



First Record of *Mugilicola bulbosa* Tripathi, 1960 (Ergasilidae: Cyclopoida) on the Gills of Greenback Mullet *Planiliza subviridis* (Valenciennes) from Shatt Al-Arab River, Southern Iraq

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Abstract: Occurrence and some ecological aspects of *Mugilicola bulbosa* Tripathi, 1960 were studied. A total of 63 specimens of *Planiliza subviridis* (Valenciennes) were collected from Garmat Ali River, Basrah Province. (30° 34' to 30° 35' N; 47° 44' to 47° 34' E) from October 2023 till January 2024. The copepod was recorded from the gill arches during three months. Total body length was 3.686-4.069 (3.875) mm. Statistical analysis showed no significant differences between males and females of fish host in all the studied traits. The highest prevalence of infestation was recorded in November (35%), while the lowest value was during October (0%). The high intensity of infestation was recorded during December (2.6), while the lowest intensity was in October (no fishes were infected). The high intensity and prevalence of infestation appear in the longest group of fishes (15-21cm). Mean length of egg sac (1.3) mm, of this mesoparasite represents the second species of *Mugilicola* from *P. subviridis*. The finding of *M. bulbosa* in Iraq represents a new geographical record for the species.

Keywords: Basrah, Copepoda, Iraq, Mesoparasite, Parasitic crustacean.

Introduction

Garmat Ali-River considered the link between Shatt Al-Arab River and Al-Hammar Marsh, is about eight km. long (30° 34' to 30° 35' N and 47°44' to 47° 43'E). The biodiversity of fishes has been constricted in this river, and only few local fishermen work with simple fish gears including cast nets, gill nets and small sein nets to capture species fishes (Adday, 2013). The family Mugilidae includes catadromous fishes found in marine, fresh and brackish waters (Al-Daraji & Mhaisen, 2023). All species, except one of mullets in the Euphrates and Tigris

rivers, are euryhaline, widespread species that enter Shatt Al-Arab River from the sea (Freyhof *et al.*, 2021). Species of this family are found worldwide in coastal temperate and tropical waters, and some species spend part or even their whole life cycles in coastal lagoons, lakes and rivers (Mohamed & Abood, 2020). Ali *et al.* (2018) listed 192 marine fish species in Shatt Al-Arab River.

In Iraq, four genera of the family Ergasilidae were recorded. These included *Dermoergasilus* (three species), *Ergasilus* (11

species plus unidentified species), *Mugilicola* (1 species plus unidentified species) and only one species of the genus *Paraergasilus* (Al-Daraji & Mhaisen, 2023).

The study aim to redescription of the mesoparasite *M. bulbosa* based on a specimens isolated from gills of *Planiliza subviridis* which represent a new record from Iraq with add some ecological aspects of this parasite.

Materials & Methods

The fishes were weekly collected from Garmat Ali River northern Basrah Province, at about eight km, during the period from October 2023 to January 2024. Fishing gears, used to collect different fish sizes included floating gill nets with dimensions of 20 × 3 m in addition to the dimensions of 25 × 2 m, mesh size 38 × 38 mm and 30 × 2 m, mesh size 27 × 7 mm. A simple thermometer was used to detect water temperature, while the salinity was detected by using EC300, Germany.

Fishes were removed from the fishing gears and then kept in iceboxes: 70 × 35 × 40 and 60 × 25 × 30 cm (Eissa, 2016), then they were transported to the laboratory of Fish Parasites and Diseases at the Department of Fisheries and Marine Resources. At the laboratory, fishes were identified based on Carpenter *et al.* (1997) and up-to-date according to Fricke *et al.* (2024).

Fish gills were removed after cutting the operculum, and isolated the gill lamellae were put in petri dishes with an amount of tap water under the dissecting microscope. Crustacean parasites were removed from gill arches then preserved in 70% alcohol. Glass slides were prepared instead of the wooden slides (See Khamees and Adday, 2013) which were conducted by Humes & Gooding (1964). The copepod parasites were cleared in 85% lactic acid for two hours and kept overnight in the modified glass slide under dissecting

microscope model Meij Germany (Lin & Ho, 2006). The water temperature was 19.5-23°C (21°C), while the salinity was 2-2.3 (2.13 ppt). To find the significance differences in infection between males and females of the fish used analysis of variance for a completely randomized design (CRD).

Copepods were examined under a compound microscope (Olympus C X 21 FS1) with magnifications up to 1000 x. Intensity and prevalence of infestation were done according to Bush *et al.* (1997). All drawings of copepods were made with the aid of camera Lucida by using ocular micrometer calibrated by stage micrometer. All measurements in micrometres unless otherwise indicated.

Results & Discussion

Description of *Mugilicola bulbosa* Tripathi, 1960

Based on eight ovigerous females

Body (Fig. 1A) consists of head, neck and trunk, body length 3.686-4.069 (3.875) mm, head (Fig. 1B) small, ovoid in shape, with total length of 231-339 (291) and of width 2.54.1-292.6 (260.26). Head has a swelling rostrum, anteriorly bearing antennule and antenna (Fig. 1C). Neck long, 2.44-2.28 (2.61), cylindrical, comprising about 2/3 of total body length, with no appendages (Fig. 1A). In many specimens, various areas of tissue as response to its host, surrounding the parasite. Trunk (Fig. 1A) pear shaped, 721-795 (763) constituting about 1/5 of the total body, bearing three pairs of biramous legs (Fig. 1A). First leg is found in the middle ventral surface of the trunk, while second and third legs are located posteriorly. Leg 4 absent and leg 5 represents with two setae are found posterior to leg 3 (Fig. 2B).

Urosome (Fig. 2A) 95-1007 (97) includes the genital complex 72.2-76 (74.1), constituting about 3/4 of urosome length, in

addition to first and second abdominal somites and caudal rami. Rows of spinules on the ventral surface, one of them on the posterior margin of abdomen and anal somite are engraved (Fig. 2B). Anal somite as a deep incise. Caudal rami (Fig. 1F) armed with four setae, one long and three unequal short, ornamented with row of thin spinules on posterior margin.

Antennule (Fig. 2C) consists of five segment, the first segment is the largest, 24-34 (28.7), about 1/3 of the total length 63.0-79.1 (70.98), setal formula as follows: 11: 6: 4: 2+ae: 6+ ae. Antenna (Fig. 3A) four segmented with basal segment (coxobasis) 35-40 (37.25) small, robust and unarmed; second segment (1st endopod) about 2.3 times longer than average width 80.5-91.7 (85.75), armed with spine, second segment (2nd endopod) short, 26-30 (28.4), about 1/3 of the first endopod segment; third segment is very small representing by minute sclerite. Claw 49-59 (54.6), robust about two times as long as second endopod segment.

Mouthparts (Fig. 2E, D) consist of small mandible with two blades, one anterior mid and the other posterior (Fig. 1E). Maxillule small with two setae and minute process in the middle. Maxilla (Fig. 1D) includes large syncoxa and small basis that has teeth in the anterior region.

B, C & D) bigamous, three 3Legs (Fig. segments. Spines (Roman number) and setae (Arabic number) of legs as follow:

	Coxa	Basis	Exopod	Endopod
Leg 1	0-0	1-0	I-0; 0-1; I, 5	0-1; 0-1; II, 4
Leg 2	0-0	1-0	I-0; 0-1; 6	0-1; 0-2; I, 4
Leg 3	0-0	1-0	0-0; 0-1; 6	0-1; 0-2; I, 4

Interpodal bar of legs 1-3 is well developed (Fig. 2DI-III). Egg sacs 0.57- 1.26 (0.84 mm).

Some ecological aspects of the infestation of *P. subviridis* with *M. bulbosa*

The total number of fishes examined was 63, of which 38 were females and 25 males. The total prevalence of infestation was 23.8% (23.6% in females and 20% in males), while the total intensity of infestation was 2.2 (2 in the females and 2.6 in the males). Monthly changes explain that the highest prevalence (35%) was in November, and intensity (2.6) was during December (Table 1). Minimum values of infestation were during October (prevalence and intensity 0). The changes of the infestation according to the length of infested fishes are shown in table (2). The prevalence and intensity of infestation were high in largest size length (210-250cm), while the low prevalence of infestation were in medial sized group (160-200cm) and the low intensity of infection was in fish group 100-150 mm.

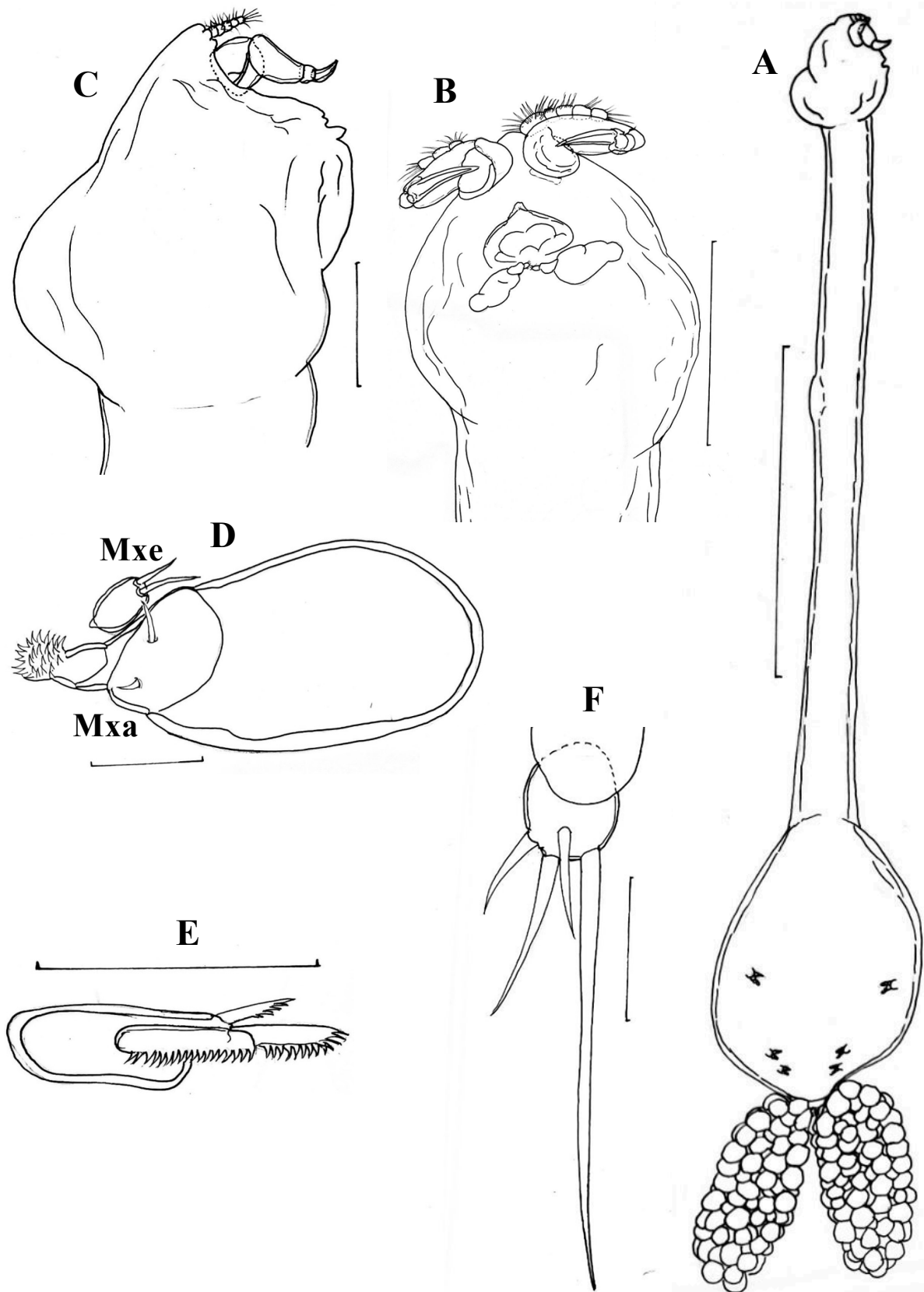


Fig. (1): *Mugilicola bulbosa* Tripathi, 1960, A adult female, habitus, ventral; B head ventral; C head lateral; D maxilla (Mxa) and maxillule (Mxe); E mandible; F caudal ramus (Scale bars= 1 mm in A; 500 μ in B and C; 50 μ in D and F; 75 μ in E).

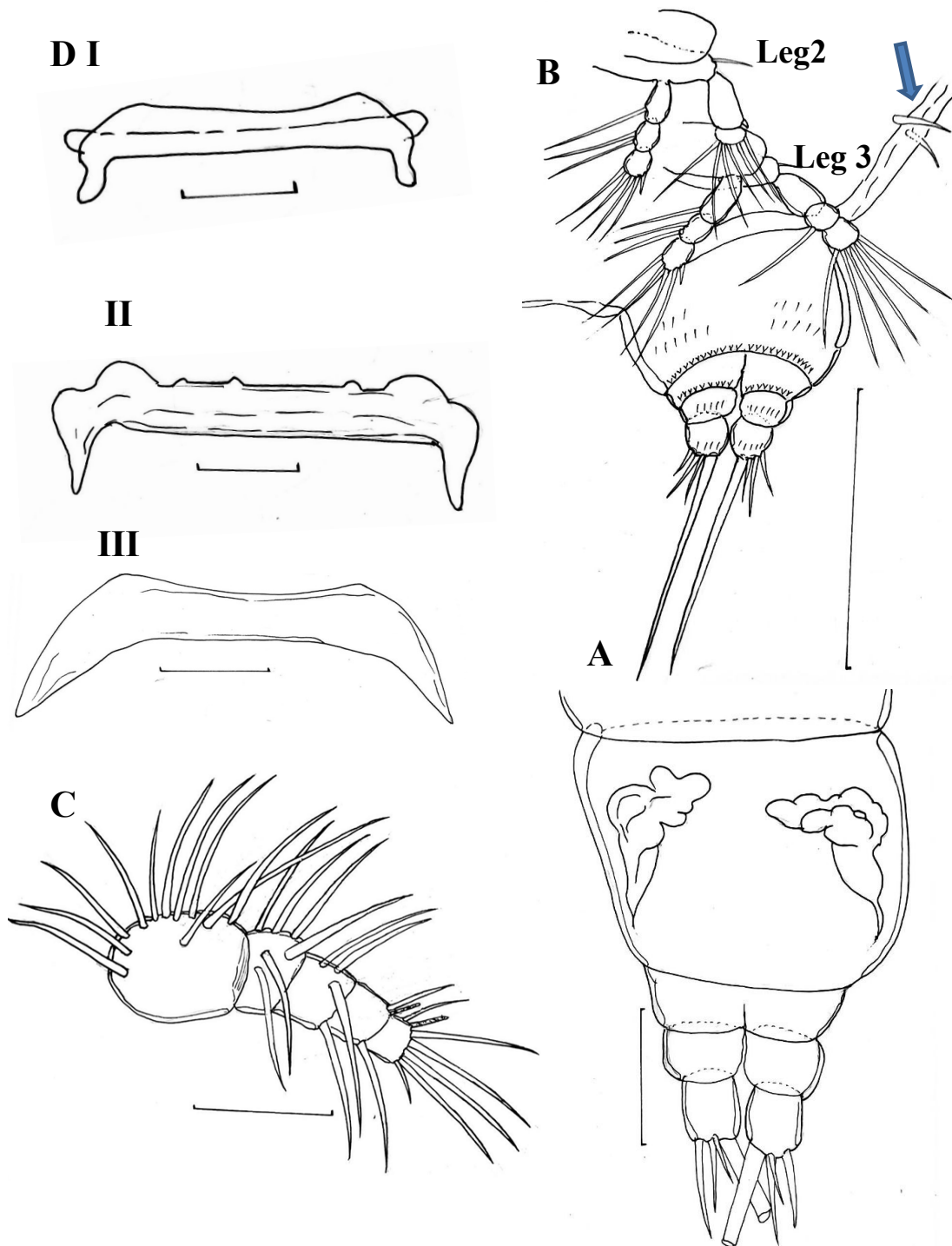


Fig. (2): *Mugilicola bulbosa* Tripathi, 1960 adult female. A: urosome, dorsal; B: urosome with leg 5 (see arrow); C: antenna; D I-III: interpodal bar legs 1-3 (Scale bars= 50 μ in A, B, C and D III; 25 μ in DI and DII).

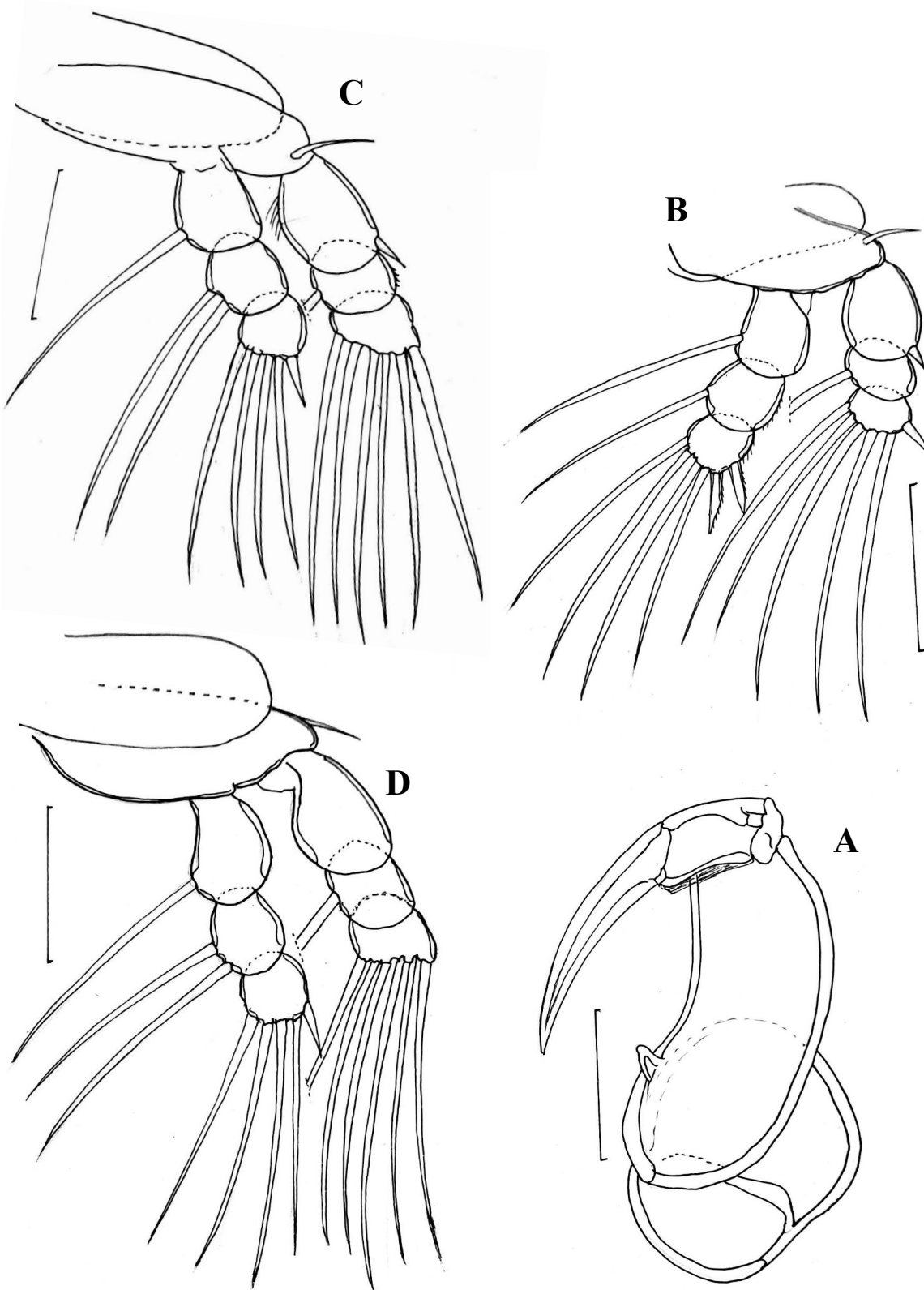


Fig. (3): *Mugilicola bulbosa* Tripathi, 1960 adult female, A antenna; B leg 1; C leg 2; D leg 3 (Scale bars= 50 μ in A, B, C & D).

Table (1): Infestation of *P. subviridis* with *M. bulbosa* from Garmat Ali River.

Month	No. fish examined		No. fish infested		No. parasites		Prevalence of Infection (%)		Intensity of infection		No. parasites	No. Fish examined	No. Fish infected	Incidence of infection (%)	Intensity of infection
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀					
October 2023	2	2	0	0	0	0	0	0	0	0	0	4	0	0	0
November	5	15	2	5	3	10	40	33.3	1.5	2	13	20	7	35	1.8
December	12	13	3	3	10	6	25	46.1	3.3	2	16	25	6	24	2.6
January 2024	6	8	0	2	0	4	0	25	0	2	4	14	2	14.3	2
Total	25	38	5	10	13	20	20	26.3	2.6	2	33	63	15	23.8	2.2

Table (2): Infestation of group length of *P. subviridis* with *M. bulbosa* from Garmat Ali River.

Fish Length group (mm)	No. Fish examined		No. fish infested		No. parasites		Prevalence of Infection (%)		Intensity of infection		Total parasites	No. Fish examined	No. Fish infected	Total Prevalence of infection	Total Intensity of infection
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀					
100-150	8	3	2	1	1	1	25	33.3	1	1	2	11	2	27.2	1
160-200	17	23	1	7	9	15	5.9	30.4	9	2.14	24	40	8	20	3
210-250	4	8	2	2	3	4	50	25	1.5	2	7	12	4	33.3	1.75
Total	29	34	5	10	13	20	20	26.3	2.3	2	33	63	15	23.8	2.2
	63		15		33		23.8		2.2						

Discussion

Ergasilidae have un flattened bodies and five pairs of legs: the first one is well-developed, cephalothorax comprises about half of body length and all are parasites of teleosts (Kabata, 1979). According to Boxshall & Walter (2024), Ergasilidae consists of 30 valid genera, among which the genus *Mugilicola* Tripathi, 1960 contains only four valid species.

The genus *Mugilicola* includes four species around the World vis. *M. australiensis* Boxshall, 1986 from sand sillago *Sillago ciliata* Cuvier off Australia (Boxshall, 1986); *M. bulbosa* Tripathi, 1960 from *Liza subviridis* (= *Planiliza subviridis*) off India; *M. kabatai* Piasecki, Khamees & Mhaisen, 1991 from *Liza abu* (= *Planiliza abu*) and *M. smithae* Jones & Hine, 1978. *M. kabatai* was recorded from Iraq by Piasecki *et al.* (1991) and Ho *et al.* (1996). Piasecki *et al.* (1993) recorded *Mugilicola* sp. parasitic on *Liza subviridis* (= *Planiliza subviridis*) in addition to *Bomolochus* sp. and *Ergasilus* spp. in a preliminary survey on copepods of fishes from Khor Al-Zubair lagoon.

The type species of this genus, *M. bulbosa* was collected from both *Mugil tade* Fabricius, 1775 (= *Planiliza tade* Forsskål) and from *M. persia* [Hamilton], (= *Planiliza persia* [Hamilton]) in a fish farm in India (Piasecki *et al.*, 1991). This type species appears to be closer to *M. kabatai*, because it has a closely related host and a less distance geographic locality.

According to three genera of mesoparasitic crustaceans of the family Ergasilidae,

Paeonodes bulbosa is considered as a synonym to *Mugilicola bulbosa* Pillai & Jayasree, 1978 with no any leg posterior to the third pair of legs. The near position of these two setae, suggests that they represent a single leg, rather than both legs (El-Rashidy & Boxshall, 2001).

The caudal rami of preset specimens armed with four setae, are fit with the same species of El-Rashidy & Boxshall (2001), but no details exists of these setae as in present study (See Fig 1F). According to a diagnostic study of total body length and body shape for species belonging to the genus *Mugilicola*, Kruger *et al.* (1998) showed that *M. bulbosa* was the first described species. The total length of parasites in the present study is longer than that mentioned by Kruger *et al.* (1998) and relatively similar to the length that mentioned by El-Rashidy & Boxshall (2001) which was 3.5 instead of 3.8. The cephalon length was 0.145-0.261 instead of 0.23-0.33 while the width of the cephalon was 0.18 instead of 0.25 in the present study. Kruger *et al.* (1998) erroneously described the antenna in the number of segments and the claw (3 instead of 4 segments) and they mentioned the curved claw instead of strong claw. El-Rashidy & Boxshall (2001) and in the present study, dimensions of cephalon length and width are similar, in addition to the difference in the armature of legs in the description of this study compared with El-Rashidy & Boxshall (2001) and the present study. Table (3): Explained the comparison of different characters of *M. bulbosus* in three different studies.

Table (3): The comparison morphometric and setal arrangement in *Mugilicola bulbosus* between different studies.

Character	Kruger et al. 1998	El-Rashidy & Boxshall, 2001	Present study																								
Total length	1.053-1.566 mm	Mean body length 3.5 mm	Mean body length 3.875 mm																								
Caudal rami	3 setae	4 setae	4 setae																								
Cephalon shape	Cephalon oval shape dorsally	Head small, ovoid, swelling dorsally	Head small, ovoid in shape																								
Antenna segments	Stout, three segments	4 segments, with straight claw	4 segments																								
Antennule	5 segments, the first longest	5 segments, first segment largest	5 segments, 1 st largest																								
Legs armature	<table border="0"> <tr> <td>Legs</td> <td>Endopod</td> <td>Exopod</td> </tr> <tr> <td>Leg1</td> <td>0-1; 0-1; I-4</td> <td>0-0; 0-1; I-5</td> </tr> <tr> <td>Leg 2</td> <td>0-1; 0-2; 0-4</td> <td>0-0; 0-1; 0-5</td> </tr> <tr> <td>Leg 3</td> <td>0-1; 0-2; 0-4</td> <td>0-1; 0-1; 0-5</td> </tr> </table>	Legs	Endopod	Exopod	Leg1	0-1; 0-1; I-4	0-0; 0-1; I-5	Leg 2	0-1; 0-2; 0-4	0-0; 0-1; 0-5	Leg 3	0-1; 0-2; 0-4	0-1; 0-1; 0-5	<table border="0"> <tr> <td>Legs</td> <td>Endopod</td> <td>Exopod</td> </tr> <tr> <td>Leg1</td> <td>0-1; 0-1; II-4</td> <td>I-0; 0-1; I-5</td> </tr> <tr> <td>Leg 2</td> <td>0-1; 0-2; I-4</td> <td>I-0; 0-1; 0-6</td> </tr> <tr> <td>Leg 3</td> <td>0-1; 0-2; I-4</td> <td>0-0; 0-1; 0-6</td> </tr> </table>	Legs	Endopod	Exopod	Leg1	0-1; 0-1; II-4	I-0; 0-1; I-5	Leg 2	0-1; 0-2; I-4	I-0; 0-1; 0-6	Leg 3	0-1; 0-2; I-4	0-0; 0-1; 0-6	Similar with El-Rashidy & Boxshall, 2001
Legs	Endopod	Exopod																									
Leg1	0-1; 0-1; I-4	0-0; 0-1; I-5																									
Leg 2	0-1; 0-2; 0-4	0-0; 0-1; 0-5																									
Leg 3	0-1; 0-2; 0-4	0-1; 0-1; 0-5																									
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Leg 3	0-1; 0-2; I-4	0-0; 0-1; 0-6																									

According to Kruger *et al.* (1998), three setae occur in each caudal rami of *M. bulbosa*, while the caudal rami were armed with four setae in copepods removed from the gill arches of grey mullet (*Liza subviridis* (= *P. subviridis*) deposited in fish collection of the British Museum (Natural History), London by El-Rashidy & Boxshall (2001) as well as in the present study.

Egg sacs are very small, containing 4-5 longitudinal rows of eggs (Kruger *et al.*, 1998). El-Rashidy & Boxshall (2001) found two rows, about six eggs in each egg sac (See Fig. 1A), while in present specimens the mean total length of egg sacs 0.84 and contain 5-8 longitudinal rows of eggs.

The geographical distribution of the four species of *Mugilicola* around the World indicated the record of *M. bulbosa*, the second species of this genus from Shatt Al- Arab River

and Iraq and the 12th species of Ergasilidae which were recorded from *Planiliza subviridis* in Iraq (Mhaisen *et al.*, 2018). According to Al-Daraji & Mhaisen (2023), *P. subviridis* in Iraq is infected with 47 different parasitic species.

No significant differences of infection in female and male of *P. subviridis* by crustacean *M. bulbosa*, in group lengths, the high prevalence of infection was in the longest group, while the high mean intensity of infection was in the middle group. Kruger *et al.* (1997) mention no preference for either male or female mullets (100-400 mm length) infected with *Mugilicola smitha*, from Nhlabane Estuary in Kwazulu Nataland, and about 80% of all infected fish has length 200-400mm, while 70% between 200-300 mm length.

Conclusion

Results indicated the occurrence of the *M. bubosa* from euryhaline marine fish in Shatt Al-Arab. River give a possibility to recorded other species from this crustacean on another marine fishes which enter the river.

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Contributions of authors

M.H.A.: Sampling, laboratory techniques.

T.K.A.: Parasite identification, preparing the illustrations and writing the manuscript.

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Conflicts of interest

The authors declare that there is no conflict of interest concerning the publication of this paper.

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أول تسجيل للقشري (*Cyclopoida :Ergasilidae*) *Mugilicola* Tripathi, 1960 على غلاصم البياح الأخضر (*Planiliza subviridis* (Valenciennes, 1836) من شط العرب، جنوب العراق مصحف هشام الموسوي² وثامر قاطع عداي^{1*}

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المستخلص: درس تواجد وبعض المؤشرات البيئية للقشري *Mugilicola bulbosa* Tripathi, 1960 حيث جمعت 63 سمكة بياح أخضر (*Planiliza subviridis* (Valenciennes, 1836) من نهر كرمة علي، محافظة البصرة 30° 34' to 30° 34' E' to 35° N, 47° 44' to 47° 34' E') من القوس الغلصمي للأسماك المصابة خلال ثلاثة أشهر. طول الجسم الكلي للطفيلي (3.875) 3.686-4.069 ملم. سجلت أعلى نسبة إصابة في شهر تشرين الأول (35%) بينما لم تسجل في أية سمكة إصابة خلال أيلول. أعلى شدة إصابة ظهرت في شهر كانون الأول (2.6%)، وأقل شدة إصابة في شهر أيلول (0)، كانت أعلى نسبة وشدة للإصابة في مجموعة الأسماك بطول 15-21 سم، بينما أقل نسبة إصابة كانت 20% في مجموعة طول 16-20 سم وأقل شدة للإصابة في مجموعة الطول 10-15 سم. كان معدل طول أكياس البيوض 1.3 ملم. يعدّ تسجيل هذا القشري ثاني نوع من الجنس *Mugilicola* من أسماك البياح الأخضر. أظهر التحليل الإحصائي عدم وجود فروق معنوية بين الذكور والإناث وفي كل الصفات قيد الدراسة.

الكلمات المفتاحية: البصرة، مجدافية الأرجل، العراق، طفيليات وسطية، بياح، قشريات متطفلة.