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ORIGINAL ARTICLE

Freshwater snails Diversity in the Middle and South Regions of Iraq

Ali B. M. Al-Waaly[1] Mohammad K. Mohammad [2]* Hadi M. Al-Miali [3]
[1] Biology Department, College of Science, University of Al-Qadisiya, Al-Diwaniya, Iraq
[2] Iraq Natural History Museums, University of Baghdad, Baghdad, Iraq
[3] Biology Departments, College of Education, University of Al-Qadisiya, Al-Diwaniya, Iraq
*Corresponding author: amarmkm82@yahoo.com

ABSTRACT
A survey for freshwater snails in the middle and south of Iraq was conducted during June 2012 to May 2013 revealed presence of 8 taxa identified to species level in addition to Radix sp. which exhibited 4 morphological forms within the studied area. They belong to7 genera and 6 families. The parameters, shell length, shell width, spire, aperture width, SL/SW and spire/SL were measured and compared among members of each species collected from different locations.
Keywords: freshwater snails, snail biodiversity, morphological forms, shell parameters.

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INTRODUCTION

Freshwater snails have a tremendous health and veterinary importance as they act as the intermediate hosts of the parasitic infections of man and animals, such as schistosomiasis, fascioliasis and many other trematode infections. It is of worthy to know that the epidemiology of human fascioliasis has changed in recent years and the number of human fascioliasis reports have increased significantly since 1980 [1]. Snails in Iraq are rather poorly studied and the works were mainly on *Bulinus truncatus* and *Lymnaea auricularia* because of their infections with *Schistosoma haematobium* and *Fasciola gigantica* respectively, and for a lesser extent on *Paramphistomum explanatum* [2-21]. Only few papers were devoted to study the taxonomy and ecology of Iraqi freshwater snails including [22-27]. On the other hand, The middle and south regions of Iraq fall within the Tigris-Euphrates alluvial salt marsh ecoregion (PA0906). This region is characterized by marshlands and seasonally inundated plains in a basin covered by recent Pleistocene and Holocene alluvial deposits and forming a vast inland delta of the Euphrates, Tigris, and Karun Rivers [28]. Iraq experienced heavy human infections of bilharziasis [29] and sporadic fascioliasis [30], both are transmitted by freshwater snils. The aim of this study is to examine the current status of the snail's diversity in the middle and south of Iraq.

MATERIALS AND METHODS

The study area lies approximately between 44˚-48˚ E, 30˚-33˚ N and represents the basin of large depression of about 600 km long, the alluvial plain (fig. 1), which is exceedingly flat and the average slope is not more than 1 m for every 10 km with permanent and semi-permanent shallow marshes in the lower part of the plain.

A total of 6607 freshwater snails were collected for examining the species diversity which was used then for anatomical and molecular examinations in another study. The collection was conducted during the period from March 2012 to February 2013.Snails were collected by using mesh scoop which consisted of a metal ring of 30 cm length and 25 cm diameter attached to a wire net of 16 meshes per inch. The metal ring connected to a metal handle with a total length of 2 meters. A number of each collection of snails were kept in the field in 70% ethanol while others were kept alive in suitable plastic bags containing

some of water and vegetation from their original habitat, to record some notes on the shell color, foot, tentacles etc., and brought to the laboratory on the same day or sometimes the next day. In the laboratory they were kept in glass aquaria which were constantly aerated. Aquatic vegetation were placed to keep the water clean for a longer period.

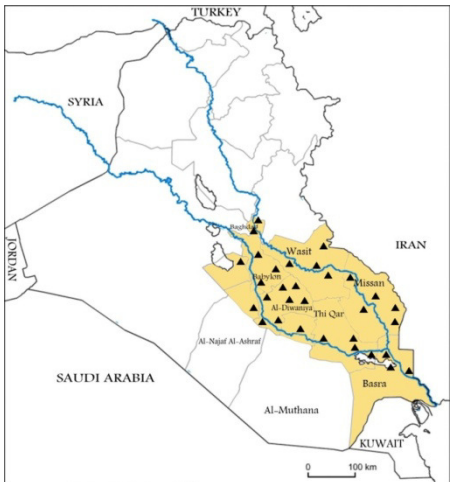

Fig. 1: Map of Iraq showing the collection sites in the middle and south of Iraq.

RESULTS AND DISCUSSION

Table 1 and fig.1 show the snail species and their collection sites distribution in provinces of the middle and south of Iraq. It is of worthy to note the absence of *Bithynia* spp. and *Bulinus truncatus* although the authors made special attention to find them at different habitats of the studied area. However, [25,31,32] could not find any *Bithynia* species in Mesopotamia. On the other hand, the only available recent record of *B. truncatus* was from Al-Yousifia district about 25 km south of Baghdad [33]. His bulinid specimens identification is questionable and may represent a case of misidentification and confusion with *Physella acuta,* a snail which is more distributed among the various habitats of study area. Both of snails are sinistral, attain rather equal size, have dark color and the latter species could be present in shallow pools and small streams, the habitat of the former snail species but not vice versa. Interviews with authorities of Communicable Diseases Directorate, Iraq Ministry of Health indicated that intense chemical control campaign targeted *Bulinus truncatus* achieved through the last five decades may lead within few years to declare Iraq clean of bilharziasis and only two cases were reported from rural areas in Diyala Province during the last five years (Abdulabbas, 2013; personal communication).

Table 1: Species, collection sites and numbers of freshwater snails collected from the middle and south of Iraq.

provinces ---------- **snail species**	**Baghdad**	**Kerbala**	**Babylon**	**Najaf**	**Diwaniya**	**Wasit**	**Muthana**	**Thi-Qar**	**Missan**	**Basra**	**Total**	**%**
Radix sp. form 1	-	-	-	-	-	-	-	-	-	51	51	1
Radix sp. form 2	-	-	-	-	-	-	-	-	48	-	48	1
Radix sp. form 3	-	-	-	-	-	-	-	-	-	69	69	1
Radix sp. form 4	-	32	72	20	77	33	39	43	41	66	423	6
Physella acuta	52	80	111	40	95	70	285	52	105	50	940	14
Melanoides tuberculata	11	34	75	70	182	30	22	121	79	270	883	13
Melanopsis nodosa	25	80	150	11	27	120	17	56	74	70	605	9
Melanopsis costata	5	50	15	30	120	60	60	98	70	160	663	10
Melanopsis buccinoidea	-	120	120	60	200	60	10	12	10	16	608	9
Bellamya bengalensis	20	200	620	60	200	159	48	60	210	75	1632	25
Theodoxus jordani	-	50	40	78	15	140	68	47	12	78	528	8
Gyraulus huwaizensis	-	-	-	-	30	-	-	12	-	115	157	2
Total	113	646	1203	369	946	672	549	501	649	1020	6607	100
%	22	10	18	6	14	10	8	8	10	15	100	

No direct threats were recorded for the snail fauna in the middle and south of Iraq, but local pollution resulted from human activities, shortage of water quantity and desiccation of marshes, deteriorated quality etc. constitute potential threats.

Bellamya bengalensis, Melanopsis spp., *Physella acuta*, *Radix* sp. forms, and *Melanoides tuberculatus* have wide distribution throughout the study area, while *Gyraulus huwaizensis* and *Theodoxus jordani* are restricted to certain habitats and with rather sporadic distribution. This is in general accordance with [34].

Table 2 shows that *Bellamya bengalensis* and *Radix* sp. specimens tend to attain larger measurements in the northern parts of the middle and south of Iraq, while in the extreme south of the area relatively smaller specimens are the dominant. This result may directly correlated with rather high water salinity content in the southern areas compared with the northern parts, the more preferable habitat. This is almost in accordance with [35] who found that *B. bengalensis* is present mainly in stagnant water and low saline water resources such as rivers, streams, lakes, ponds, wetlands, marshes, ditches, paddy fields, etc., and it can tolerate a maximum level of salinity of 0.2mg/l. It is present in all provinces included in the study area with relatively high incidence at middle region rather than southern region. It is widely distributed throughout southern Asia and assessed as least concern from the conservation point of view [35,36]. It is known as a common and abundant species found in high numbers in all kinds of freshwater bodies, mainly stagnant water and low saline water resources.

Tables 1 and 2 show that *Radix* sp., which is easily recognized by its broad triangular tentacles and sausage-shaped egg masses, is widely distributed throughout the study area. This may indicates that it is well adapted for various aquatic habitats in the middle and south of Iraq. However, the shell color may vary from dull yellow to dark red-brown, also some morphological features may vary within limited range at different collection sites. An overall of 4 forms (ecomorphs) are recognized and could be discriminated through the shape of bursa copulatrix-channel complex as follows: form 1 from Basra: it is characterized by cylindrical shape of the bursa copulatrix and channel.; form 2 from Amara: it is characterized by the conical shape of bursa copulatrix and channel; form 3 from Basra: it is characterized by the spherical shape of bursa copulatrix and its long cylindrical channel, and form 4 from all provinces: it is characterized by small oval shape of bursa copulatrix and its long slim channel.

The taxonomy of *Melanopsis* spp. was a subject of debate between the one superspecies concept "*M. praemorsa*" [37-41] and multiple species concept "*M. buccinoidea, M. nodosa, M. costata*" for Levantinian populations [42]. All these species are present in the studied area more frequently sympatric. To decide whether they are one superspecies or they are actually more than one species, it needs to be examined with more advanced methods such as molecular techniques rather than the classical morphology and anatomy to determine their identity. *Melanopsis* spp. are also known to have a wide distribution throughout Iraq [27,43]. However, table 2 shows that except for *M. buccinoidea* (smooth form) which is rather shows smaller size in relatively more saline water, most characters examined of the another two species *M. costata* and *M. nodosa* did not affected by their presence in different habitats included in the area especially in regard to salinity level. The majority of *Melanopsis buccinoidea* specimens were collected from the center of the studied area i.e., Kerbala, Babylon, Najaf, Diwaniya and Al-Muthana provinces (table 1). Most of collection sites of this snail are with high Sulphur content, clear and fast running water. This is in agreement with [27,44] . *Physella acuta* which is of Mediterranean origin, is a common gastropod species in Iraq, and known to invade all fresh waters in the world.

Table 2: Snail species, localities and some parameters to examine their diversity in the middle and south of Iraq

Snail species	Locality	SL	SW	Spire	Aperture width	SL/SW	Spire/SL
Bellamya bengalensis	Amara	21.68 (6-27.5) ±9.45	14 (3-23) ± 6.40	12.55 (2-20)±5.75	11.41 (4-16) ±3.97	1.61 (1.25-2.33) ±0.28	0.56 (0.33-0.64) ±0.096
Bellamya bengalensis	Diwaniya	27.41 (18-49) ±8.77	14.82 (11-20) ± 2.70	15.35 (11-22) ± 2.80	13.41 (11-17) ± 1.70	1.76 (1.53-2.58) ± 0.27	0.58 (0.39-0.67) ± 0.07
Bellamya bengalensis	Najaf	22.5 (15-29) ± 6.55	13.9 (12-15.8) ±5.75	14.63 (11-20) ± 4.55	13.1(10-15) ±2.25	1.66 (1.3-2.2) ± 0.33)	0.56 (0.32-0.7) ±0.088
Bellamya bengalensis	Baghdad	24.33 (7-29.9) ±8.82	15.3 (3-26) ±5.5	12.92 (2-22) ± 4,85	11.88 (4-17) ±3.11	1.55 (1.18-2.95) ±0.36	0.52 (0.33-0.68) ± 0.084
Radix sp.	Basrah	10.24 (6-17) ± 2.82	6.07 (4-9) ± 1.48	3.07 (1-5) ± 0.97	6.34 (3-11) ± 2.30	3.50 (1.71-5.67) ± 1.11	0.31 (0.14-0.56) ± 0.09
Radix sp.	Kerbala	13.30 (5-19) ± 2.51	8.56 (3-12) ± 1.85	4.07 (2-10) ± 1.96	10.46 (3-15) ± 2.47	1.57 (1.25-1.86) ± 0.17	0.31 (0.17-0.80) ± 0.14
Radix sp.	Diwaniya	14.11 (6-18)	7.67 (4-12)	3.92 (2-9)	9.35 (3-15)	2.95 (1.50-3.66)	0.33 (0.18-0.80)

		± 2.65	± 1.77	± 0.90	± 2.33	± 1.19	± 0.09
Melanopsis buccinoidea	Kerbala	14.36 (6-20) ± 3.53	6.18 (3-10) ± 1.33	8.23 (3-11) ± 1.91	6.48 (3-13) ± 2.00	2.37 (1.33-3.6) ± 0.55	0.59 (0.38-0.88) ± 0.13
Melanopsis buccinoidea	Najaf	12.35(5-21) ± 4.5	5.75 (3-10) ± 2.55	7.15 (3-11) ± 2.25	7.05 (3-12.3) ± 3.3	2.69 (1.66-3.25) ± 0.35	0.55 (0.35-0.75) ± 0.22
Melanopsis costata	Diwaniya	17.07 (11-22) ± 3.08	7.2 (4-9) ±1.42	10 (6-14) ±2.07	7.87 (5-10) ±1.36	2.13 (1.38-3.75) ±0.55	0.59 (0.44-0.82) ±0.09
Melanopsis costata	Amara-Basrah	17.7 (12-20) ±2.95	7.45 (4.5-9.5) ±1.11	10 (5-14±2.88)	7.65 (5-10) ±1.88	2.25 (1.45-3.65)±1.05	0.56 (0.4-0.75) ±0.11
Melanopsis nodosa	Diwaniya	15.11 (10-20) ±2.25	6.62 (5-8) ± 1.05	9.09 (6-13) ± 1.72	7.47 (5-9) ± 1.06	2.30 (1.88-3.17) ± 0.30	0.52 (0.40-0.71) ± 0.07
Melanopsis nodosa	Nasiriya-Basrah	15.85 (11-20) ±1.37	6.33 (4-8) ±1.11	8.83 (6-12) ± 1.18	7.12 (4-9) ± 1.55	2.45 (1.84-3.50) ±0.41	0.5 (0.40-0.65) ±0.08
Gyraulus huwaizensis	Amara-Basrah	0.97 (0.6-1.8) ±0.16	4 (2-5.5) ±0.91	1.6 (0.5-2.5) ± 0.45	1.57 (0.8-2.5) ±0.41	0.25 (0.18-0.36) ±0.05	1.63 (0.83-2.73) ±0.35
Gyraulus huwaizensis	Diwaniya	0.91 (0.5-1.6) ±0.11	4.2 (2-5.5) ±1.05	1.45 (0.45-2.6) ±0.55	1.55 (0.8-2.4) ±0.35	0.2 (0.20-0.39) ±0.07	1.73 (0.88-2.90) ±0.55
Theodoxus jordani	Diwaniya	6.21 (4-8) ±0.79	4.84 (3-6) ±0.62	2.03 (1-3) ±0.34	4.5 (3-6) ±0.63	1.29 (1-1.8) ±0.16	0.44 (0.14-0.6) ±1.88
Theodoxus jordani	Amara-Basrah	6.55 (4-8.5) ±0.88	4.45 (3.0-6.5) ±0.95	2.05 (1-3) ±0.42	4.3 (3-5.5) ± 0.47	1.25 (1.2-1.6) ± 0.12	0.4 (0.14-0. 55) ±1.25
Melanoides tuberculata	Diwaniya	18.33 (10-28) ±7.09	5 (3-8) ±1.79	13.17 (7-21) ±5.53	4.83 (4-6) ±0.75	3.66 (3.2-4.67) ±0.57	0.54 (0.31-0.75)±7.09
Melanoides tuberculata	Nasriya-Basrah	20.05(9-30.5) ±10.5	5.3(3-9) ±2.08	13.5 (7-22) ±6.95	4.55(4-6) ±0.55	3.45 (3-4.5) ± 0.65	0.61 (0.33-0.8) ±6.66
Physella acuta	Babylon-Kut	7.88(6-11) ±1.02	4.6 (3-6) ± 0.55	2.73 (2-5) ±0.72	5.49 (4-8) ± 0.74	1.73 (1.4-2) ± 0.18	0.34 (0.25-0.5) ± 0.07
Physella acuta	Najaf	6.94(5-11) ±1.5	4.22 (3-6) ± 0.75	2.15(2-5) ±0.88	5.75 (4-8.5) ±0.55	1.35 (1-4) ±0.33	0.5 (0.2-0.5) ± 0.04
Physella acuta	Missan	7.5 (5-11) ± 2.2	4.15 (3-6) ± 0.58	2.28 (2-5) ±1.05	5.2 (4-8) ± 0.63	1.53 (1-4) ± 0.47	0.45 (0.2-0.5) ± 0.05

Melanoides tuberculata is widely distributed in whole Iraq [43] in rapid flowing mountain streams with clear water in the north and in rivers, pools, lakes and ditches in the south. It is found in eastern Mediterranean countries, the entire Arabian Peninsula and south and southeast Asia [35,45,46]. It is the intermediate host of a number of trematode species of medical and veterinary importance. *Gyraulus huwaizahensis* is an endemic species for Iraq [23]. It is originally described from Huwaizah marsh, Missan province in the south. We collect many specimens from Qurna area in Basra province south to the original collection site and also from Diwaniya province, about 200 km to the north. The present work extends the known distribution of this species. *Theodoxus jordani* although it was collected from most provinces in the middle and south of Iraq, but with rather low intensity. It lives on and under stony substrate, and this may explain its low intensity since most of studied area with no stone substrate except for certain artificial sites.

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