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Parasites as biological tags of *Tenualosa ilisha* (Hamilton- Buchanan, 1822) as an indicator of fish immigration in Iraqi Waters.

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Abstract
In present study a total of 1,456 specimens (428 males, 534 females and 494 unidentified small individuals) of *T. ilisha* were collected between, **Jan.** 2013 and Dec, 2014, 20 specimens of each monthly samples were isolated in the study area. Five stations were chosen, starting from the city of Al-FAW in the estuary section of the river to the northern-most station in the Al Hammar Marshs (the current study was completed within the scientific biological team of ***Tenualosa ilisha*** fishes). The study uses' the Parasite as biological tags of fish immigration, three specie's of parasite are described: *Nothobomolochus* sp. (copepod); *Faustula* sp and *Ectenurus papillatus* (digenea). The results of the present study refers that the parasites were collected are appears only in the, first station from the estuary section of the city of Al-FAW with fish lengths 250-460(400) mm in male and female with *Faustula* sp and *Ectenurus papillatus* (digenea), and *Nothobomolochus* sp. (copepod), and there are not any infected with small individuals of *T. ilisha* fishes. The results refers also the Parasites are considered as new records in Iraqi marine fishes and give us two important points, that are fishes don't emigrate from the Indian Ocean to Iraq or that the fish lose the types of parasites during migration, and fishes is likely to be endemic in the Arab Gulf region.

Keywords: parasitic fauna, *Tenualosa ilisha*, parasite, biological tags of fish immigration, Iraqi Marine and Fresh Water fishes

1. Introduction
T. ilisha represents one of the important edible fish species especially in the south parts of Iraq and the countries which coast line in the Arab Gulf. The Hilsa shad, *Tenualosa ilisha* (Hamilton, 1822) is an anadromous clupeid that migrates from the Arabian Gulf towards freshwater rivers for spawning. In Iraq, it migrates in the Shatt al Arab River and surrounding marshes up to 100 km. It is a widely distributed species in Asia and the Middle East (Pillay and Rao, 1963) [1]. and has recently been described in Malaysia (Arai and Amalian, 2014) [2]. A dramatic decline in annual catch of Hilsa shad in Iraq has been observed, mainly because of the decrease in water availability due to the construction of dams, which has affected its spawning, feeding and migration (Roomian and Jamili, 2011) [3].
The species is known from the northern part of the India Ocean (from the Persian Gulf eastward to the Andaman coast of Myanmar, including western and eastern coasts of India, and western (Andaman) coats of Thailand and Malaysia; Reported from Viet Nam (Gulf of Tonkin), the Tigris River basin and probably present in other rivers of southern Iran.
This species is restricted to the northwestern Gulf, north to the estuary of the Shatt al-Arab River in Iraq and other rivers in Iran. It ascends the Shatt al-Arab River to the great marsh area north of Basra City, Iraq. The upper limit of its northern distribution is Al-Hammer Marsh, 180 km north of Basra City, and up to 220 km inland to the Karun River and its tributaries in Iran. This species is also found in Kuwait Bay, Historically, *T. ilisha* was found to Qalaat Salah on the Tigris River and to Al-Fahod on the Euphrates River about 150-180 km north of Basrah. the Global Distribution:
Tenualosa ilisha occurs in the Indian Ocean from The Gulf, east to the coasts of India, as far as Myanmar (Burma). It has also been reported from the Gulf of Tonkin (Viet Nam) as well as the Tigris River and probably other rivers of southern Iran.
Rahman and Halder, (1998) [4] have mentioned that this fish species plays an economic role

and is the largest single species contributor to the fisheries sector of Bangladesh. D′Silva *et al*. (2012) [5] have pointed out that the parasitic fauna of *T.ilisha* captured in east parts of Indian coastal from the line consist of fourteen species of endo- helminthes parasites. In Bangladesh. The helminthes parasites of *T.ilisha* were investigated by many workers (Bashirullah and D'Silva (1973) [6], D'Silva and Khatoon (1997) [7], D'Silva *et al.* (2012) [5]. Only two studies concerning with the helminthes parasite of *T. ilisha* were carried in the Arabian Gulf region, Al-Daraji (1995) [8] and Al-Daraji (2004) [9]. Many techniques have been used to identify and discriminate stocks, including the application of artificial tags, such as acoustic tags, coded wire tags. In particular, parasites as biological tags have gained wide acceptance in recent decades (MacKenzie, 2002) [10] as they can provide a reliable guide to under- standing the biology of their host. parasites as tags are superior to other methods, but it is recognized that they have helped answer questions on host diet and feeding behavior, movements and ranges, connectivity of stocks, recruitment patterns of juveniles and phylogenies (Moser, 1991) [11]. Parasites have also been used as bio-indicators of pollution (Poulin, 1992; MacKenzie *et al.*, 1995; MacKenzie, 1999) [12, 13, 14] and in population studies to discriminate stocks (MacKenzie, 2002) [10]. Research on parasites as biological tags for marine organisms has increased at a steady rate, with nine papers on this subject published from the 1950s, more than 30 from the 1960s, more than 50 from the 1970s and more than 140 from the 1980s (Williams *et al*., 1992) [15]. Present study is the first attempt to study the helminthes parasites fauna of a migratory fish, *T.ilisha* in different environment to determine anadromous if there was a difference in their composition between the infected freshwater, brackish and salt water and compare with Indian Ocean region studies.

3. Materials and Methods

In total, 1,456 specimens (428 males, 534 females and 494 undifferentiated small individuals) of *T. ilisha* were collected between April, 2013 and March, 2014. Five stations were chosen, starting from the city of Al-FAW in the estuary section of the river to the northern-most station in the Al Hammar Marsh. The stations of Abu al-Khasib, Sebba and Tigris-Marsh were intermediary. The Tigris-Marsh station was at the junction of the Shatt Al and Garmat Ali rivers, which flow from the Al Hammar Marsh (Fig. 1).

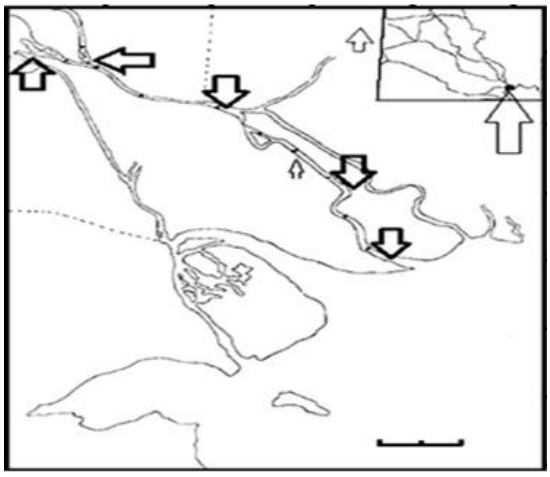

Fig 1: Study area of *Tenualosa ilisha* (Arrows indicate the sampling stations)

Specimens were collected using gillnets. To control the selectivity, fish samples were collected using panels with different mesh size (67×67, 57×57, 48×48, 42×42, 33×33 and 30×30 mm). Port samples were also taken as supplement samples with different size group of fishes. A beach seine with mesh sizes of 20×20, 18×18 and 16×16 mm was used to collect juveniles in Marsh habitats. Total Length (TL) was recorded to the nearest 1.0 mm.

Fishes were check for ectoparasite before they were dissected the weight, length and sex of each fish were recorded, and viscera of the fish were removed individually and put in 10% formalin in polyethylene bags with a label inside. Extensive search was made for helminthes parasites infecting the fish using dissecting microscope. Cardiac stomach, pyloric ceaca, stomach, intestine and mesenteries were separated, placed in Petri dishes and searched. All the parasites from each organ were sorted, cleaned and counted. They were preserved in 70% alcohol. Berland's methods were used for staining and mounting. All helminthes specimens were sent to museum for identification. Parasite were identified by Dr. K. Mackenzie, The University of Aberdeen is a charity registered in Scotland, No SC013683.and copepod parasite by Нина Самотылова USSR museum. Photographs were taken by digital Sony camera attached to microscope.

4. Results

Taxonomy of the parasites

Nothobomolocus sp.

Order Cyclopoida

Suborder Poecilostomatoida

Family Iomolochidae

Genus *Nothobomolocus* Vervoort, 1962.

Nothobomolocus sp. (fig -1b).

Class	:	Trematoda
Order	:	Strigeataidea
Family	:	Fellodistomatidae
Genus	:	*Faustula*

Faustula sp. (Fig-1 c)

Order	:	Plagiorchiidae
Family	:	Hemiuridae
Genus	:	*Ectenurus*
Species	:	*Ectenurus papillatus (f*ig -1D).

The results confirmed that the fish migrates from the Gulf region to the marshes area, The size and weight of the specimens of *T. ilisha* collected throughout the migration season in the study area (Table 1) ranged from 50-460 mm TL and 0.97-1253 g, (Table 1). Males were smaller in length and weight than females. Total length of females ranged from 90-460 mm, with an average of 261.03 (±64.5 SD) mm and a body weight range of 7.0-1253 g, with an average of 231.79 (±103 SD) g. Males had a total length range of 50-400 mm, with mean of 244 (±56.5 SD) mm and a body weight range of 3.5-690 g with an average of 178.87(±67.6 SD) g. The maximum weight of females and males was observed in June. The highest mean total length was observed in October. The monthly variation in mean length for both sexes combined showed two distinct peaks. The first was recorded during February-March and the second was recorded during September-November. However, a big decline in mean length was observed during May and July (The current study was completed within the scientific team to study the migration and biological of *Tenualosa ilisha* fishes). Fish infected appear in the total length 250-460 in both male and female. The study uses' the Parasite as biological tags of fish immigration, three

specie's of parasite are described: *Nothobomolochus* sp. (copepod); *Faustula* sp and *Ectenurus papillatus* (digenea). The results of present study refers that the parasites were collected and appeaed only in the, starting from the city of Al-FAW in the estuary section of the river with total length 250-460 in male and female with *Faustula* sp and *Ectenurus papillatus* (digenea), and *Nothobomolochus* sp. (copepod) and lose the copepod parasite in the Shatt Al and Garmat Ali rivers, which flow from the Al Hammar the northern-most station in the Al Hammar Marsh. Whereas internal parasite appears in the Shatt Al and Garmat Ali rivers, which flow from the Al Hammar the northern-most station in the Al Hammar Marsh until the Jul.

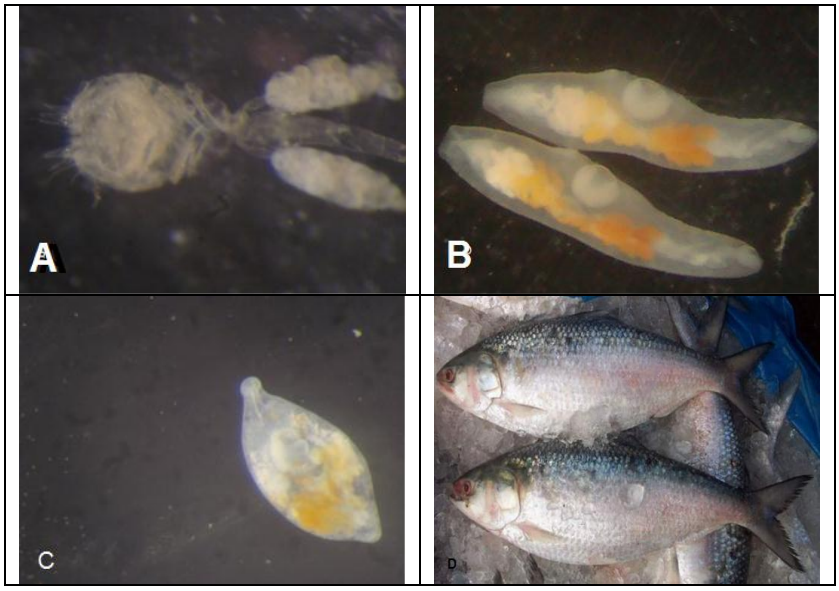

Fig 1: photograph of parasites A: *Nothobomolocus* sp., C: *Faustula* sp. D: *Ectenurus papillatus*. D**: *Tenualosa ilisha* (Hamilton- Buchanan, 1822)**

Table 3: the percentage of prevalence and intensity of infection during study periods.

Month	No of Exm. Fish	No of fish infected with			Prevalence %			Intensity		
		E.papillatus	*Noth.*sp	***Faustula* sp**	***E.papillatus***	*Noth.*sp	***Faustula* sp**	***E.papillatus***	*Noth.*sp.	***Faustula* sp**
Feb 2013	20	12	3	385	60	15	100	1.66	1.66	19.25
Mar	20	4	4	200	1	1	90	2	5.75	11.11
Apr	20	6	6	350	30	30	100	1.3	16.6	17.5
May.	20	8	6	350	40	30	90	1.25	4.16	19.4
June.	20	2	0	12	10	0	10	0	0	6
Jul.	20	1	0	9	5	0	5	7	0	9
Aug	20	0	0	0	0	0	0	0	0	0
Sept.	20	0	0	0	0	0	0	0	0	0
Oct.	20	0	0	0	0	0	0	0	0	0
Nov	20	0	0	0	0	0	0	0	0	0
.	20	0	0	0	0	0	0	0	0	0
Dec.	20	0	0	0	0	0	0	0	0	0

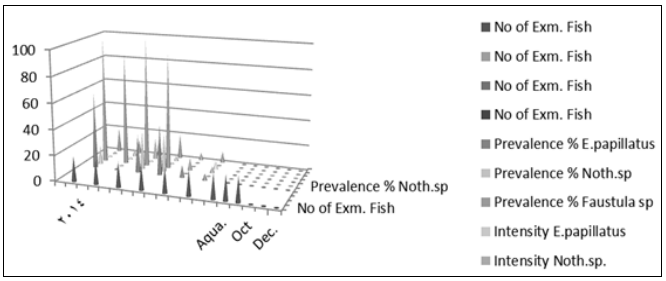

Fig 2: The percentage of prevalence and intensity of infection during study periods.

The present study showed that there are varied in the percentage of prevalence and intensity of infection during study periods table 3.

Also, results showed that the infections with all of parasites species appear during the months Feb. to Jul. Of the years 2013, these are marine and brackish sample and some of fresh water area and disappear from the month of July to December, and these are freshwater sample area.

In addition to that, results showed that there are varied in infections with *Nothobomolocus* species during the months of infection in March and April with 30% prevalence and 16.6, 5.75 0f intensity of infection during and decreased in January and February, with differ in the prevalence 15%,1% and intensity 1.66, 5.75. See table 3.

Highly infections were observed with *Faustula* sp. During the months January to April with prevalence 100% to 90% of infection in the in marine sample and intensity 19.25, 11.11, 17.5, 19.4. And decrease in May and June prevalence 10%, 5% and intensity 6, 9 in brackish fish sample, and losing the infection in the other months of years in the freshwater sample.

Whereas, *the E. papillatus* height prevalence were observed in January and April 60% to 40% and decreased in May 30%,june 5% to 1%in Feb.in marine fish sample and with intensity 1.66,2,1.3,1.25,0,7 during the months January to June

and absent in the other months of freshwater fish sample.

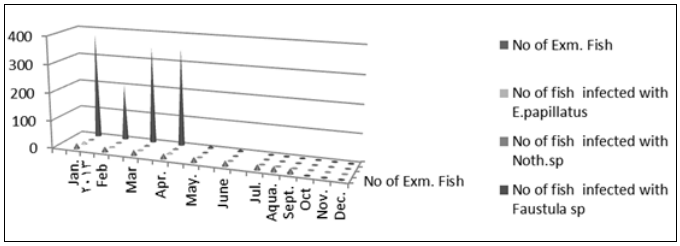

Fig 3: infected fish during the period study

The current study also showed changed values of salinity and temperature during the seasonal variation, the salinity values ranged between in the northwest Arabian Gulf region and Al-Mashab in the region of marshes and Shatt Al-Arab, this change in salinity values reflected on the distribution and prevalence of parasites in their host, where there exists great diversity in terms of species and parasites setting down these values when you change the values of salinity in the Shatt al-Arab and particularly external parasites including..

The results of this study have showed obvious seasonality per size group, suggesting two distinct peaks. The first peak was recorded during February-March and the second was recorded during September-November, indicating that fishes with different sizes have not occurred in the same area year-around. The observed temporal pattern of size structure was probably due to the spawning migration of the species (Mutlak, 2012; Mohamed and Qasim, 2014; Hussain *et al.*, 1991) [16, 17, 18]. Along the study period, males were slightly smaller than females except in June.

5. Discussion

According to (D Silva and Khatoon, 1997) [7] *T.Hilsha* fishes are resident in the Bay of Bengal. During spawning, it migrates to upstream, the migration begins in the monsoon season around the month of May, and fish return to the Bay in December. In Iraq the migration starts in Feb.to May and return to Arabian Gulf in October and the hypothesis was that the *Tenualosa ilisha* might lose some parasites and acquire others during its migration and the frequency distribution of the parasites would be related to sex and size of the host fish.

So, the Frequency of infestation and distribution of parasites within different organs of the fishes is influenced by age and diet, abundance of parasites within the fish and fish abundance (Snieszko, 1983) [19], and the goal of his study to analyzed the epidemiology of parasitism of the size, and locality of infection.

The present studied model is represented by the helminthes parasitic in community of fish collected from two representative stations from marine water of Iraq by used prevalence and intensity as defined by Margolis *et al.* (1982) [20]. to evaluate the demography of parasitism. The two earliest records describing the application of parasites as biological tags in population studies of fishes are that of Dogiel and Bychovsky (1939) [21], who distinguished between groups of stur- geon (*Acipenser* spp.) in the Caspian Sea using the monogenean parasites *Diclybothrium circularis* and *Nitzschia sturionis*. Since these investigations, the use of parasites as biological tags in population structure studies has flourished to include a wide range of fish species and geographical localities. Investigations have primarily focused on, although not limited to, fish species of economic importance, such as herring (Sindermann, 1957; Parsons and Hodder, 1971; Arthur and Arai, 1980) [22, 23, 24]. A diverse range of taxonomic groups of parasites have also been applied as biological tags.

The benefits and limitations of using parasites as biological tags has been extensively reported by Sindermann (1957, 1983) [22, 25], Gibson (1972) [26], MacKenzie (1987, 1999, 2002) [27, 15, 11], Lester (1990) [28], Moser (1991) [12].The use of parasites as biological tags in population structure studies has also been reviewed by many authors (Sindermann, 1983; MacKenzie, 1987; Lester, 1990; Williams *et al.*, 1992) [26, 22, 29, 16]. The most recent reviews of parasites as biological tags in fish population studies are given by MacKenzie (1999, 2002) [15, 11]. In the past 5 years, numerous studies have been published which used parasites as biological tags as the sole approach to discriminate fish stocks (Santos *et al.*, 2009; Charters *et al.*, 2010; Luque *et al*., 2010; Mele *et al*., 2010; Chou *et al*., 2011; Henriquez et al., 2011; Hutson et al., 2011; Khan *et al.*, 2011; McClelland and Melendy, 2011; Moore *et al.*, 2011; Braicovich *et al.*, 2012; Reed *et al.*, 2012; MacKenzie *et al.*, 2013; Oliva, 2013) [29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42].

Bhuiyan and Momen (2012) [43]. on his investigation was conducted to study the protozoan parasites of Hilsha shad, *T. ilisha* collected from Aricha Ghat, result showed that A total of 1099 individuals of protozoan parasite of eight species have been recorded, these parasites were found on body surface, gills and gall bladder of the fish. The infection differed from that recorded from the same host in marine and freshwater habitats depend on geographical distribution and variation ecological aspects that effect on both the parasite structure and their host.

Note the task in India there is a huge diversity in parasite fish found in the Arabian Gulf fish that gives the sign of two important points, one the fish don't emigrate fish from the Indian Ocean to Iraq or that the fish lose the types of parasites during migration and the fish is likely endemic in the Arab Gulf region.

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