *P. abu* (reported as *L. abu*) from Garmat Ali River (Al-Dosary, 1999), *P. latipinna* from Garmat Ali River (Kadhim, 2009) and *S. triostegus* from Garmat Ali River (Al-Dosary, 1999) as well as from Al-Hammar Marsh (Jori, 2006). Occurrence of *Trichodina* sp. from the blood and cardiac muscles of *S. triostegus* (Jori, 2006) is doubtful. In addition to 24 recognized *Trichodina* species so far recorded from fishes of Iraq, some unidentified species of *Trichodina* were so far recorded from six fish species (Mhaisen, 2016).

Tetrahymena corlissi Thompson, 1955 was isolated for the first time in Iraq from dead eggs, larvae and eyes of both *C. carpio* and *M. sharpeyi* (reported as *B. sharpeyi*) from the hatchery of Marine Science Centre, University of Basrah (Al-Daraji *et al.*, 2006). These authors had erroneously reported the authority of this parasite as Hoffman & Glenn, 1978. Al-Ali *et al.* (2013) while reporting this parasite from both *C. carpio* and *G. holbrooki* (misidentified as *G. affinis*) from fish ponds of Marine Science Centre, University of Basrah, claimed that this parasite was reported for the first time in Iraq from *C. carpio*, *G. holbrooki* (reported as *G. affinis*) and *M. sharpeyi* (reported as *B. sharpeyi*) by Salih (2005) but as a result of continuous searching for such reference, especially in collaboration with Miss Hanaa Husein Mohammed, Marine Science Centre who is in charge with the Iraqi Journal of Aquaculture, the authors of this article came to a conclusion that Salih (2005) is in fact a faked reference. No more records on *T. corlissi* from fishes of Iraq are so far available (Mhaisen, 2016).

Nyctotheroides cordiformis (Ehrenberg, 1838) Grassé, 1928 was reported as *Nyctotherus cordiformis* Ehrenberg, 1838 as trophozoite from the intestine of *C. carpio*, *P. abu* (reported as *L. abu*) and *P. carinata* (reported as *L. carinata*) from fish ponds of Marine Science Centre (Al-Daraji *et al.*, 1999). According to EOL (2016), *Nyctotherus cordiformis* is a synonym of *Nyctotheroides cordiformis* (Ehrenberg, 1838) Grassé, 1928 and according to Brands (2015), the specific name *cordiformis* belongs not to the genus *Nyctotherus* but to the genus *Nyctotheroides*. No more records on *N. cordiformis* are so far available from fishes of Iraq (Mhaisen, 2016).

Phylum Cnidaria-Subphylum Myxozoa

Okamura *et al.* (2015) reviewed the multicellular nature of myxozoan spores and led to early proposals that myxozoans should not be classified as Protozoa but as Metazoa. Fiala *et al.* (2015) considered the Myxozoa as an unranked subphylum of the phylum Cnidaria. A recent phylogenomic analysis demonstrated by Chang *et al.* (2015) confirmed that myxozoans are cnidarians. The Myxozoa was recognized as Myxozoa by both EOL (2016) and ITIS (2016) but it was considered as a class within the phylum Cnidaria by WoRMS (2016). The Myxozoa is represented in fishes of Basrah Province with one species of the genus *Henneguya* and seven species of *Myxobolus* in addition to some unspecified species of the genera *Myxobolus* and *Thelohanellus* (Table 1). The authority of most *Myxobolus* species was checked in accordance with Eiras *et al.* (2005).

Henneguya tachysuri Menon, 1979 was reported from the subcutaneous tissues

of *S. triostegus* from Al-Hammar Marsh (Jori, 2006) and from the stomach of the same fish and same locality by Abbas (2007). *H. tachysuri* was described as a new species from the subcutaneous muscles of the marine catfish *Tachysurus thalassinus* (= *Netuma thalassina*) caught off Gulf of Mannar at Tuticorin of India (Menon, 1979). No more records are so far known for this parasite in Iraq (Mhaisen, 2016).

Myxobolus cyprinicola Reuss, 1906 was reported in Basrah Province from the intestine of *S. triostegus* from Al-Hammar Marsh (Abbas, 2007). This parasite was reported for the first time in Iraq from gills and fins of *C. carpio* from Dokan Lake (Abdullah, 1997) and so far it has nine host species in Iraq (Mhaisen, 2016).

Myxobolus diversus Nie & Li, 1973 was reported only from fins of *P. subviridis* (reported as *L. subviridis*) from Al-Hammar Marsh (Jori, 2007). No more records are available for this parasite in Iraq (Mhaisen, 2016).

Myxobolus intrachondrealis Molnár, 2000 was reported only from *C. carpio* from the southern part of Al-Hammar Marsh in a conference abstract (Bannaï *et al.*, 2005) without mentioning parasite authority and the site of infection and the generic name was misspelled as *Myxobobulus*. No more records are available for this parasite in Iraq (Mhaisen, 2016).

Myxobolus mesopotamiae Molnár, Masoumian & Abbasi, 1996 was reported only from fins of *S. triostegus* from the southern part of Al-Hammar Marsh (Jori, 2006). This parasite was reported for the first time in Iraq from *C. luteus* (reported as *B. luteus*) from Greater Zab River (Abdullah, 2002) and so far it has three host species in Iraq (Mhaisen, 2016).

Myxobolus oviformis Thélohan, 1892 was reported from different external and internal sites of seven fish species in Basrah Province. These were *M. sharpeyi* (reported as *B. sharpeyi*) from Shatt Al-Arab River (Al-Salim, 1989a) as well as six fish species from Garmat Ali River (Abdul-Rahman, 1999) which included *C. luteus* (reported as *B. luteus*), *Carassius carassius*, *C. carpio*, *L. vorax* (reported as *A. vorax*), *P. abu* (reported as *L. abu*) and *P. subviridis* (reported as *L. subviridis*). *M. oviformis* was reported for the first time in Iraq from *A. grypus* (reported as *B. grypus*), *L. vorax* (reported as *A. vorax*), *Luciobarbus esocinus* (reported as *Barbus esocinus*) and *M. sharpeyi* (reported as *B. sharpeyi*) by Herzog (1969). It is appropriate to mention here that the year of authority of *M. oviformis* was given as 1882 instead of 1892 in most Iraqi literature. So far, it has 20 fish host species in Iraq (Mhaisen, 2016).

Myxobolus pfeifferi Thélohan, 1895 was reported from different external and internal sites of 14 fish species in Basrah Province. These were *A. arabicus* (reported as *A. latus*) from Garmat Ali River (Al-Janae'e, 2010), *Alburnus sellal* (reported as *Chalcalburunus sellal*) from Garmat Ali River (Abdul-Rahman, 1999), *C. luteus* (also reported as *B. luteus*) from Mehajjeran Creek (Khamees, 1983; Mhaisen *et al.*, 1986), Shatt A-Arab River (Al-Salim, 1986), Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990) and from Garmat Ali River (Abdul-Rahman, 1999), *C. carassius* from Garmat Ali River (Abdul-Rahman, 1999), *C. idella* from Garmat Ali River (Abdul-Rahman, 1999), *C. carpio* from Garmat Ali River (Abdul-Rahman, 1999) and from fish cages at Al-Qurnah City and Al-Dayr Town as well as from the river at Al-Qurnah City, Al-Dayr Town and Abul-Khaseeb City (Eassa *et al.*, 2014), *H. fossilis* from Garmat Ali River (Abdul-Rahman, 1999), *L. vorax* (reported as *A. vorax*) from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990) and from Garmat Ali River (Abdul-Rahman, 1999), *M.*

mastacembelus from Garmat Ali River (Abdul-Rahman, 1999), *M. sharpeyi* (Also reported as *B. sharpeyi*) from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990) and from Garmat Ali River (Abdul-Rahman, 1999), *Periophthalmus waltoni* from Khor Al-Zubair Estuary (Mhaisen and Al-Maliki, 1996), *P. abu* (reported as *L. abu*) from Mehajjeran Creek (Khamees, 1983; Mhaisen *et al.*, 1986), from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990), Shatt A-Arab River (Al-Salim, 1989), Garmat Ali River (Jori, 1998; Abdul-Rahman, 1999; Al-Niaeem, 2002, 2006a, b; Al-Janae'e, 2010) and from Al-Salihya Canal (Al-Janae'e, 2010), *P. subviridis* (reported as *L. subviridis*) from Shatt Al-Arab River (Al-Salim, 1992a) and from Garmat Ali River (Abdul-Rahman, 1999) and *S. triostegus* (also reported as *P. triostegus*) from Al-Hammar Marsh (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990; Jori, 2006; Abbas, 2007) and from Garmat Ali River (Abdul-Rahman, 1999). *M. pfeifferi* was reported for the first time in Iraq from *A. marmid* from Tigris River at Mosul City (Fattohy, 1975) and so far, it was recorded from 35 fish host species in Iraq (Mhaisen, 2016) which makes it the most distributed *Myxobolus* species in fishes of Iraq.

Myxobolus punctatus Chandhuri & Chakravarty, 1970 was reported as trophozoite only from the epithelial layer of the intestine of *C. carpio* from fish ponds of Marine Science Centre (Al-Daraji *et al.*, 1999). The authority of this parasite was erroneously given as Raychandhuri & Chakravarty, 1970 by Al-Daraji *et al.* (1999). No more records of this parasite are so far available in fishes of Iraq (Mhaisen, 2016).

Unidentified *Myxobolus* species were reported from gills, gonads, intestinal wall and blood of *P. abu* (reported as *L. abu*) from Garmat Ali River (Al-Dosary, 1999) and from cardiac muscle and tissues of *S. triostegus* from Al-Hammar Marsh (Jori, 2006). Three myxozoans reported from gills of some fishes from Al-Hammar Marsh by Ali *et al.* (1990) cannot be taken in consideration as no adequate information on their hosts were documented. So far, seven fish species are known as hosts for unidentified *Myxobolus* species from fishes of Iraq (Mhaisen, 2016).

Unidentified *Thelohanellus* species was reported only from *C. carpio* from the southern part of Al-Hammar Marsh in a conference abstract (Bannai *et al.*, 2005) without mentioning the site of infection. No more records are so far known of *Thelohanellus* species in fishes of Iraq (Mhaisen, 2016).

Host-Parasite List

The names of all fish hosts infected with protozoans and myxozoans in Basrah Province (28 valid fish names and 15 synonymous and misidentified names) are alphabetically arranged. For each host, the parasite species are also alphabetically arranged. For each parasite species, the references are chronologically arranged but references of the same year are alphabetically arranged. The present host list included the valid as well as the synonymous fish names.

Acanthobrama marmid: *Trichodina domerguei* (Al-Janae'e, 2010).

Acanthopagrus arabicus, reported also as *A. latus*: *Myxobolus pfeifferi* (Al-Janae'e, 2010), *Trichodina domerguei* (Al-Janae'e, 2010).

Acanthopagrus latus: See *Acanthopagrus arabicus*.

Alburnus mossulensis: *Trichodina domerguei* (Al-Janae'e, 2010).

Alburnus sellal, reported as *Chalcalburnus sellal*: *Myxobolus pfeifferi* (Abdul-Rahman, 1999).

- Aphanius dispar*: *Trichodina* sp. (Kadhim, 2009).
- Arabibarbus grypus*, reported as *Barbus grypus*: *Trichodina domerguei* (Al-Janae'e, 2010).
- Aspius vorax*: See *Leuciscus vorax*.
- Barbus grypus*: See *Arabibarbus grypus*.
- Barbus luteus*: See *Carasobarbus luteus*.
- Barbus sharpeyi*: See *Mesopotamichthys sharpeyi*.
- Barbus xanthopterus*: See *Luciobarbus xanthopterus*.
- Carasobarbus luteus*, reported also as *Barbus luteus*: *Ichthyophthirius multifiliis* (Khamees, 1983; Al-Daraji, 1986; Mhaisen, 1986; Mhaisen *et al.*, 1986), *Myxobolus oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Khamees, 1983; Al-Daraji, 1986; Al-Salim, 1986; Mhaisen *et al.*, 1986; Al-Daraji and Al-Salim, 1990; Abdul-Rahman, 1999), *Trichodina domerguei* (Al-Janae'e, 2010), *Trypanosoma carasobarbi* (Al-Salim, 1985; Al-Daraji, 1986; Mhaisen *et al.*, 1986; Al-Daraji and Al-Salim, 1990).
- Carassius auratus*: *Ichthyophthirius multifiliis* (Al-Janae'e, 2010), *Trichodina domerguei* (Al-Janae'e, 2010).
- Carassius carassius*: *Myxobolus oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Abdul-Rahman, 1999).
- Chalcalburnus sellal*: See *Alburnus sellal*.
- Coptodon zillii*, reported as *Tilapia zillii*: Unidentified protozoan cyst (Al-Maliki *et al.*, 2015).
- Ctenopharyngodon idella*: *Ichthyophthirius multifiliis* (Jassim, 2007), *Myxobolus pfeifferi* (Abdul-Rahman, 1999), *Trichodina domerguei* (Jassim, 2007).
- Cyprinus carpio*: *Balantidium* sp. (Al-Daraji *et al.*, 1999), *Entamoeba* sp. (Al-Daraji *et al.*, 1999), *Haemogregarina cyprini* (Al-Salim, 1992b), *Ichthyophthirius multifiliis* (Al-Daraji *et al.*, 2002a; Jassim, 2007; Al-Janae'e, 2010; Ahmed and Ali, 2013; Eassa *et al.*, 2014), *Myxobolus intrachondrealis* (Bannai *et al.*, 2005), *M. oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Abdul-Rahman, 1999; Eassa *et al.*, 2014), *M. punctatus* (Al-Daraji *et al.*, 1999), *Nyctotheroides cordiformis*, reported as *Nyctotherus cordiformis* (Al-Daraji *et al.*, 1999), *Opalina ranarum* (Al-Daraji *et al.*, 1999), *Tetrahymena corlissi* (Al-Daraji *et al.*, 2006; Al-Ali *et al.*, 2013), *Thelohanellus* sp. (Bannai *et al.*, 2005), *Trichodina domerguei* (Mhaisen, 1986; Jassim, 2007; Al-Janae'e, 2010; Eassa *et al.*, 2014), *Trichodina* sp. (Al-Dosary, 1999; Ahmed and Ali, 2013).
- Gambusia affinis*: See *Gambusia holbrooki*.
- Gambusia holbrooki*, misidentified as *Gambusia affinis*: *Ichthyophthirius multifiliis* (Kadhim, 2009), *Tetrahymena corlissi* (Al-Ali *et al.*, 2013), *Trichodina domerguei* (Kadhim, 2009).
- Garra rufa*: *Ichthyophthirius multifiliis* (Mhaisen, 1986).
- Heteropneustes fossilis*: *Ichthyobodo necator*, reported as *Costia necatrix* (Bhatti, 1979), *Myxobolus pfeifferi* (Abdul-Rahman, 1999), *Trichodina domerguei* (Mohamad, 1989; Al-Salim and Mohamad, 1995).
- Hypophthalmichthys molitrix*: *Trichodina domerguei* (Jassim, 2007).
- Leuciscus vorax*, reported as *Aspius vorax*: *Ichthyophthirius multifiliis* (Al-Daraji, 1986; Mhaisen, 1986; Al-Daraji and Al-Salim, 1990), *Myxobolus oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990; Abdul-Rahman, 1999), *Trypanosoma basrensis* (Al-Salim and Al-

- Daraji, 1992).
- Liza abu*: See *Planiliza abu*.
- Liza carinata*: See *Planiliza carinata*.
- Liza dussumieri*: See *Planiliza subviridis*.
- Liza subviridis*: See *Planiliza subviridis*.
- Luciobarbus xanthopterus*, reported as *Barbus xanthopterus*: *Trichodina domerguei* (Al-Janae'e, 2010).
- Mastacembelus mastacembelus*: *Myxobolus pfeifferi* (Abdul-Rahman, 1999), *Trichodina domerguei* (Adday, 2001).
- Mesopotamichthys sharpeyi*, reported also as *Barbus sharpeyi*: *Haemogregarina majeedi* (Al-Salim, 1989a; 1993), *Myxobolus oviformis* (Al-Salim, 1989a), *M. pfeifferi* (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990; Abdul-Rahman, 1999), *Tetrahymena corlissi* (Al-Daraji et al., 2006).
- Mystus pelusius*: *Apiosoma* sp. (Adday, 2001), *Ichthyophthirius* sp. (Al-Dosary, 1999), *Trichodina domerguei* (Al-Janae'e, 2010), *Trypanosoma mystuii* (Al-Dosary, 1999).
- Parasilurus triostegus*: See *Silurus triostegus*.
- Periophthalmus waltoni*: *Myxobolus pfeifferi* (Mhaisen and Al-Maliki, 1996).
- Planiliza abu*, reported as *Liza abu*: *Balantidium* sp. (Al-Daraji et al., 1999), *Haemogregarina meridianus* (Al-Salim, 1989b), *Ichthyophthirius multifiliis* (Jori, 1998; Al-Dosary, 1999), *Ichthyophthirius* sp. (Sharma, 1977), *Myxobolus oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Khamees, 1983; Al-Daraji, 1986; Mhaisen et al., 1986; Al-Salim, 1989b; Al-Daraji and Al-Salim, 1990; Jori, 1998; Abdul-Rahman, 1999; Al-Niaeem, 2002, 2006a, b; Al-Janae'e, 2010), *Myxobolus* sp. (Al-Dosary, 1999), *Nyctotheroides cordiformis*, reported as *Nyctotherus cordiformis* (Al-Daraji et al., 1999), *Opalina ranarum* (Al-Daraji et al., 1999), *Trichodina domerguei* (Jori, 1998; Al-Janae'e, 2010), *Trichodina* sp. (Al-Dosary, 1999), *Trypanosoma* sp. (Al-Dosary, 1999).
- Planiliza carinata*, reported as *Liza carinata*: *Balantidium* sp. (Al-Daraji et al., 1999), *Nyctotheroides cordiformis*, reported as *Nyctotherus cordiformis* (Al-Daraji et al., 1999).
- Planiliza subviridis*, reported as *Liza dussumieri* and *L. subviridis*: *Haemogregarina* sp. (Al-Salim, 1992a), *Myxobolus diversus* (Jori, 2007), *M. oviformis* (Abdul-Rahman, 1999), *M. pfeifferi* (Al-Salim, 1992a; Abdul-Rahman, 1999), *Trichodina domerguei* (Al-Salim, 1992a; Al-Janae'e, 2010).
- Poecilia latipinna*: *Apiosoma amoeba* (Kadhim, 2009), *Ichthyophthirius multifiliis* (Kadhim, 2009), *Trichodina domerguei* (Al-Janae'e, 2010), *Trichodina* sp. (Kadhim, 2009).
- Silurus triostegus*, reported also as *Parasilurus triostegus*: *Apiosoma* sp. (Adday, 2001), *Chilodonella hexasticha* (Abbas, 2007), *Henneguya tachysuri* (Jori, 2006; Abbas, 2007), *Ichthyophthirius multifiliis* (Jori, 2006; Abbas, 2007), *Myxobolus cyprinicola* (Abbas, 2007), *M. mesopotamiae* (Jori, 2006), *M. pfeifferi* (Al-Daraji, 1986; Al-Daraji and Al-Salim, 1990; Abdul-Rahman, 1999; Jori, 2006; Abbas, 2007), *Myxobolus* sp. (Jori, 2006), *Trichodina domerguei* (Adday, 2001; Jori, 2006; Al-Janae'e, 2010), *T. nigra* (Jori, 2006), *T. prowazeki* (Jori, 2006), *T. reticulata* (Jori, 2006), *Trichodina* sp. (Al-Dosary, 1999; Jori, 2006), *Trypanosoma arabica* (Al-Salim and Al-Daraji, 1990; Jori, 2006), *Trypanosoma* sp. (Al-Dosary, 1999; Jori, 2006).

Sparidentex hasta: *Trichodina domerguei* (Al-Janae'e, 2010).
Tilapia zillii: See *Coptodon zillii*.

Addenda

With this article and the previous allied articles (Mhaisen *et al.*, 2013a, b, c; Ali *et al.*, 2014; Mhaisen *et al.*, 2014; Khamees *et al.*, 2015), checklists of all the groups of protozoan and metazoan parasites infecting fishes of Basrah Province were achieved. However, it is appropriate to mention here that Al-Maliki *et al.* (2015) indicated that a protozoan cyst was recovered from the intestine of *Coptodon zillii* (reported as *Tilapia zillii*) from Tigris River, north of Qurna City. As neither description and measurements nor illustration for such cyst were given, it remains as a vague record. Also, there were two reports on the occurrence of *Glugea plecoglossi* Takahashi & Egusa, 1974 from skin, liver and intestine of *S. triostegus* from Al-Hammar Marsh (Jori, 2006) and from the stomach of the same fish from the same region (Abbas, 2007). Both researchers claimed that *G. plecoglossi* is a protozoan. In fact, it belongs to the Microspora, which, based on analyses of various molecular markers, was considered as a separate phylum in the kingdom Fungi (Dyková, 2006; EOL, 2016; WoRMS, 2016).

Acknowledgements

Special thanks are due to Dr. Omar M. Amin of the Institute of Parasitic Diseases, Arizona, U.S.A. for his comments on some of the protozoan parasites. Thanks are due to Dr. Beth Okamura of the Department of Life Sciences, Natural History Museum, London, UK for forwarding some valuable articles. We appreciate the continuous efforts exerted by Miss Hanaa Husein Mohammed of the Marine Science Centre, University of Basrah for her search with us about one reference (Salih, 2005) which finally appeared to be as a faked reference. Special thanks are due to anonymous reviewers for their suggestions to improve this manuscript.

Table 1. List of protozoan and myxozoan parasites of fishes of Basrah Province.

Phylum Sarcodina
 Class Lobosa
 Order Amoebida
 Family Entamoebidae
Entamoeba sp. {1/1}*
 Phylum Mastigophora
 Class Kinetoplastidea
 Order Kinetoplastida
 Family Trypanosomatidae
Trypanosoma arabica Al-Salim & Al-Daraji, 1990 {1/1}
Trypanosoma basrensis Al-Salim & Al-Daraji, 1992 {1/1}
Trypanosoma carasobarbi Al-Salim, 1985 {1/1}
Trypanosoma mystuii Al-Jafery & Rahemo, 1982 {1/1}
Trypanosoma spp. {2/12}
 Family Bodonidae
Ichthyobodo necator (Henneguy, 1883) Pinto, 1928 {1/7}
 Phylum Opalinata
 Class Opalinatea
 Order Opalinida
 Family Opalinidae
Opalina ranarum Ehrenberg, 1831 {2/2}
 Phylum Apicomplexa
 Class Sporozoa
 Order Eimeriida
 Family Haemogregarinidae
Haemogregarina cyprini Smirnova, 1971 {1/1}
Haemogregarina majeedi Al-Salim, 1993 {1/1}
Haemogregarina meridianus Al-Salim, 1989 {1/1}
Haemogregarina sp. {1/2}
 Phylum Ciliophora
 Class Kinetophragminophorea
 Order Trichostomatida
 Family Balantidiidae
Balantidium sp. {3/3}
 Order Cytrophorida
 Family Chilodonellidae
Chilodonella hexasticha (Kiernik, 1909) Kahl, 1931 {1/2}
 Class Oligohymenophorea
 Order Hymenostomatida
 Family Ichthyophthiridae
Ichthyophthirius multifiliis Fouquet, 1876 {10/35}
Ichthyophthirius sp. {2/4}
 Order Petrichida
 Family Epistylididae
Apiosoma amoeba (Grenfell, 1887) Lom, 1966 {1/5}
Apiosoma sp. {2/2}
 Order Mobilina
 Family Trichodinidae
Trichodina domerguei (Wallengren, 1897) Haider, 1964 {19/39}
Trichodina nigra Lom, 1961 {1/9}
Trichodina prowazeki Grupcheva & Lom, 1980 {1/1}
Trichodina reticulata Hirschmann & Partsch, 1955 {1/4}

- Trichodina* sp. {5/6}
 Order Tetrahymenida
 Family Tetrahymenidae
Tetrahymena corlissi Thompson, 1955 {3/3}
 Class Polymenophora
 Order Heterotrichida
 Family Sicuophoridae
Nyctotheroides cordiformis (Ehrenberg, 1838) Grassé, 1928 {3/3}
- Phylum Cnidaria
 Subphylum Myxozoa
 Class Myxosporea
 Order Bivalvulida
 Family Myxobolidae
Henneguya tachysuri Menon, 1979 {1/1}
Myxobolus cyprinicola Reuss, 1906 {1/9}
Myxobolus diversus Nie & Li, 1973 {1/1}
Myxobolus intrachondrealis Molnár, 2000 {1/1}
Myxobolus mesopotamiae Molnár, Masoumian & Abbasi, 1996 {1/3}
Myxobolus oviformis Thélohan, 1892 {7/20}
Myxobolus pfeifferi Thélohan, 1895 {14/35}
Myxobolus punctatus Chandhuri & Chakravarty, 1970 {1/1}
Myxobolus sp. {2/7}
Thelohanellus sp. {1/1}

* Numbers in curly brackets after the authority of each parasite species refer to number of hosts recorded for that parasite in Basrah Province/ number of hosts recorded for the same parasite from the whole water bodies of Iraq, based on Mhaisen (2016).

Table (2). List of fishes of Basrah Province and their richness with the protozoan and myxozoan parasites[§].

Class Actinopterygii
Order Cypriniformes
Family Cyprinidae
Acanthobrama marmid Heckel, 1843 {1/7}
Alburnus mossulensis Heckel, 1843 {1/1}
Alburnus sellal Heckel, 1843 {1/4}
Arabibarbus grypus (Heckel, 1843) {1/25}
Carasobarbus luteus (Heckel, 1843) {5/28}
Carassius auratus (Linnaeus, 1758) {2/4}
Carassius carassius (Linnaeus, 1758) {2/5}
Ctenopharyngodon idella (Valenciennes, 1844) {3/7}
Cyprinus carpio Linnaeus, 1758 {14/43}
Garra rufa (Heckel, 1843) {1/7}
Hypophthalmichthys molitrix (Valenciennes, 1844) {1/7}
Leuciscus vorax (Heckel, 1843) {4/9}
Luciobarbus xanthopterus Heckel, 1843 {1/19}
Mesopotamichthys sharpeyi (Günther, 1874) {4/16}

Order Siluriformes
Family Bagridae
Mystus pelusius (Solander, 1794) {4/10}

Family Siluridae
Silurus triostegus Heckel, 1843 {15/29}

Family Heteropneustidae
Heteropneustes fossilis (Bloch, 1794) {3/4}

Order Cyprinodontiformes
Family Poeciliidae
Gambusia holbrooki Girard, 1859 {3/3}
Poecilia latipinna (Lesueur, 1821) {4/4}

Family Cyprinodontidae
Aphanius dispar (Rüppell, 1829) {1/3}

Order Synbranchiformes
Family Mastacembelidae
Mastacembelus mastacembelus (Banks & Solander, 1794) {2/5}

Order Perciformes
Family Sparidae
** *Acanthopagrus arabicus* Iwatsuki, 2013 {2/4}
** *Sparidentex hasta* (Valenciennes, 1830) {1/1}

Family Cichlidae
Coptodon zillii (Gervais, 1848) {1/5}

Family Gobiidae
* *Periophthalmus waltoni* Koumans, 1941 {1/1}

Order Mugiliformes
Family Mugilidae
Planiliza abu (Heckel, 1843) {12/36}
** *Planiliza carinata* (Valenciennes, 1836) {2/2}
** *Planiliza subviridis* (Valenciennes, 1836) {5/5}

§ Richness of fishes with the protozoan and myxozoan parasites: number of protozoan and myxozoan species recorded in any particular fish in Basrah Province/ number of protozoan and myxozoan species recorded from that fish from the whole water bodies of Iraq, based on Mhaisen (2016).

* Marine fishes, ** Marine fishes entering fresh waters and the remaining are freshwater fishes.

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قوائم مرجعية للحيوانات الإبتدائية والبوغيات المخاطية لأسماك المياه العذبة والبحرية في محافظة البصرة، العراق

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المستخلص - أظهر إستعراض المراجع عن كل الحيوانات الإبتدائية والبوغيات المخاطية المتطفلة على أسماك المياه العذبة والبحرية في محافظة البصرة، العراق وجود 25 نوعا من الحيوانات الإبتدائية (نوع واحد من اللحميات، ستة أنواع من حاملات الأسواط، نوع واحد من الأوبيلينا، أربعة أنواع من الأبيكومبلكسا، 13 نوعا من حاملات الأهداب) إضافة لعشرة أنواع من البوغيات المخاطية. بعض هذه الطفيليات تصيب جلد، زعانف وغلاصم مضيقاتها في حين تعدّ الأخرى طفيليات داخلية في عضلات الأسماك أو جوفها الجسمي أو مختلف الأحشاء الداخلية. بإستثناء نوع واحد فقط سجل من بيئة بحرية، فقد سجلت كل الأنواع الباقية من بيئات مياه عذبة. تذبذب العدد الكلي لعدد أنواع تلك الطفيليات لكل نوع من الأسماك المضيقة مابين حد أدنى هو نوع واحد من تلك الطفيليات في 11 نوعا مضيقا من الأسماك إلى حد أقصى عدد وهو 15 نوعا من تلك الطفيليات في سمكة الجري الآسيوي *Silurus triostegus*. وتذبذب عدد أنواع الأسماك المضيقة لهذه الطفيليات مابين مضيقة واحد فقط في حالة 21 نوعا من الطفيليات إلى أقصى عدد وهو 19 نوعا مضيقا في حالة الإصابة بحامل الأهداب *Trichodina domerguei*.