

Helminth fauna of Lebanon Lizard, *Phoenicolacerta laevis* (Gray, 1838), (Squamata: Lacertidae) from Southern Turkey

S. BİRLİK¹, H. S. YILDIRIMHAN¹, N. SÜMER¹, Y. KUMLUTAŞ², Ç. ILGAZ², S. H. DURMUŞ³, Ö. GÜÇLÜ⁴, K. CANDAN²

¹Uludağ University, Faculty of Arts and Sciences, Department of Biology, Nilüfer, Bursa, Turkey; ²Dokuz Eylül University, Faculty of Science, Department of Biology, 35160, Buca-İzmir, Turkey; ³Dokuz Eylül University, Faculty of Education, Department of Biology, 35160, Buca-İzmir, Turkey; ⁴Aksaray University, Güzelyurt Vocational School, Department of Plant and Animal Production, 68500, Güzelyurt/Aksaray, Turkey

Article info

Received December 1, 2015
Accepted March 3, 2016

Summary

In the years 2010 and 2014, fifty-four samples of *Phoenicolacerta laevis* from eight localities in Adana (n=6) and Hatay (n=48) were collected and examined for helminth parasites. New host and locality records were recorded. As a results of present study, three species of Digenea, *Sonsionotrema tacapense*, *Prosthodendrium chilostomum*, *Brachylaima* sp. (metacercaria); two species of Cestoda, *Oochoristica tuberculata* and *Mesocestoides* sp. and four species of Nematoda, *Skrjabiodon medinae*, *Spauligodon* sp., *Thubunaea* sp. and a larva of the Ascaridiidae *Ascarididae* gen. sp. were reported for lizard samples. We document new host records for all of helminth species reported here. *Sonsionotrema tacapense* (Digenea), and *Thubunaea* sp. (Nematoda) are recorded for the first time from Turkey. There are, to our knowledge, no reports of helminths for *P. laevis* in Turkey and also from its range.

Keywords: *Phoenicolacerta laevis*; Digenea; Cestoda; Nematoda; helminth; Turkey

Introduction

Turkey is situated in junction point of fauna unit from several different origins and has 157 amphibia and reptilia species with as rich as continental Europe (Baran & Atatür, 1998; Baran *et al.*, 2012). However, the literature dealing with the parasitic fauna of the Turkey still contains little information on helminths of lizards. Reptiles are commonly infected by a wide range of parasites, serving either as their definitive or intermediate hosts (Azhar, 2010). However, despite the great diversity of the Lacertidae lizards relatively few species have been surveyed for helminths.

Across the world, there are several studies on helminth fauna of some Lacertid lizards especially from Palearctic region. These species and localities are; *Lacerta agilis* from Poland (Lewin, 1992a) and *Zootaxa vivipara* (Lewin, 1992b), *Lacerta agilis* from Palaeartic (Sharpilo *et al.*, 2001); *Lacerta viridis* from Bulgaria (Biserkov & Kostadinova, 1998); *Lacerta viridis* and *Podarcis mu-*

ralis from Bulgaria (Kirin, 2002), *Podarcis pityusensis* from Spain (Hornero & Roca, 1992), *Lacerta schreiberi* from Spain (Roca & Ferragut, 1989); *Podarcis pityusensis* and *Podarcis lilfordi* from Spain (Roca & Hornero, 1994), Lacertidae family from Spain (Roca & Lluch, 1988), *Lacerta agilis* from Romania (Mihalca *et al.*, 2007), *Podarcis bocagei* and *Podarcis carbonelli* from Portugal (Galdon *et al.*, 2006), *Zootaxa vivipara* from Spain (Sanchis *et al.*, 2000), *Gallotia caesaris gomerae* and *Gallotia caesaris caesaris* from Spain (Martin & Roca, 2004), *Podarcis vaucheri* from Algeria (Carretero *et al.*, 2011). There are some helminth parasite studies in Turkey especially for lacertid lizards. These species are European Green Lizard, *Lacerta viridis* (Schad *et al.*, 1960); Crimean Wall Lizard *Podarcis tauricus* (Schad *et al.*, 1960); Dwarf Lizard, *Parvilacerta parva* (Saygı & Olgun, 1993); Danford's Lizard, *Anatololacerta danfordi* (Gürelli *et al.*, 2007), Balkan Emerald Lizard, *Lacerta trilineata* (Yıldırımhan *et al.*, 2011); Pleske's Racerunner-Transcaucasian Racerunner, *Eremias pleskei*, Strauch's Rac-

erunner, *Eremias strauchi*, Suphan Racerunner, *Eremias suphani* (Düsen *et al.* 2013), Anatolian Lizard, *Apathya cappadocica*, (Birlik *et al.*, 2015), Spiny-Tailed Lizard, *Darevskia rudis* (Roca *et al.*, 2015a), and Uzzel's lizard *Darevskia uzzelli*, Bendimahi Lizard *D. bendimahiensis* and Van Lizard *D. sapphirina* (Roca *et al.*, 2015b). Lebanon lizard *Phoenicolacerta laevis* occurs in southern and western Turkey (Vilayets Hatay, Adana, Mersin, Kahramanmaraş, Osmaniye, Antalya, Muğla and İzmir), western Syria, throughout Lebanon (where widespread, including on Palm Island), northern Israel and northwestern Jordan (Ilgaz *et al.*, 2016). It has a plumped body with a total length up to 25 cm. Head and body is flattened dorso-ventrally. The ground color of dorsum is greenish brown with dark markings. The chin and neck are red or yellowish-red color in spring (Baran & Atatür, 1998; Baran *et al.*, 2012). It is found up to 1,800 m above sea level (asl). In suitable habitats, the population density is so high. This reasonably adaptable species is found in rocky forested areas, in meadows, in gardens, on walls of houses and in orchards. It is an egg-laying species. The species prefers humid habitats in oak forests, gardens and valleys. More recent, Tamar *et al.* (2015) conducted the most compressive molecular study based on both mitochondrial and nuclear gene fragments (covering 12S rRNA, cytb, MC1R and ACM4) on genus *Phoenicolacerta*. They found high levels of undescribed diversity within *P. laevis* which necessitate a thorough revision but did not do any taxonomical rearrangement. For that reason, we can accept the host species used in the present study as *P. laevis* now. Recently, studies of helminth parasites from lizards have been started to increase gradually in defined geographical areas but studies on helminth fauna of lizards of the genus *Phoenicolacerta* are partial and scarce, none for *P. laevis*. Thus, this work represents an opportunity to know for the first time helminth communities parasitizing *P. laevis* from Turkey.

Material and Methods

In November 2010 and between April and May 2014, 54 *P. laevis* (24 ♀, 31 ♂) mean snout-vent length = $68,57 \pm 11,46$ mm, with a range from 46.0 to 87.0 mm, were collected by hand from Hatay and Adana, Turkey: Kırıkhan- Hatay (36°29'N, 36°21'E, 151 m elevation, on 2 November 2010, n=19), Döver Village, Harbiye, Hatay (36°06'N, 36°07'E, 251 m elevation, on 2 May 2014, n=12), Yenişehir Lake, Reyhanlı, Hatay (36°14'N, 36°34'E, 179 m elevation, on 1 May 2014, n=1), Ceylanlı, Kırıkhan, Hatay (36°33'N, 36°21'E, 401 m elevation, on 1 May 2014, n=1), Çevlik, Samandağ, Hatay (36°07'N, 35°55'E, 28 m elevation, on 2 May 2014, n=11), Delibekirli Village, Kırıkhan, Hatay (36°32'N, 36°19'E, 550 m elevation, on 1 May 2014, n=4), Köleli Village, Feke, Adana (37°48'N, 35°54'E, 557 m elevation, on 21 April 2014, n=2), Dağılcak Recreation Area, Kozan, Adana (37°32'N, 35°50'E, 305 m elevation, on 17 April 2014, n=1), Gedikli Village, Kozan, Adana (37°30'N, 35°52'E, 398 m elevation, on 27 April 2014, n=3).

The body cavity was opened, and the digestive tract removed. The

oesophagus, stomach, small and large intestine and lungs were opened and separately examined for helminths under a dissecting microscope. Nematodes were killed in hot saline solution, fixed in 70 % ethanol, and mounted in glycerol. For the morphological examination, the helminth species were cleared gradually in glycerin. Digeneans and cestodes were fixed in 70% ethanol, stained with iron-carmin as described by Georgiev *et al.*, (1986), cleared in clove oil, and mounted in Entellan. Parasites were identified, where possible, to species, and the number and location of individuals of each species were recorded. Helminth identification was based on keys given by Schmidt (1986), Petter & Quentin (1976), Yorke & Maplestone (1926), Yamaguti (1961), Baker (1987), Bray *et al.* (2008). Helminth voucher specimens were deposited in the helminth collection of Uludag University Science and Art Faculty, Department of Biology, Bursa, Turkey.

Results

Nine species of helminth parasites were detected in Lebanon Lizard. These species were 3 species of Digenea, *Sonsinotrema tacapense*, *Prosthodendrium chiloostomum*, *Brachylaima* sp. (metacercaria); two species of Cestoda, *Oochoristica tuberculata* and *Mesocestoides* sp. and four species of Nematoda, *Skrjabinodon medinae*, *Spauligodon* sp., *Thubunaea* sp. and a larva of the Ascaridiidae *Ascarididae* gen. sp. Of 54 *P. laevis* 33 (61 %) were infected with one or more parasites. Of 54 host lizard 21 (38 %) were infected by any parasite species. Total 278 individuals of nine parasite species were collected from 33 of the 54 Lebanon lizards examined. Of these, three (9 %) were larval forms not capable of reaching maturity in lizards. There were nine helminth species represented in the lizards but no individual host harbored more than three helminth species. Of the infected lizards, 24 harbored one species of helminth; six harbored two species and three harbored three species. There were 7.72 ± 0.88 ($x \pm SE$) helminth species/infected lizard.

Infection prevalence, abundance and mean intensity of the parasites in *P. laevis* were given in Table 1. More than 45% of the total helminths found belong to a single species, *Prosthodendrium chiloostomum* (Digenea), followed by *Skrjabinodon medinae* 36% (Nematoda). All helminths found in *P. laevis* are new host records.

Digenea: Brachylaimidae

Brachylaima Dujardin, 1843

Brachylaima sp. (metacercariae)

Species of *Brachylaima* are parasites that often exhibit a triheteroxenous terrestrial life cycle in which molluscs serve as first and second intermediate hosts and amphibians and reptiles may harbor unencysted metacercariae, before reaching the definitive hosts, birds and mammals. Adults are parasites of the small intestine of birds and mammals (Yamaguti, 1958) metacercaria in Reptilia (Roca *et al.*, 1989, Roca & Hornero, 1994; Galdon *et al.*, 2006; Roca *et al.*, 2006). We found this species in only one infected host lizard (3 %) from Hatay province. A total parasite number of this

Table.1 Prevalence, mean intensity and mean abundance of helminth species found in lizards

Helminth species	Site of infection	Prevalence (%)	Mean intensity	Mean abundance
Digenea				
<i>Sonsinotrema tacapense</i>	small intestine	1.85	7	0.12
<i>Prosthodendrium chilostomum</i>	small intestine	7.40	31.75	2.35
<i>Brachylaima</i> sp.	small intestine	1.85	1	0.01
Cestoda				
<i>Mesocestoides</i> sp. (larvae)	body cavity	1.85	1	0.01
<i>Oochoristica tuberculata</i>	small intestine	3.7	2.5	0.09
Nematoda				
<i>Spauligodon</i> sp.	caecum	16.6	3.11	0.5
<i>Skrijabinodon medinae</i>	large intestine	48.14	3.88	1.87
<i>Thubunaea</i> sp.	stomach	1.85	7	0.12
<i>Ascarididae</i> gen. sp.	small intestine	1.85	1	0.01

species was one. According to the literature, this is the third report of metacercaria of *Brachylaima* from Turkey; Other reported hosts: *Lacerta trilineata* (Yildirimhan *et al.*, 2011) and *Chalcides ocellatus* (Incedogan *et al.*, 2014). *P. laevis* represents a new host record for the genus *Brachylaima*.

Trematoda: Lecithodendriidae

***Sonsinotrema tacapense* (Sonsino, 1894) Balozet & Callot, 1938**

Specimens of this digenetic trematode were detected in the small intestine of *P. laevis* from only one of the localities studied. A total parasite number were seven in one host from Kırıkhan, Hatay province. There are no reports from Turkey for this species. This is the first report of *S. tacapense* from Turkey. *P. laevis* is a new host record for this species.

***Prosthodendrium chilostomum* (Mehlis, 1831)**

Lecithodendriid flukes form the bulk of the intestinal parasites of bats, and of these, a large part belong to the genus *Prosthodendrium* Dollfus, 1931. This trematode attained sexual maturity in its intermediate host. It was reported from *Lacerta viridis* and *Zootaca vivipara* (Sharpilo, 1976) from Ukraine. There are no reports from

Turkey for this species. We found this species in the small intestine. A total parasite number were 120 in four hosts from Hatay province. This is the first report of *P. chilostomum* from Turkey. *P. laevis* is a new host record for this species. The most abundant helminth that was found parasitizing *P. laevis* was *Pr. chilostomum*, with a mean intensity of 31.75 parasites per host.

Cestoidea

Cyclophyllidea: Mesocestoididae

***Mesocestoides* sp. Vaillant, 1863**

Adults are parasites of birds and mammals, and according to Witenberg (1934) the first mention of tetrathyridium as accidental or paratenic parasites of lizards was *Lacerta viridis* and *Podarcis muralis* listed by Rudolphi (1819). The genus *Mesocestoides* is cosmopolitan (Schmidt, 1986). Tetrathyrida is frequently found in the body cavities of amphibians, reptiles, and rodents (Padgett & Boyce, 2004).

In our study, only one tetrathyrida was collected from one of 33 infected host lizard (3%). *P. laevis* represents fourth host record for the genus *Mesocestoides* from Turkey. The first report of this genus was in the *Lacerta trilineata* from Bursa, Turkey (Yildirimhan *et al.*, 2011). The second report was *Anatolalacerta danfordi* from

Western Turkey (Gürelli *et al.*, 2007). The third report was *Apathya cappadocica* from Turkey (Birlik *et al.*, 2015). *P. laevis* represents new host record for tetrathyridia of *Mesocestoides*.

Cestoidea

Cyclophyllidea: Anoplocephalidae

Oochoristica tuberculata

(Rudolphi, 1819) Lühe, 1898

In our study, this species was observed in only two hosts (6%). This species was reported from *Paralaudakia caucasia* (Yıldırımhan *et al.*, 2006), *Lacerta trilineata* (Yıldırımhan *et al.*, 2011), *Chalcides ocellatus* (Incedogan *et al.*, 2014) and *Apathya cappadocica* (Birlik *et al.*, 2015) from several localities in Turkey. This report is the fifth for *O. tuberculata* from reptiles in Turkey. We document herein a new host record for *O. tuberculata*, the first report of a cestode parasite from *P. laevis*.

Spirurida: Physalopteridae

***Thubunaea* Seurat, 1914**

***Thubunaea* sp.**

According to Burseý & Goldberg (1991) there are at present 17 species of *Thubunaea* including the parasites of reptiles. Adult worms are found in the stomach or intestine of lizards and snakes. The physalopterines are usually found firmly attached to the gastric mucosa with the aid of large dentate pseudolabia and a collette which presses into the mucosa. There is only limited information on species in reptiles. In our study, only female specimens have been found. So this specimen was identified at a genus level. When males are found, the length of the spicule, in association with other morphometric data, is a useful comparative character for specific identification.

We found this parasite species in only one host lizard (1.85%) from Samandağ, Hatay province. A total parasite number of this parasite species was seven. According to the literature, there are no records of *Thubunaea* sp. from Turkey. This helminth species is a new helminth record for Turkey. Also, *P. laevis* is a new host record for *Thubunaea* sp.

Oxyurida: Pharyngodonidae

***Skrjabinodon* (Inglis, 1968)**

***Skrjabinodon medinae* (Garcia Calvente, 1948)**

Skrjabinodon medinae is a cosmopolitan parasite of reptiles (Inglis, 1968; Petter & Quentin 1976). Small cylindrical nematodes, evident sexual dimorphism, males approximately one-fourth length of female. Lateral alae present in males, absent in females. Females with vulva near esophageal bulb. Several morphological characteristics noted by different authors (Skrjabin *et al.*, 1960; Inglis, 1968; Petter & Quentin 1976), as last pair of papillae not rosette-shaped and the absence of caudal alae in the male, indicate the genus *Skrjabinodon* Inglis, 1968. *S. medinae* possesses four pairs of cloacal papillae, including two pairs of postcloacal papillae (Hornero & Roca 1992).

We found this parasite species in twenty-six infected host lizards (78%) from Adana and Hatay provinces. More than 35% of the total helminths found belong to *Skrjabinodon medinae*. This species was the second most abundant helminth that was found parasitizing *P. laevis* with a prevalence of 48.14% and a mean intensity of 3.88 parasites per host.

A total parasite number of this parasite species was 101. Both male and female specimens have been found. According to the literature, two species of *Skrjabinodon* Inglis, 1968 have been reported previously from reptiles of Turkey. These species and hosts are *Skrjabinodon medinae* from *Lacerta trilineata* (Yıldırımhan *et al.*, 2011), *Sk. aegyptiacus* from *Chalcides ocellatus* (Incedogan *et al.*, 2014). This species was reported from *Apathya cappadocica* (Birlik *et al.*, 2015). This is the third report for *Sk. medinae* from Turkey. *P. laevis* is a new host record for *S. medinae*.

Ascaridida: Heterakoidea

Ascarididae Baird, 1853

(Undetermined larvae)

Ascarididae larvae, genera of the Ascarididae often exhibit unique esophageal characters, which when present can be used to identify a larva. Unique characters are generally absent, and it is impractical to assign such larvae to a genus.

In present study, larval forms of helminths have been found in host lizard. This suggests that this lizard is a useful intermediate host for heteroxenous helminth species.

We found this larvae in only one infected host lizard (3%) from Samandağ, Hatay province. A total parasite number of this larvae was one. According to the literature, Ascarid larva reported from *Stellagama stellio* from Turkey (Yıldırımhan *et al.*, 2006). This is the second report for this parasite and *P. laevis* represent new host record for larvae assigned to the Ascarididae.

Oxyuroidea: Pharyngodonidae

***Spauligodon* Skrjabin, Schikhhobalova and Lagodovskaja, 1960**

***Spauligodon* sp.**

Species of *Spauligodon* are separated on the basis of the presence or absence of a spicule, the appearance of the tail, egg morphology, and geographical distribution.

Currently, 50 species are assigned to *Spauligodon*. Based upon the zoogeographic regions described by Holt *et al.* (2013) eight from the Afrotropical realm, one from the Australian realm, one from the Madagascan realm, seven from the Nearctic realm, three from the Neotropical realm, three from the Oceanian realm, one from the Oriental realm, 16 from the Palaearctic region, five from the Panamanian realm, and five from the Saharo-Arabian realm. Three species have previously been described in which males have aspinose filamentous tails and a spicule absent, and females have spinose filamentous tails and barrel-shaped eggs, namely, *S. atlanticus*, *S. eremiasii*, and *S. occidentalis*. The location of the vulva can be used to distinguish some species. In *S. occidentalis*,

the vulva is anterior to the esophageal bulb. In this study, male specimens have no spicule and aspinose filamentous tail; female specimens have spinose filamentous tail. There are no *Spauligodon* records about prebulbar vulva location from Palearctic up to now. Advanced studies will be needed about this species.

We found this nematode in nine infected host lizard (27%) from Samandağ, Hatay province. A total parasite number of this species was 28. According to the literature, there is one record of *Spauligodon* sp. from Turkey (Saygı & Olgun, 1993). Also, *P. laevis* is a new host record for *Spauligodon* sp.

Discussion

Studies on the community ecology of parasites of European reptiles, and particularly lacertids, have increased in the last years. (Roca *et al.*, 2012). However, there are 66 species of lizards known from Turkey (Uetz, 2015): one species of Phyllodactylidae, five species of Gekkonidae, one species of Eublepharidae, four species of Agamidae, one species of Chamaeleontidae, two species of Anguillidae, one species of Varanidae, 39 species of Lacertidae, nine species of Scincidae and three species of Amphisbaenidae. Up to now, only 10 lizard species from Lacertidae have been investigated for helminth fauna in Turkey.

In our study, the helminth fauna of the studied population of *P. laevis* was rich as helminth biodiversity was concerned but was poor as numbers of helminth were investigated. Most helminth species occurred at low prevalence. The low value of prevalence and mean intensity of infection indicate that many members of the helminth infracommunities occur only irregularly and occasionally (Martin & Roca, 2005). Helminth species have been classified as core and secondary species according to their prevalence (P): species with prevalence >30% redeemed core species and species with 10-30% prevalence is considered secondary species (Roca, 1993). There is only one core species (prevalence of infection 30% or higher) in helminth population (*Skrjabinodon medinae* with a prevalence 48.17) so only the *Sk. medinae* appears to be a common parasite of *P. laevis*. This agrees with the typical pattern of helminth infection in many reptiles, i.e., few species occur frequently, few species occur moderate prevalence and many species are rare (Aho, 1990; Martin & Roca, 2005). The remaining helminth species can be considered as a secondary species of *P. laevis*. The low richness of helminths and the low prevalence and infection rates found for *P. laevis* might be related to the diet. Our results confirm previous findings, suggesting that small carnivorous reptiles harbor poorer helminth communities than herbivorous ones (Petter & Quentin, 1976; Martin *et al.*, 2005; Carretero *et al.*, 2006).

In our study, especially for some helminth species obtained from host lizard -for example *Thubunaea* sp.- if male specimens are found, it will be identified at species level in next studies. It will be same for Ascarididae, too (undetermined larvae).

In summary, we have documented nine new host and four new

distributional records for helminths of *P. laevis*. *P. laevis* represents a new host record for each of the parasite species. Two helminth species are reported from Turkey for the first time. We suspect that with additional surveys, particularly those carried out other parts of its range where studies are lacking, additional host and distributional records for its parasites will be potentially reported.

Acknowledgement

The lizard samples used in this study were collected within the scope of the project supported by TUBITAK (The Scientific and Technological Research Council of Turkey), project number 112T269.

References

- AHO, J.M. (1990): Helminth communities of amphibians and reptiles: comparative approaches to understanding patterns and processes. In: ESCH, G., BUSCH, A., AHO, J. (Eds) *Parasite communities: patterns and processes*. London, UK: Chapman and Hall, pp. 157 – 195.
- ANDERSON, R.C. (2000): *Nematoda Parasites of Vertebrates, their Development and Transmission*. 2nd Edition, Wallingford, UK, CABI Publishing, 650 pp.
- AL-MOUSSAWI, A.A. (2010): First record in Iraq of *Tanquaanomala* (Linstow, 1904) from the dice snake, *Natrix tessellata tessellata* (Laurenti, 1768). *Bull. Iraq Nat. Hist. Mus.*, 11(1): 27 – 38.
- BAER, J.G. (1927): Monographie des Cestodes de la famille des Anoplocephalidae. *Bull. Biol. France et Belgique*, suppl. 10: 1 – 241
- BAKER, M.R. (1987): *Synopsis of the Nematoda Parasitic in Amphibians and Reptiles. Occasional Papers in Biology*. Volume 11. St. John's Newfoundland, Canada: Memorial University of Newfoundland, 325 pp.
- BALOZET, L., CALLOT, J. (1938): Trematodes de Tunisie. Trematodes de *Rana ridibunda* Pallas. *Arch. l'Insti. Pasteur Tunis.*, 27: 18 – 30.
- BARAN, I., ATATUR, M.K. (1998): *Herpetofauna of Turkey (Amphibia and Reptilia)*. Ankara (Ministry of Environment), 214 pp.
- BARAN, I., ILGAZ, C., AVCI, A., KUMLUTAS, Y., OLGUN, K. (2012): *Amphibians and Reptiles of Turkey*. Ankara (TÜBİTAK) 204 pp. (In Turkish)
- BEVERIDGE, I. (1994): Family Anophalidae Cholodkovsky, 1902. In: KHAIL, L.F., JONES, A., BRAY, R.A. (Eds) *Keys to the cestode parasites of vertebrates*. Wallingford, Oxon, UK: CAB International, pp. 315 – 323.
- BIRLIK, S., YILDIRIMHAN, H.S., SUMER, N., KUMLUTAS, Y., ILGAZ, C., GUCLU, O., DURMUS, S.H. (2015): The helminth fauna of *Apathya cappadocica* (Werner, 1902) (Anatolian Lizard) from Turkey. *Helminthologia*, 52(4): 310 – 315. DOI: 10.1515/helmin-2015-0049
- BISERKOV, V., KOSTADINOVA, A. (1998): Intestinal helminth communities in the green lizard, *Lacerta viridis*, from Bulgaria. *J. Helminthol.*, 72: 267 – 271. DOI: <http://dx.doi.org/10.1017/S0022149X00016540>

- BRAY, R., GIBSON, D., JONES, A. (2008): *Keys to the Trematoda*. Vol. 3, London, UK, CAB International, 824 pp.
- BURSEY, C.R., GOLDBERG, S.R. (1991): *Thubunaea intestinalis* n. sp. (Nematoda: Spiruroidea) from Yarrow's spiny lizard, *Sceloporus jarrovi* (Iguanidae), from Arizona, U.S.A. *T. Am. Microsc. Soc.*, 110: 269 – 278. DOI: 10.2307/3226661
- BURSEY, C.R., ROCHA, C.F.D., MENEZES, V.A., ARIANI, C.V., VRCIBRADIC, D. (2010): New species of *Oochoristica* (Cestoda; Linstowiidae) and other endoparasites of *Trachylepis atlantica* (Sauria: Scincidae) from Fernando de Noronha Island Brazil. *Zootaxa*, 2715: 45 – 54. DOI: 10.1654/4489.1
- BURSEY, C.R., GOLDBERG, S.R., WOOLERY, D.N. (1996): *Oochoristica piangkai* sp. n. (Cestoda: Linstowiidae) and other helminths of Moloch Horridus (Sauria: Agamidae) from Australia. *J. Helminthol. Soc. W.*, 63: 215 – 221.
- CARRETERO, M.A., PERERA, A., HARRIS, D.J., BATISTA, V., PINHO, C. (2006): Spring diet and resource partitioning in an alpine lizard community from Morocco. *Afr. Zool.*, 41(1): 113 – 122. DOI: [http://dx.doi.org/10.3377/1562-7020\(2006\)41\[113:SDATPI\]2.0.CO;2](http://dx.doi.org/10.3377/1562-7020(2006)41[113:SDATPI]2.0.CO;2)
- CARRETERO, M.A., ROCA, V., LARBES, S., FERRERO, A., JORGE, F. (2011): Intestinal helminth parasites of Wall Lizards, *Podarcis vaucheri* complex (Sauria: Lacertidae) from Algeria. *J. Herpetol.*, 45: 385 – 388. DOI: <http://dx.doi.org/10.1670/10-118.1>
- CHABAUD, A.G. (1975): Keys to the genera of the Order Spirurida Part 2. Spiruroidea, Habronematoidea and Acuarioidea. In: ANDERSON, R.C., CHABAUD, A.G., WILMOTT, S. (Eds) *CIH Keys to the Nematode Parasites of Vertebrates* England: CAB, pp. 29 – 58.
- DAUOOD, K.S. (1974): *Studies on the protozoan and trematode parasites of some amphibian from Nienava District, North Iraq*. M. Sc. Thesis, Iraq, Mosul: Mosul University. ,
- DAVES, B. (1946): *The Trematoda with Special Reference to British and other European forms*. Cambridge, UK, Cambridge University Press, 644 pp.
- DOLLFUS, R.P. (1951): Miscellanea helminthologica maroccana. I. Quelques trematodes, cestodes and acanthocephales. *Arch. Inst. Pasteur Maroc.*, 4: 104 – 229.
- DUSEN, S., KUMLUTAS, Y., ILGAZ, C., YAKA, H., KARADAYI, F. (2013): Helminth Parasites of the Three Racerunner Lizards: *Eremias pleskei* Nikolsky, 1905 (Pleske's Racerunner-Transcaucasian Racerunner), *Eremias strauchi* Kessler, 1878 (Strauch's Racerunner) and *Eremias suphani* Basoglu and Hellmich, 1968 (Suphan Racerunner) collected from Eastern Part of Turkey. *Helminthologia*, 50(2): 108 – 111. DOI: 10.2478/s11687-013-0117-3
- EL AYADI, M., NAVARRO, P., LLUCH, J. (2003): Estudios preliminares sobre la helmintofauna parasita de anuros de la provincia de Tetuan (Marruecos). Datos faunísticos. XII Bienal de la Real Sociedad Espanola de Historia Natural. Comunicaciones sobre Zoología de Invertebrados No Artropodos. Spain.
- GALDON, M.A., ROCA, V., BARBOSA, D., CARRETERO, M.A. (2006): Intestinal helminth communities of *Podarcis bocagei* and *Podarcis carbonelli* (Sauria: Lacertidae) in NW Portugal. *Helminthologia*, 43: 37 – 41. DOI: 10.2478/s11687-006-0008-y
- GEORGIEV, B.B., BISERKOV, V.Y., GENOT, T. (1986): In toto staining method for cestodes with iron acetocarmine. *Helminthologia*, 23: 279 – 281.
- GIBSON, D.I., BRAY, R.A. (1994): The evolutionary expansion and host-parasite relationships of the Digenea. *Int. J. Parasitol.*, 24: 1213–1226. DOI: 10.1016/0020-7519(94)90192-9
- GUILLEN-HERNANDEZ, S., GARCIA-PRIETO, L., ARIZMENDI-ESPINOSA, M.A. (2005): A new species of *Oochoristica* (Eucestoda: Cyclophyllidae) parasite of *Ctenosaura pectinata* (Reptilia: Iguanidae) from Oaxaca, Mexico. *J. Parasitol.*, 91: 99 – 101. DOI: <http://dx.doi.org/10.1645/GE-1118R.1>
- JOHRI, L.N. (1950): Report on cestodes collected in India and Burma. *Indian J. Helminthol.*, 2: 23 – 34.
- GURELLI, G., GOCMEN, B., CETIN-DOGAN, T., ALPAGUT-KESKIN, N. (2007): First record of *Mesocestoides* spp. Vaillant, 1863 Tetrathyridia (Cestoidea: Cyclophyllidae) in Anatolian lizard, *Anatololacerta danfordi* (Günther, 1876) in Turkey. *N. West J. Zool.*, 3(2): 96 – 104
- HOLT, B.G., LESSARD, M.K., BORREGAARD, S.A., FRITZ, M.B., ARAUJO, D., FABRE, P.H., GRAHAM, C.H., GAVES, G.R., JONSSON, K.A. (2013): An update of Wallace's zoogeographic regions of the World. *Science*, 339: 74 – 78. DOI: 10.1126/science.1228282
- HORNERO, M.J., ROCA, V. (1992): Redescription of *Skrjabinodon medinae* (Galicia-Calvente, 1948) (Nematoda: Pharyngodonidae) from the cloaca of *Podarcis pityusensis* (Bosca, 1883) (Sauria: Lacertidae) of the Balearic Islands (Spain). *Syst. Parasitol.*, 23: 31 – 35. DOI: 10.1007/BF00008006
- HUGHES, R.C. (1940): The genus *Oochoristica* Lühe, 1898. *Am. Midl. Nat. J.*, 23: 368 – 380.
- ILGAZ, C., KUMLUTAS, Y., CANDAN, K. (2016): A new locality record for *Phoenicolacerta laevis* (Gray, 1838) (Squamata: Lacertidae) in the Western Anatolia. *Turk. J. Zool.*, 40: 129 – 135. DOI: 10.3906/zoo-1412-11
- INGLIS, W.G. (1968): Nematodes parasitic in Western Australian Frogs. *Bull. Brit. Mus. (Natural History). Zoology*, 16: 163 – 183.
- INCEDOGAN, S., YILDIRIMHAN, S., BURSEY, C.R. (2014): Helminth parasites of the ocellated skink, *Chalcides ocellatus* (Forsk., 1775) (Scincidae) from Turkey. *Comp. Parasitol.*, 81(2): 260 – 269. DOI: 10.1654/4708.1
- KHOTENOVSKI, I.A. (1970): Family Pleurogenidae Looss, 1899. In: SKRJABIN, K.I. (Eds) *Trematodes of Animals and Man.*, *Izd-vo Akademii nauk Moscow*, 23: 139 – 306.
- KIRIN, D. (2002): New data on the helminth fauna of *Lacerta viridis* Laurenti, 1768, and *Podarcis muralis* (Laurenti, 1768) (Reptilia: Lacertidae) in Bulgaria. *Acta Zool. Bulg.*, 54: 43 – 48.
- LEVIN, J. (1992A): Parasites of the sand lizard (*Lacerta agilis* L.) in Poland. *Acta Parasitol.*, 37: 19 – 24.
- LEVIN, J. (1992B): Parasites of *Lacerta vivipara* Jacquin, 1787 in Poland. *Acta Parasitol.*, 37: 79 – 82.
- LUHE, M. (1898): *Oochoristica* nov. gen. Taeniadarum (Vorläufige Mitteilung). *Zool. Anz.*, 21: 650 – 652.
- MARTIN, J.E., ROCA, V. (2004): Helminth infracommunities of *Gallotia caesaris caesaris* and *Gallotia caesaris gomerae* (Sauria: La-

- certidae) from the Canary Islands (Eastern Atlantic). *J. Parasitol.*, 90: 266 – 270.
- MARTIN, J.E., ROCA, V. (2005): Helminths of the Atlantic lizard, *Gallotia atlantica* (Reptilia: Lacertidae), in the Canary Islands (Eastern Atlantic): composition and structure of component communities. *Acta Parasitol.*, 50: 85 – 89.
- MARTIN, J.E., LLORENTE, G.A., ROCA, V., CARRETERO, M.A., MONTORI, A., SANTOS, X., ROMEU, R. (2005): Relationship between diet and helminths in *Gallotia caesaris* (Sauria: Lacertidae). *Zoology*, 108: 121 – 130. DOI: 10.1016/j.zool.2005.03.002
- MCALLISTER, C.T., MATTHEW, B.C., BURSEY, C.R., STANLEY, E., TRAUTH, H.W., DAVID, B.C. (2014): Six New Host Records for *Mesocestoides* sp. Tetrathyridia (Cestoidea: Cyclophyllidea) from Amphibians and Reptiles of Arkansas, U.S.A. *Comp. Parasitol.*, 81(2): 278 – 283. DOI: <http://dx.doi.org/10.1654/4685R.1>
- MEGGITT, F.J. (1934): On some tapeworms of the bullsnake (*Ptyopsis savi*), with some remarks on the species of the genus *Oochoristica* (Cestoda). *J. Parasitol.*, 20: 181 – 189.
- MIHALCA, A.D., GHERMAN, C., GHIRA, I., COZMA, V. (2007): Helminth parasites of reptiles (Reptilia) in Romania. *Parasitol. Res.*, 101: 491 – 492. DOI: 10.1007/s00436-007-0486-y
- PADGETT, K.A., BOYCE, W.M. (2004): Life history studies on two molecular strains of *Mesocestoides* (Cestoda: Mesocestoididae): Identification of sylvatic hosts and infectivity of immature life stages. *J. Parasitol.*, 90(1): 108 – 114. DOI: <http://dx.doi.org/10.1645/GE-100R1>
- PETTER, A.J., QUENTIN, J.C. (1976): CIH keys to the nematode parasites of vertebrates. No. 4 keys to genera of the Oxyuroidea, 1st ed. Commonwealth Agricultural Bureaux International, Farnham Royal, U.K., 30 pp.
- RASHED, A.A. (2008): A new parasitic metacercaria from the land snail *Monacha obstructa* Pfeiffer 1842 with critical review on relevant metacercariae belonging to the genus *Brachylaima* Dujardin 1843. *J. Egypt. Soc. Parasitol.*, 38: 483 – 500.
- RAUSCH, R.L. (1994): Family Mesocestoididae Fuhrmann, 1907 - In: KHAIL, L.F., JONES, A., BRAY, R.A. (Eds) *Keys to the Cestode Parasites of Vertebrates*. International Institute of Parasitology, Institute of CAB International, University Press, Cambridge, pp. 309 – 314.
- ROCA, V., LOPEZ-BALAGUER, E., HORNERO, M.J. (1989): Helminthofauna de *Podarcis hispanica* (Steindachner, 1870) y *Podarcis bocagei* (Seoane, 1884) (Reptilia: Lacertidae) en el Cuadrante Noroccidental de la Península Ibérica. *Rev. Ibér. Parasitol.*, 49: 127 – 135.
- ROCA, V., HORNERO, M.J. (1994): Helminth infracommunities of *Podarcis pityusensis* and *Podarcis lilfordi* (Sauria: Lacertidae) from the Balearic Islands (western Mediterranean Basin). *Can. J. Zool.*, 72: 658 – 664.
- ROCA, V., LLUCH, J. (1988): L'helminthofaune des lacertidae (Reptilia) de la zone thermomediterraneenne de l'est de l'Espagne. *Aspects ecologiques Vie Milieu*, 38: 201 – 205.
- ROCA, V., CARRETERO, M.A., MARQUES, A., BARBOSA, D., GALDON, M.A. (2006): Relationships between helminth communities and host traits in *Podarcis bocagei* and *P. carbonelli* from NW Portugal. *Ita. J. Zool.*, 73(3): 213 – 217. DOI: 10.1080/11250000600727634
- ROCA, V., JORGE, F., CARRETERO, M.A. (2012): Synopsis of the helminth communities of the lacertid lizards from the Balearic and Canary Islands. *Basic Applied Herpetology*, 26: 107 – 116.
- ROCA, V., JORGE, F., ILGAZ, C., KUMLUTAS, Y., DURMUS, S.H., CARRETERO, M.A. (2015a): The intestinal helminth community of the spiny-tailed lizard *Darevskia rudis* (Squamata, Lacertidae) from Northern Turkey. *J. Helminthol.*, 90(2): 144 – 51 doi:10.1017/S0022149X14000911
- ROCA, V., JORGE, F., ILGAZ, C., KUMLUTAS, Y., DURMUS, S.H., CARRETERO, M.A. (2015b): Are the helminth communities from unisexual and bisexual lizards different? Evidence from gastrointestinal parasites of *Darevskia* spp. in Turkey. *Acta Zool. Acad. Sci. Hung.*, 61(3): 279 – 288. DOI: 10.17109/AZH.61.3.6.2015
- ROCA, V., FERRAGUT, M.V. (1989): Helminthofauna del lagarto verdinegro, *Lacerta schreiberi* Bedriaga, 1878 (Reptilia: Lacertidae) del sistema central (España). *Rev. Iber. Parasitol.*, 49: 291 – 300.
- RUDOLPHI, C. (1819): Entozoorum Synopsis, cui Accedunt manissa duplex et indices locupletissimi. Augusti Rücker, Berlin, Germany 811 pp.
- SANCHIS, V., ROIG, J.M., CARRETERO, M.A., ROCA, V., LLORENTE, G.A. (2000): Host-parasite relationships of *Zootoca vivipara* (Sauria: Lacertidae) in the Pyrenees (North Spain). *Folia Parasit.*, 47: 118 – 122.
- SAYGI, G., OLGUN, K. (1993): The nematode found in Dwarf Lizard (*Lacerta parva*) in Sivas province: *Spauligodon*. *Turk. Parazitol. Derg.*, 17(1): 40 – 45.
- SCHAD, G.A., KUNTZ, R.E., WELLS, W.H. (1960): Nematode parasites from Turkish vertebrates. An annotated list. *Can. J. Zool.*, 38: 949 – 963.
- SCHMIDT, G.D. (1986): Handbook of Tapeworm Identification. CRC Press Inc., Boca Raton, Florida 675 pp.
- SHARPILO, V.P., BISERKOV, V., KOSTADINOVA, A., BEHNKE, J.M., KUZMIN, Y.I. (2001): Helminths of the sand lizard, *Lacerta agilis* (Reptilia, Lacertidae), in the Palaearctic: faunal diversity and spatial patterns of variation in the composition and structure of component communities. *Parasitology*, 123: 389 – 400.
- SHARPILO, V.P. (1976): Parasitic worms of reptiles in the fauna of SSSR. Trudy Vsesoyuznogo Instituta Gel'mintologii. Izd. Naukova Dumka, Kiev, 286 pp. (In Russian).
- SKARBILOVICH, T.S. (1948): Lecithodendriidae Odhner, 1911. Pages 337-590 // K. I. Skrjabin, ed. Trematodi Zhivotnikh i Cheloveka. Vol. II. Akad. Nauk SSSR, Moscow.
- SKRJABIN, K.I., SHIKHOBALOVA, N.P., LAGODOVSKAYA, E.A. (1960): Oxyurata of animal and man. part I. Osnovynematodologii 8. Publ. House Acad. Sci. U.S.S.R., Moscow.
- SKRYABIN, K.I., SOBOLEV, A.A. (1964): Spirurata of animals and man and the diseases caused by them. Part 2. Physalopteroidea. Osnovy nematodologii 12. Nauka, Moscow. 334 pp. (In Russian).
- SPASSKII, A.A. (1951): Anoplocephalate tapeworms of domestic and wild animals. Academy of Sciences of the USSR, Moscow.

- Translated from Russian, 1961, The Israel Program for Scientific Translations for the National Science Foundation, Washington, D. C. 783 pp.
- TAMAR, K., CARRANZA, S., BOSCH, H., SINDACO, R., MORAVEC, J., MEIRI, S. (2015): Hidden relationships and genetic diversity: Molecular phylogeny and phylogeography of the Levantine lizards of the genus *Phoenicolacerta* (Squamata: Lacertidae). *Mol. Phylogenet. Evol.*, 91: 86 – 97. DOI:10.1016/j.ympev.2015.05.002
- UETZ, P. (2015, June): The Reptile Database, <http://www.reptile-database.org>, accessed.
- WARDLE, R.A., MCLEOD, J.A. (1952): The zoology of tapeworms. University of Minnesota Press. 780 pp.
- WITTENBERG, G.G. (1934): Studies on cestode genus *Mesocostoides* (with summaries in French, English and German). *Arch. Zool. Ital.*, 20: 467 – 509.
- YAMAGUTI, S. (1958): Systema Helminthum, Vol. I. Pts. 1 and 2, The Digenetic Trematodes of Vertebrates. Interscience Publ. Inc New York 1575 pp.
- YAMAGUTI, S. (1961): Systema Helminthum: The Nematodes of Vertebrates. Vol. III, Part II. Nematodes of Amphibians. Intersciences Publishers, London, England 679 pp.
- YAMAGUTI, S. (1971): Synopsis of Digenetic Trematodes of Vertebrates, Vols. I and II. Keigaku Publ. Co., Tokyo 1774 pp.
- YILDIRIMHAN, H.S., GOLDBERG, S.R., BURSEY, C.R. (2006): Helminth parasites of the Caucasian agama, *Laudakia caucasia*, and the rougtail rock agama, *Laudakia stellio* (Squamata: Agamidae) from Turkey. *Comp. Parasitol.*, 73: 257 – 262. DOI: 10.1654/4205.1
- YILDIRIMHAN, H.S., SUMER, N., YILMAZ, N. (2008): The helminth fauna of *Hemidactylus turcicus* (Mediterranean Gecko) (Linnaeus, 1758) from Hatay province. *Acta Parasitol. Turcica*, 32: 393 – 395 (In Turkish)
- YILDIRIMHAN, H.S., YILMAZ, N., INCEDOGAN, S. (2009): Helminth Fauna of the Anatolian Worm Lizard, *Blanus trauchi* (Bedriaga, 1884) from Hatay. *Türk Parazitol. Derg.*, 33(4): 327 – 329.
- YILDIRIMHAN, H.S., BURSEY, C.R., ALTUNEL, F.N. (2011): Helminth parasites of the Balkan green lizard *Lacerta trilineata* Bedriaga 1886 from Bursa, Turkey. *Turk. J. Zool.* 35(4): 519 – 535. DOI:10.3906/zoo-0910-1
- YORKE, W., MAPLESTONE, P.A. (1926): The nematode parasites of vertebrates. London, UK, J. and A. Churchill pp 536.