On the Helminth Fauna of Some Iraqi Reptiles

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SUMMARY: A study on the parasitofauna of 7 species of Iraqi reptiles revealed the presence of at least 8 adult helminth species and some tentatively identified larvae. The reptiles were Hemidactylus flaviviridis, H. persicus, Asaccus elisae, Spalerosophis d. clifordi, Testudo g. terrestris, Mauremys c. caspica and Trionyx euphraticus. The helminths found comprised 1 species of digenetic trematodes (Telorchis sunkardi), cysticercoids of Diplopylidium nolleri and 7 nematode species (Thelandros sp., Microtetrameres sp., Angusticaecum holopterum, Atractis dactylar, Tachygontia nicoller, Camallanus microcephalus, and Falcaustra japonensis). Information about the locality of collection, infection site and rate and parasite burden is provided. Although similar cysticercoid larvae and adults of Thelandros sp. and Microtetrameres sp. were previously recorded from Iraq, the scope of the data is considerably extended. In the researchers’ judgment, the rest of the parasite species represents a new addition to the Iraq list.

Key words: Turtle, Lizard, Snake, Helminth, Iraq

IRAK'ın Bazı Reptillerinin Helmin Faunası


Anahtar Sözcüklər: Kaplumbağא, Kertenkele, Yilan, Helmint, Irak.

INTRODUCTION

Many species of reptiles are prevalent in the Iraqi ecosystems. They comprise such principal categories like lizards, snakes, tortoises and turtles. However, very little attention has been paid by Iraqi and non-Iraqi biologists to the parasitism in any group of them. To date as far as it is discernible from the review of the literature, only few species of lizards and snakes have been examined for this purpose (2, 14, 17, 20, 23, 26). Then altogether only a species of blood Protozoa, 4 species of adult helminthic parasites (2 Nematoda and 2 Cestoda) and few cysticercoid larvae are hitherto recovered from these animals. Therefore, the paucity of data relevant to this field of Iraqi parasitology is obvious.

By virtue of constituting a major group of vertebrates, researches on reptiles and their parasitic communities in any part of the world are important to pure and applied sciences in many different ways (5, 6, 11). They are bound to improve the knowledge about their diseases and zoonoses as well as that pertinent to the biodiversity and bionomics of different populations involved in these types of associations. Hence, for example, they may provide invaluable evidences to such significant and interrelated issues like the patterns of natural selection of various parasites towards their hosts and host-parasite relationships, assemblages and adaptations of life cycles including epidemiology of infective stages and competitive processes between species parasitizing the same hosts.

A helminthological research of 7 species of reptiles, collected from different localities within Iraq, was carried out. Four of these reptiles are examined for the first time from this country.
Several species of parasites were either definitely or tentatively identified, among which were new national records as well as new host and locality records. The implications of these findings are appraised and discussed. Moreover, the researchers regard this study as an additional means of encouragement to investigate specifically the parasitofauna of Iraqi reptiles.

**MATERIALS AND METHODS**

The samples of hosts examined in this study represent 5 important families of the Iraqi reptiles, namely, Gekkonidae, Colubridae, Testudinidae, Bataguridae and Trionychidae. They made a total number of 365 individuals, divided as following: 134 yellow-bellied house geckos *Hemidactylus flaviviridis* (Ruppell, 1835); 69 Persian geckos *H. persicus* (Anderson, 1872); 85 leaf-toed geckos *Asaccus (= Phylodactylus) elisae* (F. Werner, 1895), 5 diadem snakes *Spalerosophis diadema cliffordi* (Schlegel, 1837), 22 common Mediterranean spur-thighed tortoise *Testudo graeca terrestris* (Forskall, 1775); 45 Eastern Caspian turtle *Mauremys caspica caspica* (Gmelin, 1774); and 5 Euphrates soft-shelled turtle *Trionyx (= Rafetus) euphraticus* (Daudin, 1802).

Reptiles were at their adult stage and selection of specimens of the two sexes was at random. They were collected from different localities of Iraq (Fig. 1) during 1985-1992. Euthanasia was often carried out with chloroform and dissection took place as soon as possible afterwards. Body cavity and different organs were examined, with a special attention being paid to the alimentary canal due to a prospect of helminth existence. The main anatomical regions of the latter organ were separated from each other, individually cut open and their contents emptied into Petri-dishes or suitable receptacles containing physiological saline. The containers were inspected closely for the presence of helminths both with a magnifying lens and a dissecting microscope.

Collection and temporary and permanent preparations of the helminths were made according to the standard methodologies for trematodes, cestodes and nematodes. Illustrations, morphological descriptions and diagnostic keys of Baker (6), Skrjabin (28) and Anderson (5) aid in the analysis of the distinctive characters and ultimately in the identification of most of the parasitic forms encountered. Furthermore, whenever necessary, duplicate of the specimens were sent to experts on parasite systematics in order to confirm their identification.

Determination of the parasitization level was carried out in accordance with the concept that by the “infection rate” is meant the prevalence of a parasite among its host’s sample as a whole, while the “parasite burden” is the infection intensity or average load of the parasite members in the infected cases only.

**RESULTS**

Nine species of helminthic parasites were encountered in the specimens of reptiles examined in this study. They comprised 1 trematode, 1 cestode and 7 nematodes. These parasites belong to 9 families. A summarized account on these parasites and their hosts is presented in Tab. 1; including their names, collection localities, infection sites and rates, and parasite burdens. The global infection rate was about 73%, with no significant overall sex variation. No adult cestodes and adult or larval acanthocephalans were encountered during the course of this study.

Out of the samples of 3 species of gekkonid lizards examined, as well as the male specimen of the diadem snake, there were specimens harbouring on their coelomic peritoneal membranes some cyclophyllidean neotenic growths or lacunal metacestodes of *Diplopylidium nolleri* (Skrjabin, 1924). These objects appeared to be attached to the host’s tissues by pedicel-like structures and showed histological characteristics of the cysticercoids. Therefore, they represent a larval stage, which means that they are not qualified to complete their life cycles in the reptilian hosts from which they were recovered. The level of parasitization, whether in terms of infection rate or parasite burden, in *A. elisae* was constantly higher than in the 2 other species of geckos. The figures on the sex variation may look significantly different, but upon averaging the data for the 3 lizard species, only a slight variation, if of any suggestive intrinsic influence, is apparent. On the other hand, the infected specimen of the snake was male.
Amongst the nematode forms encountered, 2 of them were reserved at the generic category. The rest of the parasite forms were definitely identified.

Both of the nematodes that were not completely identified were found in geckos. The first of them belongs to the genus *Thelandros* (Wedl, 1862) (*Oxyurida: Oxyuridae*), for which *A. elisae* is thought to represent a new host record. The highest parasitization level with this parasite was found to be in *A. elisae* and the average figures indicate that males of these geckos serve slightly better hosts than their females for the forenamed species of intestinal nematodes. The second nematode belongs to the genus *Microtetrameres* (Travassos, 1915) (*Oxyurida: Tetrameridae*) . This observation involves a new host record whose infection nature will constitute a subject of appraisement in discussion.

One species of trematode and 5 species of nematodes were recovered from the alimentary canals of 72 specimens of tortoises and turtles inspected. These were identified as: *Angusticaecum holopterum* (Rudolphi, 1819) and *Atractis dactyluris* (Rudolphi, 1819) both of family *Atractidae* (*Ascarida*), and *Tachygonetria nicolleri* of family *Pharyngodonidae* (*Oxyuroidea*), from the Mediterranean spur-thighed tortoise *T. g. terrestris*; *Camallanus microcephalus* (Dujardin, 1845) of family Camallanidae (*Spiruroidea*) and

### Table 1. Parasitic species found in specimens of 7 Iraqi reptile species examined in this study.

<table>
<thead>
<tr>
<th>Host species (no of examined)</th>
<th>Locality</th>
<th>Parasite species</th>
<th>Infection site(s)</th>
<th>Infection Rate (%)</th>
<th>Mean Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>H. flaviviridis</em> (n=134)</td>
<td>Baghdad, Diyala, Samarra, Ramadi, Maysan, Basrah, Kirkuk, Erbil, Dohuk</td>
<td><em>Diplopydium nolleri</em></td>
<td>Peritoneum</td>
<td>7.5</td>
<td>9.0</td>
</tr>
<tr>
<td>Male: 67</td>
<td>Female: 67</td>
<td><em>Thelandros sp</em></td>
<td>Rectum, S.intestine</td>
<td>17.9</td>
<td>20.9</td>
</tr>
<tr>
<td><em>H. persicus</em> (n=69)</td>
<td>Baghdad, Diyala, Samarra, Ramadi, Maysan, Kirkuk</td>
<td><em>Diplopydium nolleri</em></td>
<td>Peritoneum</td>
<td>5.9</td>
<td>11.4</td>
</tr>
<tr>
<td>Male: 34</td>
<td>Female: 35</td>
<td><em>Thelandros sp.</em></td>
<td>Rectum, S.intestine</td>
<td>14.7</td>
<td>5.7</td>
</tr>
<tr>
<td><em>A. elisae</em> (n=85)</td>
<td>Mousul, Erbil, Kirkuk</td>
<td><em>Diplopydium nolleri</em></td>
<td>Peritoneum</td>
<td>11.9</td>
<td>9.3</td>
</tr>
<tr>
<td>Male: 42</td>
<td>Female: 43</td>
<td><em>Thelandros sp.</em></td>
<td>Rectum, S.intestine</td>
<td>50.0</td>
<td>34.9</td>
</tr>
<tr>
<td><em>S. d. cliffordi</em> (n=5)</td>
<td>Kirkuk</td>
<td><em>Diplopydium nolleri</em></td>
<td>Peritoneum</td>
<td>33.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Male: 3</td>
<td>Female: 2</td>
<td><em>Angusticaecum holopterum</em></td>
<td>S. intestine, stomach</td>
<td>27.3</td>
<td>36.4</td>
</tr>
<tr>
<td><em>T. g. terrestris</em> (n=22)</td>
<td>Mawat, Rabia’a</td>
<td><em>Atractis dactyluris</em></td>
<td>S. intestine, stomach</td>
<td>54.5</td>
<td>63.6</td>
</tr>
<tr>
<td>Male: 11</td>
<td>Female: 11</td>
<td><em>Tachygonetria nicolleri</em></td>
<td>Rectum</td>
<td>54.5</td>
<td>45.5</td>
</tr>
<tr>
<td><em>M. c. caspica</em> (n=45)</td>
<td>Hareer, Sar-Jinar</td>
<td><em>Camallanus microcephalus</em></td>
<td>S. intestine</td>
<td>31.8</td>
<td>34.8</td>
</tr>
<tr>
<td>Male: 22</td>
<td>Female: 23</td>
<td><em>Telorchis stunkardi</em></td>
<td>S. intestine</td>
<td>18.2</td>
<td>21.7</td>
</tr>
<tr>
<td><em>T. euphraticus</em> (n=5)</td>
<td>Alton-Kopri</td>
<td><em>Falcaustra japonensis</em></td>
<td>S. intestine</td>
<td>66.7</td>
<td>50.0</td>
</tr>
<tr>
<td>Male: 3</td>
<td>Female: 2</td>
<td><em>Telorchis euphraticus</em></td>
<td>S. intestine</td>
<td>18.2</td>
<td>21.7</td>
</tr>
</tbody>
</table>
Telorchis sunkardi of family Telorchiidae (Digenea) from Eastern Caspian turtle M. c. caspica; and Falcaustra (=Spironoura) japonensis (Yamaguti, 1935) of family Kathlianiidae (Cosmocercoidea) from Euphrates soft-shelled turtle T. euphraticus.

Telorchis sunkardi (Chandler, 1923) was the only trematode species found in this study. The Eastern Caspian turtles that were recovered from were collected from 4 different localities in 3 Provinces (Kirkuk, Erbil and Sulaimania) of northern region of Iraq. The infection rate seems to be slightly higher in the sample of females than males, while the parasite burden is considerably higher among infected males than females.

The infection rates and parasite burdens of the above mentioned nematodes of a tortoise and turtles were variable (Tab. 1). The highest and lowest infection rates were for F. japonensis in males of T. euphraticus and C. microcephalus in males of M. c. caspica, respectively; whereas, the highest and lowest parasite burdens were for A. dactyluris among the infected males of T. g. terrestris and A. holopterum among the infected females of the same host, respectively. The outcome of averaging all the relevant data to these gastrointestinal nematodes would suggest an overall infection rate of about 46%, with only slightly higher parasitization indices for male than female chelonian hosts.

DISCUSSION

The same number of helminthic species was obtained for male and female specimens of reptiles studied. Moreover, no significant variation in the infection rate or parasite burden was generally noticed in accordance with the sex of the host. This indicates that whatever influences the reptilian sex hormones exert on their helminthic parasites, they are not profoundly reflected on the levels of parasitization.

Failure to encounter any infection with adult cestodes and acanthocephalans in the material of the study may be due to some barriers of phylogenetic incompetency and host-specificity nature (29). The same situation was observed from pond turtle in Turkey by Yildirimhan and Sahin (33). But of course unless proven by further studies including experimentation, other possibilities, like the absence of some appropriate intermediate hosts which may be essential to the development of the infective stages of helminths and vectors to convey them to the reptile species under consideration, cannot be ruled out.

The scarcity of parasitization by trematode species in the inhabitants of arid areas has been observed in many parts of the world (32). Here what applies to reptiles may also apply to other groups of vertebrates. Thus, a nice demonstration could also be presented from Iraq by comparing the component of the helminth community of rodents (3) with that of frogs and toads (25). Such a phenomenon is likely to have arisen as a direct consequence of rareness in the intermediate hosts whose requirement is obligatory by flukes to complete their life cycles (12). This is to say some mollusces inhabiting the usual areas of the definitive hosts of the digenetic trematodes.

On the other hand, a relative richness in nematode infections in the sample of reptiles studied could be attributed to lack or loosen of complications in their life cycles and consequently to a widespread of their infective stages. According to Olsen (22), infections by nematode parasites in the vast majority of the land vertebrates are bound to happen during the terrestrial stages of the life cycle of these parasites.

The cysticercoids, which were found attached to the peritonea of geckos and the diadem snake, belong to particular members of the cyclophyllidean cestodes. Similar larvae were previously encountered in geckos and snakes from Iraq (20, 23, 26). Five species of the family Dilepididae, namely, Diplopylidium nolleri, D. acanthotaera, Diplopylidium caninum, D. sexcoronatum and Joyeuxiella pasqualeti, were found to be amongst the commonest intestinal parasites of cat in Iraq (2, 4, 21, 27). At least some of these species are also capable of infecting other carnivorous mammals, such as dog and fox (10). In other parts of the world, several species of arthropods, amphibians, lizards and snakes were incriminated as possible intermediate hosts for these tapeworms (29, 31), including the Turkish gecko Hemidactylus turcicus (19).

A Thelandros sp. was recovered in each of the 3 species of geckos used in this study. Its relatively higher infection rate in A. elisae may be attributed to abundance in the availability of its infective stage besides the behavioural pattern of this host. However, in every infected case only the females of this parasite were found. The deficiency represented in male absence made a specific identification of these forms impossible (6). Similar problems often faced the researchers in Iraq, for example, in respect to identification of Thelandros forms encountered in geckos, toads and frogs (2, 14, 25) and, elsewhere, in connection with the identification of these nematodes in the geckos (13) as well as in the tree frogs (9). In the researchers’ opinion the absence of males among the encountered specimens of Thelandros may suggest two possibilities: either the individuals of this sex are free-living organisms or parthenogenesis is the mode of female reproduction. However, it is the first possibility, which seems more reasonable, for example, in view of the available evidence represented by actually finding males in allied species from the same hosts and localities. Thus, upon recovery and description of adequate specimens of both sexes of a form found in the recta of the rough-scaled gekko Cyrtodactylus scaber from northern Iraq, Hassan and Abdul-lah (14) demonstrated that they definitely belong to the species T. micipsae, while another existing form was reserved at the genus level because of lacking of male specimens.

It is important to remark though that approval of Adamson and Nasher’s (1) hypothesis, which implies that members of the
The intermediate hosts the Microtetrameres nematodes use in their life cycle are insects, such as some members of the orders Orthoptera (grasshoppers, crickets, katydids and cockroaches) and Coleoptera (beetles) (18). In the researchers’ opinion these observations represent cases of accidental infection by way of food ingestion, that is, the geckos come into possession of such parasites from insects harbouring their infective larvae. Their presence in geckos in a rarely parasitized site like the stomach tends to strengthen this hypothesis. It is interesting to mention that Al-Barwari and Nassir (2) and Rahemo and Ami (24), respectively, encountered adults and larvae of a Microtetrameres sp. in the gastrointestinal canal of Bufo viridis. Then basically they appraised the nature of infection of the forenamed toad by this parasite in a similar manner.

The digenetic fluke T. stunkardi was the only species of trematodes found in this study. The specimens of its definitive host, the Eastern Caspian turtle M. c. caspica, were captured from some grounds around the tributaries of Tigris River in the northern part of the country. It is not known which intermediate host(s) within the available ecosystem it makes use of in its development. However, the likelihood is that it is comparable to the situation of its allied forms. In this connection, a close phylogenetic relationship between Telorchis and Opisthioglyphe has been recently suggested (30) and in fact it is also shown that several members of both genera have a 3-host life cycle one of which is regularly a molluscan like Lymnaea (12). If this also applies to T. stunkardi, besides some other species of digenetic trematodes such as Haplomera cylindracea and Opisthioglyphe ranae both of which infect the grass frog Rana ridibunda (25), then it might further increase the load on the developmental capacity of the Iraqi freshwater lymneid snails. This situation in Iraq might have an advantageous impact of lowering the overall infection incidence especially by the economically and medically important species of parasites belonging to such genera like Fasciola, Paramphistomum and Gigantocotyle. Indeed, it might even form a basis for a possible biological control scheme.

The systematic of the gastrointestinal nematodes of the Iraqi chelonians indicates that they belong to 2 families of the order Ascarida and 1 family of each of the orders Oxyuroidea, Spiruroidea and Cosmocercoida. All of the 5 species encountered are cosmopolitan in distribution and have been recorded and described in many parts of the world.

The overall nematode infection rate for the 72 specimens of tortoises and turtles examined from Iraq was 46%. Such a rate is about 49% for the 22 Mediterranean tortoises to which some data is repeatedly cited in the literature. For example, upon post-mortem examination of 144 specimens, Keymer (16) also diagnosed species encompassed by the genera Angusticaecum, Atractis and Tachygonetria, with an overall infection rate of about 44%. As to the figure of 30% for the intestinal nematode infection in the tortoises presented by Holt et al (15), actually it was obtained as a result of ova identification in survey of faecal samples of 70 live animals. Obviously, this is an area which urgently requires a systematic build-up of epidemiological evidence more than sporadic experiences of chelonian producers or carers.

Most of the chelonian intestinal nematodes have evolved life cycles which are either direct or do not demand more than some transmitting agents (6, 28). The consequence of such a natural adaptability is that tortoises and turtles may be constantly exposed to the infective stages of their parasites, for example, by ingesting the embryonated ova or the free larvae or even the arthropodan intermediate hosts containing the infective larvae. The net outcome of these circumstances is an increase in the parasite burden as some of the data in Table 1 tends to demonstrate.

The present findings on the nematode species of Iraqi chelonians also point out to the existence of certain pattern of host specificity. No doubt these relationships have developed over a long period of time (7) and most likely in their natural habitats the hosts and parasites involved often maintain an effective degree of normality. This supports the idea that efficient parasites are generally capable of achieving the best locations in their hosts, but at the same time not to endanger the life of either party.

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