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A Metazoan Parasitological Research of Some Iraqi Amphibians

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SUMMARY: The incidence and intensity of metazoan parasites in 3 species of Iraqi amphibians were studied. The amphibians were *Rana ridibunda, Bufo viridis* and *Hyla arborea*. Twenty-four species of helminths were encountered, including 16 trematodes, 1 cestode and 7 nematodes. Their respective names are: *Polystoma integerrimum, Prosotocus confusus, P. fuelleborni, Pleurogenoides gastroporus, P. medians, Sonsinotrema tacapense, Opisthioglyphe ranae, Haplometra cylindracea, Haematoloechus volgensis, H. vitelloconfluentum, H. similis, H. asper, Gorgoderina vitelliloba, Gorgodera euzeti, G. amplicava, Nematotaenia dispar, Cosmocerca ornata, C. commutata, Aplectana acuminata, Aplectana* sp., *Oxysomatium* sp., *Ozwaldocruzia filiformis* and *Rhabdias bufonis*. Collection localities, infection sites and rates and parasite burdens were determined throughout the species list. The highest and lowest rates of infection were for *R. bufonis* in *B. viridis* and *O. ranae* in *R. ridibunda*, while the highest and lowest worm burdens were for *C. ornata* in *R. ridibunda* and *P. integerrimum* in *B. viridis*. Seven of the species included in this study are thought to be new for Iraq.

Key Words: Amphibia, Trematodes, Cestodes, Nematodes, Iraq

Irak'ın Bazı Amfibilerinin Metazoan Parazitleri Üzerine Bir Çalışma

ÖZET: Bu çalışmada Irak'taki 3 amfibian türünde (*Rana ridibunda, Bufo viridis* ve *Hyla arborea*) metazoan parazitlerin insidensi ve intesitesi incelenmiştir. Bu amfibianlardan, 16 trematod, 1 cectod, 7 nematod olmak üzere toplam 24 helmint türü tespit edilmiştir. Türlerin ismi sırasıyla *Polystoma integerrimum, Prosotocus confusus, P. fuelleborni, Pleurogenoides gastroporus, P. medians, Sonsinotrema tacapense, Opisthioglyphe ranae, Haplometra cylindracea, Haematoloechus volgensis, H. vitelloconfluentum, H. similis, H. asper, Gorgoderina vitelliloba, Gorgodera euzeti, G. amplicava, Nematotaenia dispar, Cosmocerca ornata, C. commutata, Aplectana acuminata, Aplectana* sp., *Oxysomatium* sp., *Ozwaldocruzia filiformis* ve *Rhabdias bufonis*'dir. Parazitlerin Irak'ın hangi bölgelerinde bulunduğu ve konakçıda yerleştiği yere göre, dağılımları bildirilmiştir. En yüksek ve en düşük oranda parazit enfeksiyonlarının olduğu türler sırasıyla *B. viridis'*de *R. bufonis* ve *R. ridibunda* de *O. ranae* dir. Bu çalışmada bildirilen 7 tür Irak'tan ilk kez bildirilmiştir.

Anahtar Sözcükler: Amfibia, Trematod, Cestod, Nematod, Irak.

INTRODUCTION

In spite of its importance, the issue of parasitic fauna of Iraqi amphibians has received attention only from a small number of researchers. Saoud and Roshdy (26, 27) recovered 2 species of digenetic trematodes in the frog *Rana esculenta*, collected from Basrah Province, south of Iraq. To these, Dauood (9) added 8 species of protozoan parasites, 9 species of digenetic trematodes and 1 species of monogenetic trematodes. She found them in 2 species of frogs (*Rana ridibunda* and *Hyla arborea*) and 1 species of toads (*Bufo viridis*) obtained from Nineveh Province, northwest of Iraq. Al-Barwari and Nassir (2) reported on the occurrence in frogs (*R. ridibunda* and *H. arborea*) from Baghdad Province, central of Iraq, 1 species of cestodes and 4 species of nematodes. Hamad (18) found 8 species of digenetic trematodes in frogs (*R. ridibunda*) and 1 species of them in toads (*B. viridis*) from Erbil Province, northeast of Iraq. Molan *et al* (22) recorded 5 species of *Trypanosoma* and 1 species of each of *Haemogregarina*, *Dactylosoma*, *Cytamoeba* and microfilaria in frogs (*R. ridibunda*) from northern region of Iraq. Another relevant piece of research is that of Al-Alousi (1) who studied some biological and morphological features of unidentified plerocercoid larvae (spargana), which were isolated from the toads (*B. viridis*) from Nineveh Province. Finally, Rahemo and Ami (25) presented some observations on the larval encystment of *Microtetramers* sp. in the stomach wall of toads

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(*B. viridis*), the adult of which was previously found in the stomach and intestine of the same host species (2).

The purpose of the present research is to extend the range and quality of knowledge relevant to the infection of Iraqi most common amphibians by metazoan endoparasites.

MATERIALS AND METHODS

The total number of frogs and toads examined in this study was 418. It included 320 specimens of the marsh frog *Rana ridibunda*, 73 specimens of the green toad *Bufo viridis*, and 25 specimens of the tree frog *Hyla arborea*. These species are the most common amphibians of Iraq and belong to different families of the Order Anura, namely, Ranidae, Bufonidae and Hylidae.

Frogs and toads were at their adult stage. Both sexes were examined, in accordance with their availability. They were mostly collected at summer and autumn seasons (May-October) during 1985-1992 and from different localities of the northern region of the Iraq (Figure 1). The degree of anthropogenic load may have varied among some of these habitats.

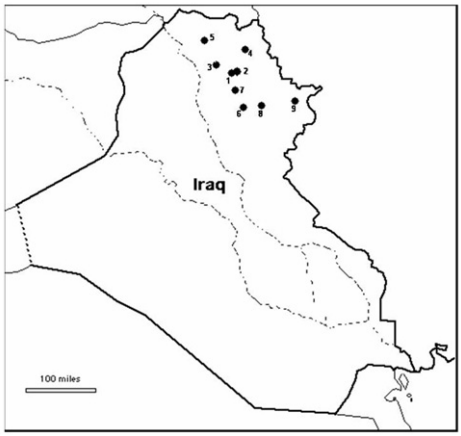

Figure 1: A map of Iraq indicating the localities from which samples of amphibians were collected: **1.** Montikawa (Erbil), **2.** Kasnazan (Erbil), **3.** Aski-Kalak (Erbil), **4.** Hareer (Erbil), **5.** Shikhan (Nineveh), **6.** Kirkuk city, **7.** Alton-Kopri (Kirkuk), **8.** Rabia'a (Kirkuk), and **9.** Sar-Jinar (Sulaimania).

Animals were sacrificed and dissected as soon as possible after they were captured. All viscera were removed and each placed in a suitable jar containing amphibian saline. The gastrointestinal tract was separated into its anatomical parts, each part of which was split and its content scraped into a Petri-dish containing saline. The dishes were examined for the presence of helminths under a dissecting microscope. Each of the lungs, urinary bladder and other organs were cut into small pieces and checked out for infection.

Helminths were cleaned in saline and studied alive macroscopically and under a dissecting microscope. Many representative specimens were also prepared for detailed microscopical examination. Trematode and cestode forms were frequently fixed in 4% formal saline for 24 hours, while being slightly pressed between 2 glass slides. They were then stained with acetocarmine, ethanol-dehydrated, xylene-cleared and permanently mounted on slides in Canada balsam. Nematodes, after washing and fixing in 70% alcohol, were cleared in glycol and mounted in gely-glycerine on slides before further examination. Specific characterizations were carefully analyzed and definite identifications were made in conformity with the published morphological descriptions and illustrations and opinions of world authorities (6, 24, 29). In some cases the species identity was confirmed by parasitological experts of British Museum (Natural History) and CAB International.

The level of parasitization was estimated in terms of both the "infection rate" and "parasite burden". The former index represents the incidence of infection for each parasite species among the sample of the examined specimens of its male or female hosts. The latter index represents the intensity or helminth load in the infected cases only, that is, the mean number of individuals of a parasite species per single infected individual of its male or female host.

RESULTS AND DISCUSSION

Table 1 lists the names of 24 species of metazoan parasites, which were recovered from the amphibian material used in this study. It also gives localities from which hosts specimens were collected, the infection sites of these parasites in their hosts, the indices of infection rates and parasite burdens.

The vast majority of the amphibian specimens examined were found infected. In terms of the taxonomic categories, the list of parasites referred to in above comprises 16 trematodes (1 monogenean and 15 digenean), 1 cestode and 7 nematodes. They belong to 10 families.

Twenty-two of the parasite forms involved were identified to the level of species. Most likely because of inadequacy of specimens, the definite identification was found difficult for the other 2 forms (*Aplectana* sp. from *R. ridibunda* and *Oxysomatium* sp. from *B. viridis*). Therefore, the latter were reserved at the generic level.

Phylum : Platyhelminthes (flatworms)

Class : Monogenea

Order : *Polystomatidea*

Family : *Polystomatidae*

Genus : *Polystoma*

Species : ***P. integerrimum*** (Froelich, 1798)

This organism was encountered in the urinary bladder of *B. viridis* only. No sex variation in the infection rate or parasite burden was detected. The latter parameter reveals that an infected green toad actually harboured a single specimen of the parasite.

Table 1. Metazoan endoparasites encountered in 3 species of Iraqi amphibians together with some relevant information

Host species (no. examined)	Locality (see map)	Helminth species	Infection site(s)	Infection rate (%) ♂	Infection rate (%) ♀	Mean intensity ♂	Mean intensity ♀
Rana ridibunda	1,3,7,9	*P. confusus*	Small intestine	2.6	3	12.5	13.6
(n=320)	4,5	*P. fuelleborni*	= =	0.6	1.2	7	6.5
Male=155	1,2,4,6,7,9	*P. gastroporus*	= =	5.8	6.1	10	8
Female=165	3,4,5	*P. stromi*	= =	3.2	2.4	5.8	4.2
	8,9	*P. medians*	= =	3.2	3.6	10.8	9.2
	3	*S. tacapense*	= =	0.6	0.6	4	2
	4	*O. ranae*	= =	0.6	0.6	2	2
	4,9	*H. cylindracea*	lung	1.3	0.6	1.5	2
	2,6,7	*H. volgensis*	=	1.9	1.8	3.3	3.3
	4,7	*H. vitelloconfluentum*	=	0.6	1.2	2	2
	3,5,6,8,9	*H. similis*	=	5.8	3.6	3	4
	3	*H. asper*	=	1.3	0.6	4.5	3.6
	3,9	*G. vitelliloba*	Urinary bladder	2.6	1.2	1.7	2.5
	2,4,8,9	*G. euzeti*	= =	4.5	3.6	3.4	2.5
	4	*G. amplicava*	= =	1.3	0	3	0
	1,4,6,9	*C. ornata*	Rectum & intestine	15.5	10	17.1	22.6
	2,6,9	*C. commutata*	= = =	3.2	1.8	3.6	4.3
	1-4,6-9	*Aplectana* sp.	Rectum	11.6	8.5	4.9	3.4
Bufo viridis	1, 6	*P. integerrimum*	Urinary bladder	2.9	5.3	1	1
(n=73)	1-4,6-9	*N. dispar*	Small intestine	20	21	3.4	2.6
Male=35	1-4,6-9	*C. ornata*	Rectum & intestine	11.4	11	17.3	18.4
Female=38	1,2,3,9	*A. acuminata*	Rectum	11.4	13	7.5	8.6
	1-4,6-9	*Oxysomatium* sp.	Rectum & intestine	14.3	13	4.8	4.4
	1-4,6-9	*O. filiformis*	Intestine & rectum	28.6	24	14.5	13.6
	1-4,6-9	*R. bufonis*	Lung	48.6	32	3.3	4.2
Hyla arborea (n=25) Male=12 Female=13	1-4,9	*N. dispar*	Small intestine	16.7	15	2	2

Dauood (9) was the first who reported on the existence of *P. integerrimum* in the green toads from Iraq. The infection rate for this parasite in the present study is close to the figure of 3.7% recorded by Vashetkov and Siddikov (31) in the same toad species from Uzbekistan. But they encountered significantly higher levels of parasite burden, ranging between 7 and 34 individuals per single infected toad. On the other hand, Al-Sorkhy and Amr (3) observed a 4-fold higher infection rate in relation to the same parasite and host species from Jordan. Concurrently, these researchers recovered an allied species, *P. viridis* Euzet *et al*. (14) from the same host and habitat but in different individuals. For the latter species, they found an infection rate of 5%.

A *Polystoma* sp. was encountered in *R. ridibunda* from Saudi Arabia (15). The situation in Turkey is such that both species of polystomatid monogeneans referred to in above were found in *B. viridis* (34). That a third and new species, *P. macrocnemis*, was found in the urinary bladder of the Iranian longlegged wood frog *Rana macrocnemis* (8).

The *P. macrocnemis* has probably as yet not been reported from elsewhere. The data on the prevalence of *P. viridis* also suggests that it is rather uncommon species even in the milieu of *B. viridis*; for example, besides Turkey and Jordan has hitherto only been recorded in toad populations from Bulgaria and the Isle of Corsica in the Mediterranean Sea (14). In Al-Sorkhy and Amr's (3) opinion besides noticeable variation in the shape of median hooks (hamuli) of the posterior attachment organ (opisthaptor) between *P. viridis* and *P. integerrimum*, these two species seem to differ in their affinities towards the definitive hosts. Thus, while accumulative evidence suggests that *P. integerrimum* is capable of infecting several species of toads and frogs

belonging to the families Bufonidae and Ranidae, *P. viridis* is solely infectious to the green toad *B. viridis*.

It is *P. integerrimum* which remains a dominant global parasite among this group of amphibian monogenea. For example, according to Vojtkova and Roca (32), the present situation in Europe confirms that this particular species is the only monogenean parasite of anuran amphibian throughout the continent. This situation suggests the need for further research to establish unequivocally not only the identity of but also the synonymy among the polystomatid monogeneans in all the Mediterranean countries and compare them with those of other regions of the world.

The monogenean species reported upon in this study undoubtedly belongs to a unique and biologically very interesting group of animals. The much higher degree of host-specificity they display, for example, in comparison with the majority of other metazoan parasites of amphibia, may be attributed to specialization in their life cycles particularly their demand of specific stimuli for host recognition and sexual development.

Class : Trematoda (flukes)

Subclass : *Digenea*

Order : *Plagiorchiida*

Family : *Lecithodendriidae*

Genus : *Prosotocus*

Species : ***P. confusus*** (Looss, 1894)

Species : ***P. fuelleborni*** (Travassos, 1930)

Both of these intestinal flukes were recovered in the marsh frog *R. ridibunda* in various localities of northern Iraq. Infection rate and parasite burden appear to be higher for the former than the latter species. Averaging the data for the two flukes would reveal that the female frogs are probably more susceptible for infection by them than the male frogs.

Genus *Prosotocus* encompasses a number of species, which are strictly endoparasites of raniid frogs. Both species of flukes referred to in above were first recorded in Iraq by Dauood (9), who also encountered them in the intestine of *R. ridibunda.* However, the finding of this researcher of *P. fuelleborni* in the urinary bladder was not duplicated in the present study. Madi (20) reported the presence of *P. confusus* in the intestine of the Levantine frog, *Rana bedriagae*, inhabiting the Azrag Oasis in Jordan. Recently, Al-Sorkhy and Amr (3) found it absent in inhabitants of the forenamed Oasis but not from pools in Al-Ghawr area. The latter researchers recorded an infection rate for *P. confusus* in *R. bedriagae,* which is 3-fold higher in comparison with the data of the present study. In Turkey, Yildirimhan *et al* (37, 39) and Dusen and Oz (12) reported on the occurrence of *P. confuses* in the intestine of *R. ridibunda.*

It is now conclusively established that *Prosotocus* flukes have evolved a biohelminthic mode of life cycle, with some molluscs serving as their intermediate hosts (16). Thus, the conspicuous variations in the infection rate may be attributed to the nature of factors involved in such a complex process. That is to say, for example, not only to the survival of the definitive host but also of the snails which are incriminated in the parasite's successive generations of parthenogenetic development.

Family : *Pleurogenidae*

Genus : *Pleurogenoides*

Species : ***P. gastroporus*** (Luhe, 1901)

Species : ***P. stromi*** (Travassos, 1930)

Species : ***P. medians*** (Olsson, 1876)

The above 3 species were found in the small intestine of *R. ridibunda* in several of the localities inspected. The highest infection rate among them was for *P. gastroporus* from female frogs, while the highest parasite burden was for *P. medians* in male frogs. Averaging their data would suggest that the infection rate is slightly higher in female than male frogs, while the reverse is the case for the parasite burden.

The present findings represent first records of *P. gastroporus* and *P. medians* from Iraq. The species *P. stromi* was originally recorded in *B. viridis* from this country by Dauood (9). This species was also recorded in *R. ridibunda* from Saudi Arabia (15) and in *R. saharica* from Morocco (13). Oguz *et al* (23), Dusen and Oz (12) and Yildirimhan *et al* (37, 38) have encountered *P. medians* in the intestine of *R. ridibunda* from Turkey. Recently, Yildirimhan *et al* (37) has registered *P. stromi* for first the time in Turkey. Two additional members of the genus *Pleurogenoides* were also reported from the Arab World; they are *P. compactus* in *R. ridibunda* from Saudi Arabia (15), and *P. tacapensis* in *R. ridibunda* from Tunisia (7) and in *R. bedriagae* from Jordan (3, 20). The overall level of parasitization in these latter species may be comparable to that encountered for the Iraqi ones.

Genus : *Sonsinotrema*

Species : ***S. tacapense*** (Sonsino, 1894)

Specimens of this digenetic trematode were detected in the small intestine of *R. ridibunda* from only one of the localities studied. The infection rate, despite being low for both sexes, was twice as much in male than female frogs.

Dauood (9) first recorded this species in the same host from Nineveh Province. She also found it in the small intestine, but once she recovered 6 specimens in the urinary bladder.

In the Arab World, *S. tacapense* was recorded and redescribed from *R. ridibunda* from Tunisia (7). A related species of the genus *Sonsinotrema, S. calloti,* has been found in *R. saharica* in Morocco (13). The figure of its parasite burden matches that in the present study, while its infection rate is significantly higher.

Family : *Plagiorchiidae*

Subfamily: *Opisthioglyphinae*

Genus : *Opisthioglyphe*

Species : ***O. ranae*** (Froelich, 1791)

This fluke was encountered in a single locality in northeast of Iraq. Its infection rate was low and equal for both sexes of its definitive host *R. ridibunda.* Slightly more individuals of this parasite were harboured in the small intestine of male than female frogs.

The first record of this parasite from Iraq is due to Dauood (9). She also found it in the small intestine of *R. ridibunda*, particularly in the duodenum. It seems to be absent in other species of Iraqi frogs and toads. However, a related species *O. endoloba*, with higher infection rate, was recorded in *R. esculenta* from southern Iraq (26). The trematod have been found in Saudi Arabia (15) and in Turkey (36, 37) and Dusen and Oz (12) in the intestine of *R. ridibunda*. Moreover, Yildirmhan *et al* (36) found it in the intestine of the fire-bellied toad *Bombina bombina* from Turkey. According to Prudhoe and Bray (24), these parasites are known elsewhere to infect several other anuran species, including the toad *Bufo bufo.*

Subfamily: Omphalometrinae

Genus : *Haplometra*

Species : ***H. cylindracea*** (Muller Zeder, 1800)

This is a pulmonary fluke of frogs. Its adult specimens were encountered in lungs of a couple specimens of *R. ridibunda* from two of the examined localities. The infection rate, despite being generally low, is seemingly higher in male hosts, while the parasite burden seems to be higher in female host.

This is the first record of this parasite from Iraq. Also no reports on its presence in countries bordering Iraq seem to be available. However, according to (24, 32), it is prevalent in Europe and some other parts of the world.

It is noteworthy to mention that there is strong evidence confirming that *Haplometra*, as well as *Opisthioglyphe*, flukes use in their life cycle freshwater snails of the genus *Lymnaea*. In Iraq, like in many other parts of the world, lymneid snails are prevailing and confirmed to act as intermediate hosts of some economically and medically important parasites, such as liver flukes and amphistomes. Therefore, the presence of other species of digenetic trematodes, such as some of those that were found in this work, it could be to reduce the development of the forenamed ones.

Family : *Haematoloechidae*

Genus : *Haematoloechus*

Species : ***H. similis*** (Looss, 1899)

Species : ***H. asper*** (Looss, 1899)

Species : ***H. volgensis*** (Sudarikov, 1950)

Species : ***H. vitelloconfluentum*** (Syn.: *Tremiorchis vitelloconfluentum*) (Rai, 1962)

Every one of these 4 flukes was found in the lungs of *R. ridibunda* in some of the examined localities. The highest infection rate was observed for *H. similis* males and the highest parasite burden in *H. asper* males. However, taking together the infection data for all of them tends to disclose no sex variation among the individuals of their hosts.

The former two of the above species were previously recorded from Iraq (9). They were also found in the lung of the same host. This is the first record for the other two species from this country.

There is an obvious scarcity of information regarding the members of the genus *Haematoloechus* in Middle East at large. Indeed, apart from *H. variegatus*, which was reported in *R. bedriagae* from Jordan (20) and the same species and *H. breviansa*, which were reported in *R. ridibunda* from Turkey (12, 37, 39), no other records in the literature could be traced. This shortage might partially be attributed to the fact that this group of digenetic flukes has evolved some sound morphological variations in response to changes in geographical factors that makes their identification a difficult task.

Members of the genus *Haematoloechus* are obligatory parasites of frogs, often raniid, and as adult normally live in their lungs (24, 28). The biology and exact life cycle of any one of these flukes from Iraq are as yet not been studied. However, related species prevalent in various parts of the world use aquatic pulmonate snails as first and naiads of odonate insects as second intermediate host (33). Frogs become infected by eating dragonfly naiads in which metacercariae encyst.

Family : *Gorgoderidae*

Genus : *Gorgoderina*

Species : ***G. vitelliloba*** (Olsson, 1876)

Genus : *Gorgodera*

Species : ***G. euzeti*** (Less and Combes, 1968)

Species : ***G. amplicava*** (Looss, 1899)

The first and second of these flukes were recovered from the urinary bladder of *R. ridibunda* in several localities of northern Iraq, while the third one was encountered in only one locality of the region. The highest infection rate among them was noted for *G. euzeti* in male frogs and the highest parasite burden in male frogs for the same fluke species. Further, the overall figures for these fluke species also reveal that both the infection rate and parasite burden are higher in male than in female frogs. Such variations are probably caused by certain intrinsic factors, which may also have impact on the behaviour of the two sexes in response to the ecological factors.

This is the first record of *G. amplicava* from Iraq. Whereas, G. *vitelliloba* and G. *euzeti* were previously recorded from this country by Dauood (9). She also found them in the same anatomical site of the same host species. *G. vitelliloba* has also been reported by Madi (20) in *R. bedriagae* from Jordan and by Yildirimhan *et al* (37, 39, 40) and Dusen and Oz (12) from Turkey in *R. ridibunda* and *R. macrocnemis*. Little is known about the life cycles of these flukes in Iraq. However, the ge-

neral belief amongst many parasitologists is such that their first intermediate host is the same species of freshwater spaeriid clam, *Musculium partumeium*; whereas the second intermediate host and in which the cercaria encysts may differ, for example, it is a tadpole for *G. vitelliloba* and larva of a *Sialis* sp. for *G. euzeti.* So, basically, like other digenetic trematodes, the geographical distribution of these species should be mainly determined by the distribution patterns of their intermediate hosts.

Class : Cestoda (tapeworms)

Order : *Cyclophyllidea*

Family : *Nematotaeniidae*

Subfamily: *Namatotaeniinae*

Genus : *Nematotaenia*

Species : ***N. dispar*** (Goeze, 1782)

This tapeworm was previously found in the small intestines of *H. arborea* and *B. viridis* in central of Iraq (2). The present study provides information about its occurrence in both these hosts in the northern region of the country as well as confirming absence in *R. ridibunda* population of Iraq. However, opposed to the 1980s observation, in this study the green toads showed significantly higher infection rate and slightly higher parasite burden than the respective data from the tree frogs. If the two sets of figures are averaged, then the infection level in the latter host would be moderately higher than in the former one (20.5 % vs. 13.8 %), while the index for the parasite burden in either species is 3. Thus, cases of hyperparasitism by *N. dispar* in either of its above named hosts, such of order of 43 adult tapeworms per single host (31), were never encountered in Iraq.

The *N. dispar* is obviously an obligatory parasite of amphibians, but with neither a high degree of host-specificity nor a restricted geographical distribution. Indeed, it seems to be the only genuine cestode species of amphibians in the whole of Europe (24). It is also widely prevalent in Africa and Asia and, as considered by Jones (19), *N. viride* of Mokhtar-Maamouri and Chakroun (21) is most likely a synonym name.

In Middle East and the surrounding territories, *N. dispar* has already been recorded from several counties with a wide-range of hosts belonging to families Bufonidae, Hylidae and Ranidae. Some of the examples are in *B. viridis* from Iran (10), Tunisia (21), Turkey (34), and Uzbekistan (31), in *B. viridis*, *R. bedriagae* and *H. arborea savignyi* from Jordan (3), in Caucasian salamander (Mertensiella caucasica), from Turkey (38).

According to Dollfus *et al* (10), some Urodela species in the Middle East are also subject of *N. dispar* infection. On the other hand, in conformity with the situation in Iraq, Fernando (15) noticed that this tapeworm is not a member of the parasitic community of *R. ridibunda* from Saudi Arabia.

Phylum : Nemathelminthes (roundworms)

Class : *Nematoda*

Order : *Ascaridia*

Family : *Cosmocercidae*

Genus : *Cosmocerca*

Species : ***C. ornata*** (Dujardin, 1845)

Species : ***C. commutata*** (Diesing, 1851)

The present study considerably enlarges the original distribution of and pertained knowledge about *C. ornata* in Iraq, for example, by finding that it is also prevalent among the populations of the frogs (*R. ridibunda*) and toads (*B. viridis*) in many localities of northern Iraq. This nematode species is most likely totally absent in the population of the tree frog *H. arborea* from this country.

The study also tends to confirm three previously made observations in Iraq (2). First, adult specimens of *C. ornata* actually inhabit the rectums of their hosts more than their small intestines, for example, with a respective ratio of 22:1; a situation which might lessen from their deleterious effect. Second, infected hosts regardless of their sex contain less adult male than female nematodes, for example, with a respective ratio of about 1:6.8. Third, no pronounced monthly variations in infection of frogs or toads could be discerned, at least during the survey period; in other words, perhaps these parasites could be encountered whenever finding their hosts.

On the other hand, the parasitization indices seem to be different. For example, in respect to *R. ridibunda* and contrary to the finding of 1980s (2), more male than female frogs were found infected. The parasite burdens, despite being of the same order, that is, female frogs harbour slightly more parasite specimens than male frogs, varied in the intensity; for example, the infection load in both sexes in the present study is approximately 4-fold higher than what was previously found.

An allied species, *C. commutata*, also infects *R. ridibunda* in Iraq. But in view of the findings of this study, the newly recorded species demonstrates lower levels of infection rate and parasite burden (Table 1).

Genus *Cosmocerca* is cosmopolitan in its geographical distribution and comprises enormous number of species. According to Baker (6) and Anderson (4), these parasites infect many species of several genera of amphibians and reptiles. In the counties near Iraq, *C. ornata* has been reported to parasitize *B. viridis, H. arborea* and *R. ridibunda* from Turkey (12, 35, 37) and Uzbekistan (5, 31). It has also been reported in the Mauritanian toad *B. mauritanicus* from Morocco (13). As to *C. commutata,* it has also been reported in green toads (*B. viridis*) (34) and in marsh frog (*R. ridibunda*) (12) from Turkey and Uzbekistan (5, 31). Related species in the Middle East region include *Cosmocerca* spp. from *R. ridibunda, R. macrocnemis* and in caucasian salamander

(*Mertensiella caucasica*) in Turkey (38, 39, 40), and *C. timophejevoi* from *B. viridis* and *R. ridibunda* in Uzbekistan (5).

Genus : *Aplectana*

Species : ***A. acuminata*** (Schrank, 1788)

***Aplectana* sp.:** Toads (*B. viridis*) and frogs (*R. ridibunda*) from northern Iraq were both found harbouring *Aplectana* parasites in their rectums. Those from the first host were definitely belonging to the species *A. acuminata*, which represents a new record from Iraq. However, specimens from *R. ridibunda* showed some varied morphological features, made the task of a definite identification difficult. It was, therefore, decided to retain these forms at the level of genus. On an average, figures for both infection rate and parasite burden were found to be higher for *B. viridis* than *R. ridibunda.* This finding verifies a previous observation in Iraq (2).

An *Aplectana* sp. has been encountered in the intestine of *R. ridibunda* from Saudi Arabia (15) and *A. acuminata* and a related species *A. multipapillossa* have been found in the alimentary canals of *B. viridis* and *R. ridibunda* from Uzbekistan (5) and in caucasian salamander (*Mertensiella caucasica*) from Turkey (38). No further data from territories near Iraq seems to be available.

Aplectana spp., like *Cosmocerca* spp., are widely distributed across large areas of the world. However, according to Baker (6) and Anderson (4), their infection capability is not restricted to frogs and toads, since some of them are also capable of parasitizing salamanders, reptiles, and even fishes. In this connection, a preliminary investigation by the researchers suggest an infection rate of a very low order by an *Aplectana* sp. among a sample of the urodela *Neurergus crocatus* from northern Iraq.

Genus : *Oxysomatium*

***Oxysomatium* sp.:** This parasitic nematode was recovered from the rectums and intestines of toads, but was absent from both frog species studied. The infection rate and parasite burden were slightly higher in the infected males than females.

The genus *Oxysomatium* belongs to the same subfamily of *Cosmocerca* and *Aplectana*. Its members have similar biology and ecology and also like either of them is comprised of several species, some of them have wide geographical distributions. No member of this genus was found before to be represented in the helminthofauna of Iraq.

Subclass : Trichstrongylina

Order : Molineoidea

Family : Trichostrongylidae

Genus : *Oswaldocruzia*

Species : ***O. filiformis*** (Goeze, 1782)

This nematode in Iraq was first recorded in *B. viridis* from Baghdad area (2). The present study substantiates that it parasitizes members of the same host species from other localities of the country. Its normal habitat is the small intestine; however, in the more heavily infected cases few organisms may be encountered in the rectum. No specimen of either *R. ridibunda* or *H. arborea* was found infected with this species.

Throughout the world, *O. filiformis* parasitizes several species of amphibians and reptiles. For example, it has been reported in *B. viridis* from Turkey (34) and Uzbekistan (5, 31), and in *R. macrocnemis* (40), *R. ridibunda* (37) and *H. arborea* (35) from Turkey. An *Ozwaldocruzia* sp. has also been reported in *R. ridibunda* from Saudi Arabia (15). A couple of related species have also been described across the neighbouring countries, including *O. Arabica* in *Bufo arabica* from Saudi Arabia (11), and *O. biolata* in *B. viridis* from Uzbekistan (5).

Order : Rhabditida

Family : *Rhabdiasidae*

Genus : *Rhabdias*

Species : ***R. bufonis*** (Schrank, 1788)

Adults of this nematode species were recovered from the lungs of *B. viridis* only. Of the entire list of parasite forms included in this study, this one was found more prevalent in terms of infection incidence (Table 1). The percentage of infection was higher in male than female toads, while the reverse was observed for the parasite burden. Its larvae were noticed in various organs including blood “en route to lungs”.

This record represents a new addition to the list of helminthic parasites from Iraq. However, *R. bufonis* is a worldwide parasite of toads and frogs (4, 6). In Middle East and adjacent regions in Asia and Africa it has been encountered in *R. ridibunda* from Turkey (12, 38); and regularly encountered in *B. viridis*, with relatively intensive infections, for example, also from Turkey (34) and Uzbekistan (5, 31), and in *B. mauritanacus* from Morocco (13). It was also found in the fire-bellied toad *B. bombina* from Turkey (36). Its widely existent infection (for example, a rate of 40-60% and parasite burden of 3.0-3.6) was observed in the populations of the northern leopard frog *R. pipiens* from North Dakota, USA (17*).* In the wild uninterrupted amphibian communities, however, Tinsley (30) found only a small population of them having heavy burdens with *R. Bufonis.*

Rhabdias species without exception are hermaphrodites. These nematodes have a direct life cycle (toad to toad infection) and also a very short life span. They, therefore, represent a potential model for investigating the general mechanisms involved in a number of crucial phenomena of biological and biomedical interest, such as transmission, embryogenesis, genetics and ageing.

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