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ORIGINAL ARTICLE

NEW RECORDS OF GASTROTRICHA FROM THE MAIN OUTFALL DRAIN, SOUTH OF BAGHDAD, IRAQ

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ABSTRACT

The current study is a taxonomic account of three gastrotrich species that belong to Chaetonotidae (Phylum Gastrotricha) namely *Ichthydium auritum* Brunson, 1950 *Lepidodermella squamata* (Dujardin, 1841) and *Chaetonotus anomalus* Brunson, 1950. These species are registered as a new record from Iraq and were collected from several locations along the main outfall drain (MOD) in south of Baghdad, from January to December 2020. The species described in this article were found to be related to *Hydrilla* and *Ceratophyllum* and prefer environments rich in detritus and decomposing organic matter. The worms preferred water that is salty, hard, alkaline, and had good oxygen content.

Keywords: Chaetonotidae, Chaetonotus, Gastrotricha, Ichthydium, Lepidodermella .

INTRODUCTION

Gastrotrichs, also known as hairy bellies or hairybacks, are a group of tiny acoelomate invertebrates that look like worms, gastrotrichs are colorless organisms with a vermiform or tenpin shape appearance, ranging in length from 0.06-3.0 mm (Kolicka, 2017). The body consists of a head and a trunk convex dorsally and flattened ventrally, the ciliated epidermis on the ventral side of the worms allows the animal to glide on the surface, the head bears a number of sensory hairs, in many species, especially freshwater forms, the trunk ends with a pair of adhesive tubes (furca) that permit temporary attachment to substrates, the body is surrounded by cuticle, which often forms scales and spines, these scales and spines differ in shapes and distribution on the body according to different species (Edmondson, 1959).

Gastrotrichs have long been considered a class of the Aschelminthes, together with nematodes, rotifers etc. However, currently they are considered a phylum allied with Platyhelminthes forming a clade named Rouphozoa (Todaro *et al*., 2019). The phylum is divided in two orders: Chaetonotida (common in fresh waters) and the Macrodasyida (entirely marine) (Rao and Clausen, 1970). Freshwater members of Gastrotricha were

long thought to lack male gametes and to exist exclusively as parthenogenetic females (Weiss, 2001). Members of this guild normally feed on biodetritus, but also microorganisms such as of bacterial, algael, and protozoans (Nozais *et al*., 2005; Danovaro *et al*., 2008). In turn, gastrotricha are preyed upon by turbellarians and other predatory organisms, therefore, gastrotrichs are very essential elements in aquatic food webs (Danovaro, 1996); indeed, in this group may be very abundant, but it is also one of the least knowns, this group of invertebrates is almost omnipresent in the benthos and periphyton communities of freshwater habitats, these organisms are highly sensitive to environmental disturbance and respond rapidly to changes in food availability (Danovaro, 1996; Fraschetti *et al*., 2006). Many freshwater gastrotrichs, which appear to prefer finer sediments with high organic matter content (Kolicka *et al*., 2017).

The majority of freshwater gastrotrich species have been described from in Europe. Many studies on the taxonomy and diversity of gastrotrichs have been published. For instance, Brunson (1950, 1949) and Robbins (1965, 1973) constructed an important classification scheme and illustrated keys for identifying freshwater species of North America; d'Hondt (1971) introduced a key that is particularly dedicated to the species of Lepidodermella; Kisielewski (1987) defined the most important features that have to be taken into consideration upon the diagnosis Gastrotricha species based on morphology ; Kisielewski (1990,1991) presented a clarification of the most essential attributes in gastrotrich systematics; Balsamo and Todaro (2002) published illustrated keys for the classification of all known freshwater species worldwide; Kånneby *et al*. (2009) described the species of *Ichthydium*, and Kånneby *et al*. (2012, 2013) provided the first classification of Chaetonotidae based on molecular phylogeny; Garraffoni and Melchior (2015) described new species and new records of freshwater *Heterolepidoderma* (Gastrotricha, Chaetonotidae) from Brazil with an identification key to the genus; Balsamo *et al*. (2020) describe successfully tested techniques for their recovery and study, and emphasize current knowledge on the ecology, distribution, and dispersal of freshwater gastrotrichs.

In Iraq, nonetheless, only one study was conducted by Jaweir and Al-Sarai (2015) could report the presence of gastrotrich in a benthic specimen from Al-Dalmaj Marsh, which is the only place where this phylum has been documented. Therefore, the aims of the current study include the identifying and describing the local species of gastrotricha, and the characterization of their preferred environment.

MATERIALS AND METHODS

Specimens' collection and description area:

From January to December 2020, a plankton net with a 25 micrometer mesh was used to collect aquatic plants, fine detritus sediments and mosses from various locations along the main outfall drain (Map 1). The MOD extends between Mesopotamia starting from the north of Baghdad until its estuary in Shatt Al-Basra and Khor Al-Zubayr and then the Arabian Gulf , this drainage canal is one of Iraq's most significant development projects, built to reduce salinity on reclaimed agricultural lands along its central and southern

regions .The study included the northern section, which starts from the Ishaqi and Saqlawiyah drainage basins, north of Baghdad, to the Al-Dalamj Marsh, with a length of (206) km, to serve the projects of Ishaqi, Saqlawiyah, Abu Ghraib, Radwaniyah, Yusufiyah, Latifiyah, Alexandria, Numaniyah and Musayyab. The eradicated plants and algae were collected in a container with water from the site and then transferred to the laboratory where they were distributed into the aquarium of (40x20x20 cm)

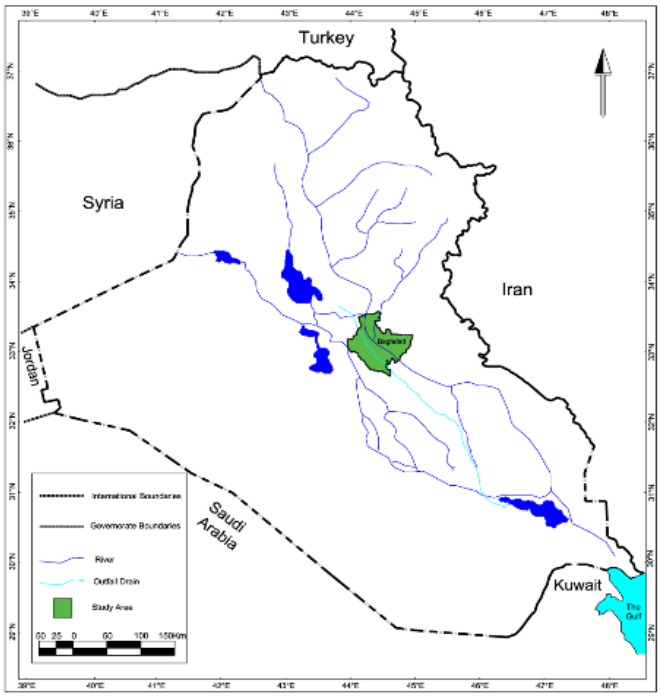
An air pump was utilized in the laboratory and left for about 7-10 days to allow the worms to settle down. Slides of the collected samples were prepared according to Kånneby *et al*. (2009, 2013), whom proposed using a digital camera with a video function that is capable of capturing multiple focus planes to record the animals and identify them, proved high efficiency in the present work. Physico-chemical parameters of water samples were assessed in the field by employing portable meters; these included water temperature, dissolved oxygen, hydrogen ion concentration as pH and salinity. Water hardness occurring due to the accumulation of calcium salts was determined based on Lind (1979).

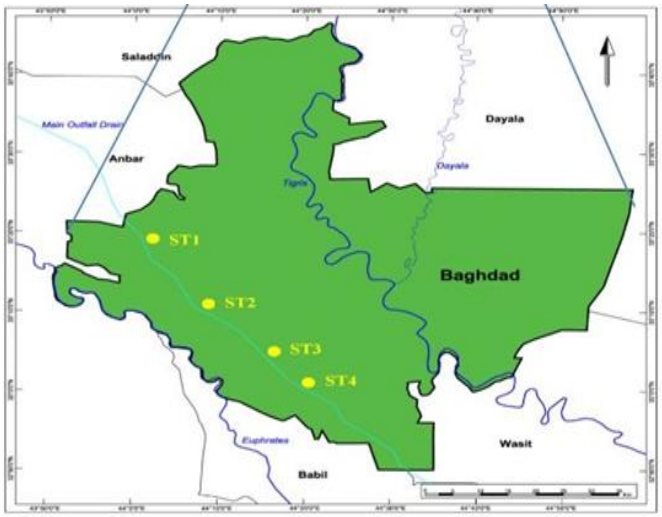
RESULTS AND DISCUSSION

A total of 6300 individuals were identified as belonging to three species of Chaetonotida: Chaetonotidae, including *Icthydium auritum*, *Lepidodermella squamata*, and *Chaetonotus anomalus*. This family is characterized by lacking adhesive tubes or with one pair (very rarely two pairs) of adhesive tubes posteriorly and no pharyngeal pores. The furca is typically branching, with a cone-shaped base and a distal adhesive duct; body mostly has numerous spines, scales, or spined scales; head has cilia organized in tufts; cephalic plates are present. In Iraq, no data are available about this group of invertebrates to compare with the present study. However, the findings are highly relevant to those stated by Edmondson (1959).

Diagnostic characters and measurements:

Lepidodermella squamata (Dujardin, 1841) (Pl. 1 A, Fig. 1 A): This species of the genus *Lepidodermella* was observed only, that identified as *L. squamata*, Head rounded (five lobed) with two pairs of sensory tufts.; body coated in unique scales placed in alternating rows and protruded from the body surface; an interciliary area that has smooth, transversely-arranged, cuticular scale plates in pharyngeal region; seven to nine dorsal columns of smooth scales, with length ranging between140-152µ pharynx 48µ; furca length 24µ. The current study showed the presence of *L. squamata* throughout the study period (Diag.1).While the total density reached 2340 ind/m2 , It was clear that the densities were a decline during the hot months June, July and August , as reached 100, 80 ind/m2 respectively. While the highest densities were recorded during moderate temperatures in the months of April, March and December, reaching 350, 320 ind/m2 and 300 ind/m2 for each.





Symbol	Site	Coordinates
ST1	Abu Graib	33°17'40.90"N 44° 9'57.67"E
ST2	Radhwaniya	33° 9'30.28"N 44°15'22.47"E
ST3	Youssifiya	33° 6'10.73"N 44°21'13.60"E
ST4	Mahmoudiya	33° 3'59.34"N 44°23'39.60"E

Map (1): Map of study areas (Used Arc-GIS Map program).

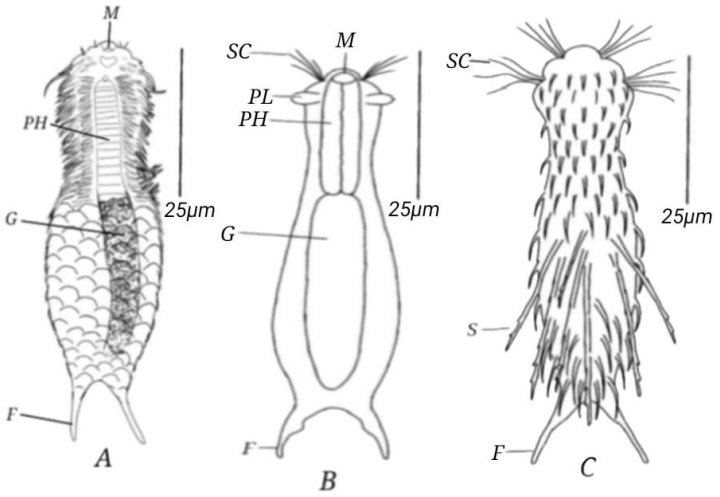


Figure (1): Schematic drawing; (A) *Lepidodermella squamata* ventral view of head and neck region showing the transverse scales of the interciliary area and trunk showing shape and distribution of scales, (B) *Ichthydium auritum* showing head with three lobes; posterior lobes are small, dorsal, earlike flaps, (C) *Chaetonotus anomalous* showing distribution of spines**.** (M = mouth, SC = sensory cilia, PH= pharynx, G= gut, F= Furca).

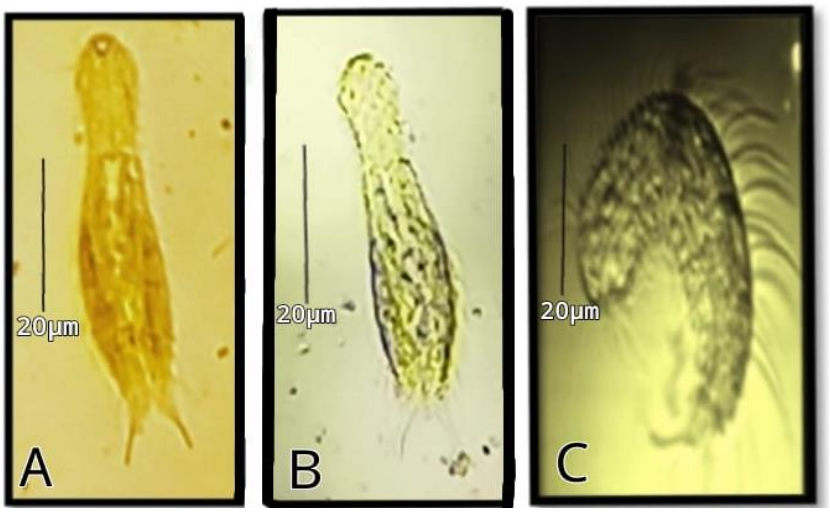


Plate (1): Photograph of live specimen; (A) *Lepidodermella squamata*, (B) *Icthydium auritum*, (C) *Chaetonotus anomalous.*

All morphological measurements were close to those recorded by earlier works Edmondson (1959); Brunson (1950); Sharma (1980); Zakarija (1980); Kanneby (2011) and Todaro *et al*. (2019). This species is considered as one of the most common species that lives on aquatic plants in lakes, ponds, streams and Marshes; also located near the bottom of the stream and between the sediment particles. *L. squamata* a widely distributed species reported from, United Kingdom (Martin, 1981), Italy (Mola, 1932), Poland (Kisielewska and Kisielewski, 1986), Sweden (Kånneby, 2011, 2013), Australia (Hochberg, 2005), Brazil (Kisielewski, 1987, 1991), South Korea (Lee and Chang, 2000).

Ichthydium auritum Brunson, 1950 (Pl. 1 B, Fig. 1 B)

The species of *I. auritum* was observed belong *Ichthydium* only, this species characterizes by: head with three lobes; posterior lobes small, dorsal, earlike flaps; tactile bristles absent, caudal furca carried at higher plans than ventral body surface; cuticle not especially thick; mouth ring small, without pharyngeal teeth, while the total length range between 85- 87µ; pharynx length 30 µ; caudal furca length 11µ. The total density reached 2112 ind/m2 (Diag.1). It is clear that *I. auritum* found in all study periods except the months of July and August, while the lowest density was sorted in June and reached 88 ind/m2 and then they increased progressively in April and March, reaching 440 and 264 for each. The specimens matched those reported by Brunson (1950), Edmondson (1959), Sharma (1980), Kanneby *et al*. (2009) and Todaro *et al*. (2019).

Chaetonotus anomalus Brunson, 1950 (Pl. 1C, Fig. 1C)

This species of the genus *Chaetonotus* was observed only; the presence of a five-lobed head was used to identify this species. Body with 6 to 8 longitudinal rows, 8 to 10 spines each, with increased size at the posterior part; seven long spines that twice bifurcate and extend beyond other spines originate in a hexagonal region on the trunk., total length 147µ; pharynx length 43µ ;furca length 27µ; long spines length 45-60µ. The total density reached 1848 ind/m2 (Diag.1). The results of the present study showed that monthly variations in density of *C. anomalus* ranged from highest density in April and December reached 264 in each and the lowest density were sorted in July and October reached 44 and 88 for each, while absence in August .The specimens described in this paper matched those reported by the previous studies such as: Edmondson (1959), Brunson (1950), Sharma (1980), Kanneby *et al*. (2009) and Balsamo *et al*. (2008, 2015).

In this study, *Ceratophyllum demersum* and filamentous algae were used to collect specimens. Diagram (1) shows all data concerning the species identified, including the density of each species in each studies month and their occurrence frequencies. The highest density values were recorded during April reaching 440 ind/m2 for *I. auritum*, 350 ind/m2 for *L. squamata*, and 290 ind/m2 for C. anomalous. It is clear that chaetonotidae density decreases during the hot months of the year and increases with moderate temperatures. The results also show that *L. squamatum* and *I. auritum* recorded the highest percentages of 37% and 34 %, respectively (Diag.2), while C. anomalous recorded the lowest percentage of 29% of the total number of chaetonotidae. *L. squamata* is the most abundant species, showing 100% occurrence frequency, because it was

recorded in all months, while a frequency of 91.6% was recorded for *C. anomalous*, since it was recorded in all months, except August. *I. auritum* recorded the frequency of 66.66%, being recorded in all months except August and July.

The highest number of chaetonotidae was recorded in April. The species described here were discovered to have correlations with *Hydrilla* and *Ceratophyllum*, while favoring environments with detritus and decomposing organic material. Table (1) shows all data concerning the Physico-chemical characteristics of the main outfall drain during the studied Months (2020), while the results showed that pH values obtained in the present study ranged (7.4-8.9), the results showed that dissolved oxygen (DO) values ranged between the (6.9-8.9) mgL^{-1}. Hardness showed a range of 820-2232 mg/l, while that of salinity was 2.1-4.8 ‰. Hence, the worms exhibited a predilection for water that tends to be salty, hard, alkaline, and good in oxygen, which agrees with Rao and Chandra (1977). Gastrotrichs were abundantly found in regions with low dissolved oxygen levels. Gastrotrichs belong to those organisms that can still be typically found in anaerobic settings (Brunson, 1949), keeping high density even when anoxia lasts for longer periods. No investigation has yet been made that addresses the anaerobiosis of freshwater gastrotrichs based on physiological mechanisms. It is plausible that certain freshwater gastrotrichs possess a mechanism of sulfide detoxification that is comparable to such mechanisms described for marine gastrotrichs (Powell *et al*., 1979). These mechanisms control the increased amounts of H2S that are typically associated with extended periods of anoxia. Direct evidence on the factors regulating gastrotrich populations in nature is lacking. However, scarce quantitative investigations were published that describe the seasonal dynamics of these populations in freshwater habitats. Nesteruk (2011) indicated that population densities generally reach the lowest values throughout the winter. We have no explanation in relation to the driving force behind these seasonal dynamics. However, evident candidates can include seasonal alterations in water temperature, food supply, and predation pressures candidates .

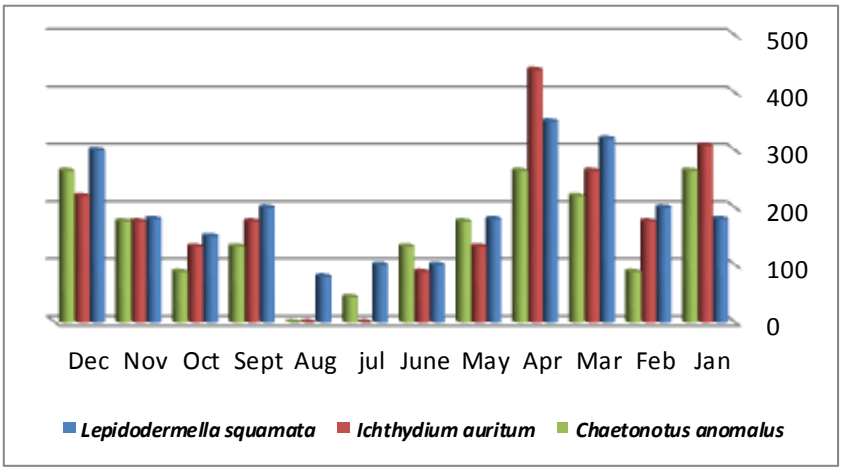


Diagram (1): Total density of different species of the family Chaetonotidae collected during different studied months.

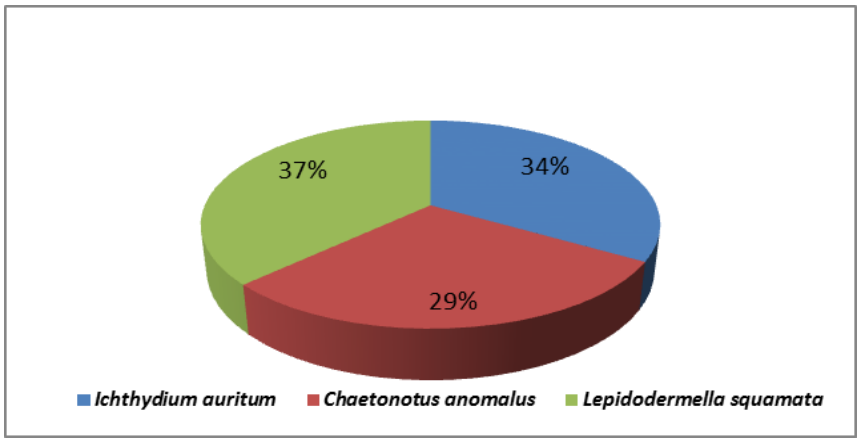


Diagram (2): Percentage composition of different species of the family Chaetonotidae collected during the studied months.

Table (1): Average values of Physico-chemical characteristics of the main outfall drain during this study.

Properties	Water temp.°C	pH	Total hardness mg $CaCO_3$\L	Salinity‰	Dissolved Oxygen mgL^{-1}	Organic Sediment%
January	9	7.4	1028	2.1	6.9	2.5
February	10	7.4	933	2.2	6.8	2.4
March	15.5	7.8	820	2.3	7.3	1.5
April	20	7.9	840	2.4	6.8	3
May	22	8.6	870	2.9	7.9	2.5
June	25	8.7	990	3.2	8.5	2.5
July	30	8.8	2232	3.9	8.4	2.5
August	32	8.9	1200	4.2	8.7	3.0
September	33	7.7	1960	4.3	8.5	3.3
October	30	7.3	1944	4.7	8.7	2.1
November	28	7.5	306	3.7	8.8	1.5
December	14	7.5	1138	2.8	7.4	2.8

CONCLUSIONS

Three species are newly recorded in Iraq, belonging to phylum Gastrotricha, family Chaetonotidae, which are *Icthydium auritum*, *Lepidodermella squamata*, and *Chaetonotus anomalous*. The highest density was recorded during April. It is clear that Chaetonotidae density decreases during the hot months of the year and increases with moderate temperatures. The species described in the current study were found to be associated with *Hydrilla* and *Ceratophyllum*, preferring habitats with detritus and decaying organic material. Furthermore, these species showed a preference for water that tends to be salty, hard, alkaline, and low in oxygen .

CONFLICTS OF INTERESTSTATEMENT

The author has no conflicts of interest to declare.

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تسجيل جديد للديدان شعرية البطن في المصب العام، جنوب بغداد، العراق

ميسون حسن مشجل

قسم علوم الحياة، كلية العلوم للبنات، جامعة بغداد، بغداد، العراق.

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الخلاصة

الدراسة الحالية هي تصنيفة لثلاثة أنواع من شعرية البطن Chaetonotidae (Phylum Gastrotricha) شملت: *Icthydium auritum* Brunson, 1950 و *Lepidodermella squamata* (Dujardin, 1841) و *Chaetonotus anomalus* Brunson, 1950 وتعد هذه الانواع تسجيل جديد في العراق . جمعت العينات من مواقع مختلفة من المصب العام الرئيسي جنوب بغداد للفترة من كانون الثاني إلى كانون الأول 2020.

اثبتت الدراسة الحالية أن الأنواع المذكورة في الدراسة الحالية كان مرتبطا بتواجد النباتات المائية للاجناس *Hydrilla* و*Ceratophyllum*، و كذلك البيئات ذات المخلفات والمواد العضوية المتحللة؛ كما أظهرت الديدان تفضيلها للمياه التي تميل إلى أن تكون مالحة عسرة قلوية و ذات تهوية جيدة.