

New records of trematode and acanthocephalan species in frogs in Erzurum Province, Turkey

Y. TEPE^{1*}, Y. YILAN¹

¹Department of Biology, Science Faculty, Ataturk University, Erzurum, Turkey,
ORCID: 0000-0002-4589-9860 (Tepe), 0000-0002-6011-7708 (Yilan), *E-mail: ytepe@atauni.edu.tr

Article info

Received September 17, 2021
Accepted October 27, 2021

Summary

A total of 32 frogs of two species (*Rana macrocnemis*, *Pelophylax ridibundus*) that were dissected in some lectures in Ataturk University Science Faculty Biology Department were investigated parasitologically even after the lectures between 2008 and 2014. 9 digenean species (*Cephalogonimus retusus* [Cephalogonimidae]; *Diplodiscus subclavatus* [Paramphistomidae]; *Gorgoderina vitelliloba* [Gorgoderidae]; *Haplometra cylindracea*, *Haematoloechus variegatus*, *Opisthioglyphe ranae*, *Skrjabinoeces similis* and *Skrjabinoeces breviansa* [Plagiorchiidae]), 3 acanthocephalan species (*Acanthocephalus ranae*, *Centrorhynchus* sp., *Pomphorhynchus laevis*) were found. All the parasites are the first record for Erzurum province, *Cephalogonimus retusus* and *Skrjabinoeces similis* are the first records of the parasite fauna of Turkey.

Keywords: Anura; Helminths; Erzurum; Turkey

Introduction

The herpetofauna of Turkey consists of 157 species. 14 of those are newts and 14 are frogs (Baran *et al.*, 2012). As a component of the ecosystem frogs can harbour several parasites. There are numerous studies on parasites of amphibians in Turkey as well as all over the world. In the light of the literature, it is figured out that parasites of 24 amphibian species of 29 different provinces of Turkey were investigated but frogs from Erzurum have not been studied for now (Fig. 1).

The study aims to evaluate the dissected frogs used as lecture materials and contribute to the parasite fauna of Turkey.

Material and Method

Between 2008 and 2014, a total of 32 frogs from Erzurum province of 2 species that were etherized and dissected in the Vertebrate

Laboratory and the Zoology Laboratory lectures were investigated parasitologically even after.

The visceral organs of the frogs, that were died with high-dose ether and dissected, were put into the petri dishes filled with saline water. After the macro investigation, parasites were separated from tissues with needles, forceps and tiny brushes. The trematodes and acanthocephalans were relaxed with an Alcohol-Formalin-Acetic Acid mixture and mounted in Canada balsam according to Pritchard and Kruse (1982). The description of the parasites was executed under the light of the literature (Skrjabin, 1947, 1949, 1950, 1952, 1953, 1962, 1974; Prudhoe & Bray, 1982) and description of the frogs was done according to Budak and Göçmen (2008).

Ethical Approval and/or Informed Consent

This study was approved by Ataturk University Local Ethics Council Of Animal Experiments Erzurum/TURKEY (36643897-118).

* – corresponding author

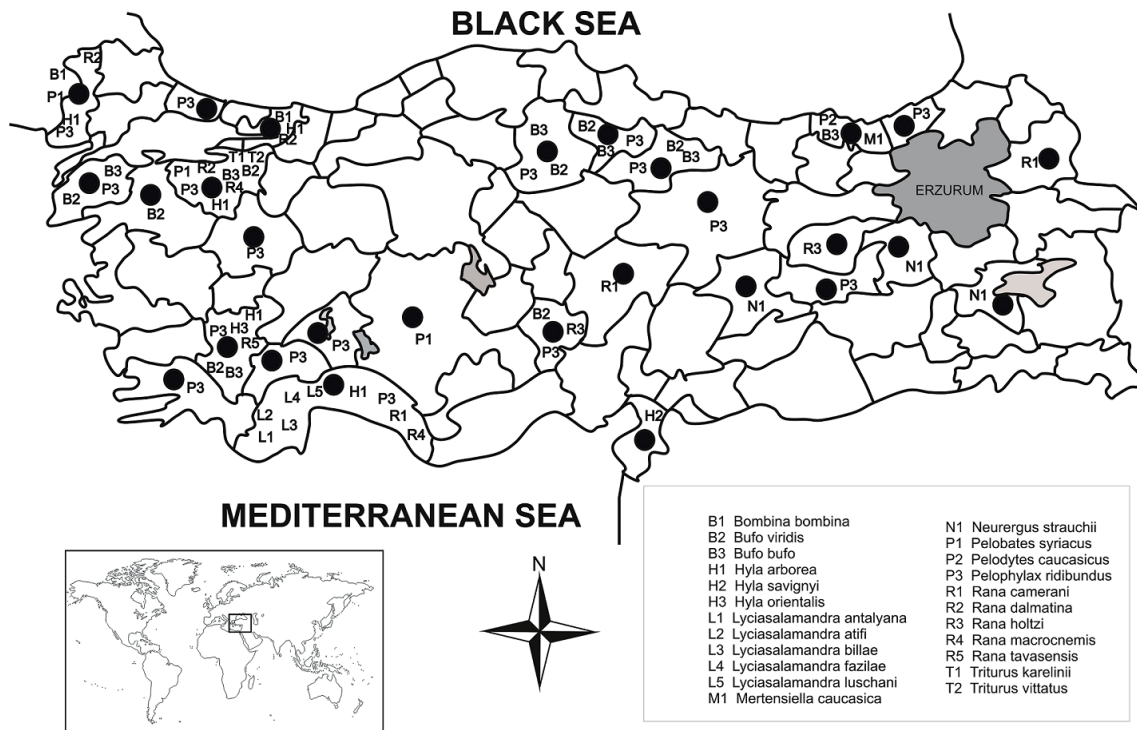


Fig. 1. Provinces of Turkey where studies on frog parasites have been made.

Results and Discussion

A total of 32 frogs of 2 species were investigated and 149 parasites of 12 species were found. While one of *Rana macrocnemis* (17 %) didn't harbour any parasite species, 4 of *Pelophylax ridibundus*

(15 %) were found parasite free. Of the investigated frogs, 27 (84 %) harboured one or more helminth parasites. One of the *P. ridibundus* was parasitized with 5 different helminth species. *Acanthocephalus ranae* is the most prevalent parasite (34 %). 3 different helminth species were come across in *Rana macrocnemis*

Table 1. Statistical data of parasites of *R. macrocnemis* and *P. ridibundus*

HOST	PARASITE	IFN	TPN	PREV	MA	MI
<i>Rana macrocnemis</i> (n=6)	D <i>Dolichosaccus rastellus</i>	2	34	33	17.0	5.7
	<i>Haplometra cylindracea</i>	2	10	33	5.0	1.7
	<i>Gorgodera cygnoides</i>	1	2	17	2.0	0.3
	A <i>Acanthocephalus ranae</i>	1	4	17	4.0	0.7
<i>Pelophylax ridibundus</i> (n=26)	D <i>Cephalogonimus retusus</i>	3	4	12	1.3	0.2
	<i>Diplodiscus subclavatus</i>	5	24	19	4.8	0.9
	<i>Gorgodera cygnoides</i>	5	11	19	2.2	0.4
	<i>Gorgoderina vitelliloba</i>	1	1	4	1.0	0.01
	<i>Haematoloechus variegatus</i>	1	2	4	2.0	0.1
	<i>Opisthioglypha ranae</i>	5	31	19	6.2	1.2
	<i>Skrjabinoeces similis</i>	1	2	4	2.0	0.1
	<i>Skrjabinoeces breviansa</i>	1	1	4	1.0	0.1
	A <i>Acanthocephalus ranae</i>	10	17	38	1.7	0.7
	<i>Centrorhynchus</i> sp.	1	3	4	3.0	0.1
<i>Pomphorhynchus</i> sp.	3	4	12	1.3	0.2	

(IFN: Infected Frog Number; TPN: Total Parasite Number; PREV: Infection rate; MA: Mean Abundance; MI: Mean Intensity; D: Digenea; A: Acanthocephala; N: Nematoda)

while 11 parasite species were found in *Pelophylax ridibundus*. (Table 1), (Figs. 2, 3).

Platyhelminthes

Digenea

Cephalogonimidae

Cephalogonimus retusus (Dujardin, 1845)

Synonym: *Cephalogonimus europaeus*

Host: *Pelophylax ridibundus*

Site of infection: intestine

Geographic range: Bulgaria, Czechoslovakia and Germany

Remarks: Cephalogonimideans are parasites of chelonian reptiles and amphibians, the intermediate host is *Helisoma* sp. (Gastropoda) (Prudhoe & Bray, 1982).

The body is 4 mm in length and covered with spines. Testicles are just behind the ventral sucker and anterior half of the body. The ovary is pretesticular, and the uterus reaches the posterior end. The vitelline glands are located between the pharynx and the level of the posterior margin of the rear testis (Fig. 2e).

Cephalogonimus retusus was recorded before in *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Walton, 1949; Vojtkova & Vojtek, 1975; Erhan & Gherasim, 2015); *Pelophylax ridibundus* (Walton, 1949; Vojtkova & Vojtek, 1975; Bray *et al.*, 2005); *Rana temporaria* (Vojtkova & Vojtek, 1975); *Natrix tessellata* (Buchvarov *et al.*, 2000); *Malpolon monspessulanus* and *Coluber jugularis* (Kiriin, 1994).

In the study, morphological and anatomical features of *C. retusus* was convenient with those mentioned by Skrjabin (1950). *C. retusus* was recorded only in the intestine of *P. ridibundus* and the infection rate was 12 %. It is found in Turkey for the first time.

Gorgoderidae

Gorgodera cygnoides (Zeder, 1800)

Synonym: *Distomum cygnoides*

Host: *Pelophylax ridibundus*, *Rana macrocnemis*

Site of infection: Bladder

Geographic range: Czechoslovakia, Germany, Poland, Russia, Tatarstan, Turkey

Remarks: Gorgoderids are small and non-spinous trematodes and found in fishes, amphibians and reptiles but *Gorgodera* and *Gorgoderina* live in amphibians (Prudhoe & Bray, 1982).

The body is 6.5 mm long. The ventral sucker is distinctly larger than the oral sucker. Testes are divided into nine follicles arranged in two longitudinal rows. The ovary is pretesticular. Vitelline glands are located at the anterior region of the ovary and form two symmetrically disposed oval masses (Fig. 2f).

Gorgodera cygnoides was found before in *Bombina bombina* and *Bombina variegata* (Vojtkova & Vojtek, 1975); *Bufo igneus* (Gurtt, 1845); *Pelodytes caucasicus* (Yildirimhan *et al.*, 2009); *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Walton, 1949; (Vojtkova

& Vojtek, 1975; Gurtt, 1845; Andre, 1913; Yildirimhan *et al.*, 2005; Düşen & Öz, 2006; Chikhlyayev *et al.*, 2009a; Düşen *et al.*, 2010; Popiolek *et al.*, 2011); *Pelophylax lessonae* (Vojtkova & Vojtek, 1975; Popiolek *et al.*, 2011); *Pelophylax ridibundus* (Vojtkova & Vojtek, 1975; Popiolek *et al.*, 2011; (Koyun *et al.*, 2015); *Rana arvalis* (Vojtkova & Vojtek, 1975); *Rana camerani* (Yildirimhan *et al.*, 2006a); *Rana dalmatina* (Yildirimhan *et al.*, 2016); *Rana temporaria* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Andre, 1913; Linstow, 1878).

In the study, anatomical and morphological features of *G. cygnoides* was the same as those given by Skrjabin (1952). *G. cygnoides* was recorded in the urinary bladder of both *R. macrocnemis* (n=11, 17 %) and *P. ridibundus* (n=2, 19 %). *G. cygnoides* has been found in some provinces of Turkey before but in Erzurum, it is the first record.

Gorgoderina vitelliloba (Olsson, 1876)

Synonym: *Distomum vitellilobum*, *Distomum cygnoides* juv. *Gorgoderina simplex*, *Gorgodera vitelliloba*

Host: *Pelophylax ridibundus*

Site of infection: Urinary bladder

Geographic range: Czechoslovakia, Germany, Iran, Russia, Tatarstan, Turkey

Remarks: *Gorgoderina vitelliloba* is a parasite of the urinary bladder of amphibians (Prudhoe & Bray, 1982).

The body is almost 2.5 mm and non-spinous. The ventral sucker is larger than the oral one. Testes are large and located at the posterior half of the body. The ovary is lobed and pretesticular. Vitelline glands are situated in the anterior region of the ovary (Fig. 2c).

Gorgoderina vitelliloba is detected formerly in *Bombina bombina* and *Bombina variegata* (Vojtkova & Vojtek, 1975); *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Walton, 1949; Vojtkova & Vojtek, 1975; Chikhlyayev *et al.*, 2009a; Chikhlyayev *et al.*, 2009b; Rezvantseva *et al.*, 2010); *Pelophylax bedriagae* (Demir *et al.*, 2015); *Pelophylax ridibundus* (Walton, 1949; Yildirimhan *et al.*, 2005; Düşen & Öz, 2006; Düşen *et al.*, 2010; Koyun *et al.*, 2015; Sağlam & Arıkan, 2006; Saeed *et al.*, 2007; Rezvantseva, 2008; Rezvantseva, 2009; Düşen & Oğuz, 2010; Karakaş, 2015); *Rana arvalis* (Vojtkova & Vojtek, 1975); *Rana camerani* (Yildirimhan *et al.*, 2006a); *Rana macrocnemis* (Yildirimhan *et al.*, 1997a); *Rana temporaria* (Linstow, 1878; Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975).

Gorgoderina vitelliloba were found in *Pelophylax bedriagae*, *Pelophylax esculentus*, *Pelophylax ridibundus*, *Rana camerani* and *Rana macrocnemis* from some provinces of Turkey. According to Skrjabin (1953) length of *G. vitelliloba* is 6 – 8 mm but in the study, the specimen recorded in the urinary bladder of *P. ridibundus* was 2.5 mm in length. Other morphological and anatomical features are the same as those given in the literature mentioned before. The infection rate is 4 %. It is found in frogs of Erzurum province for the first time.

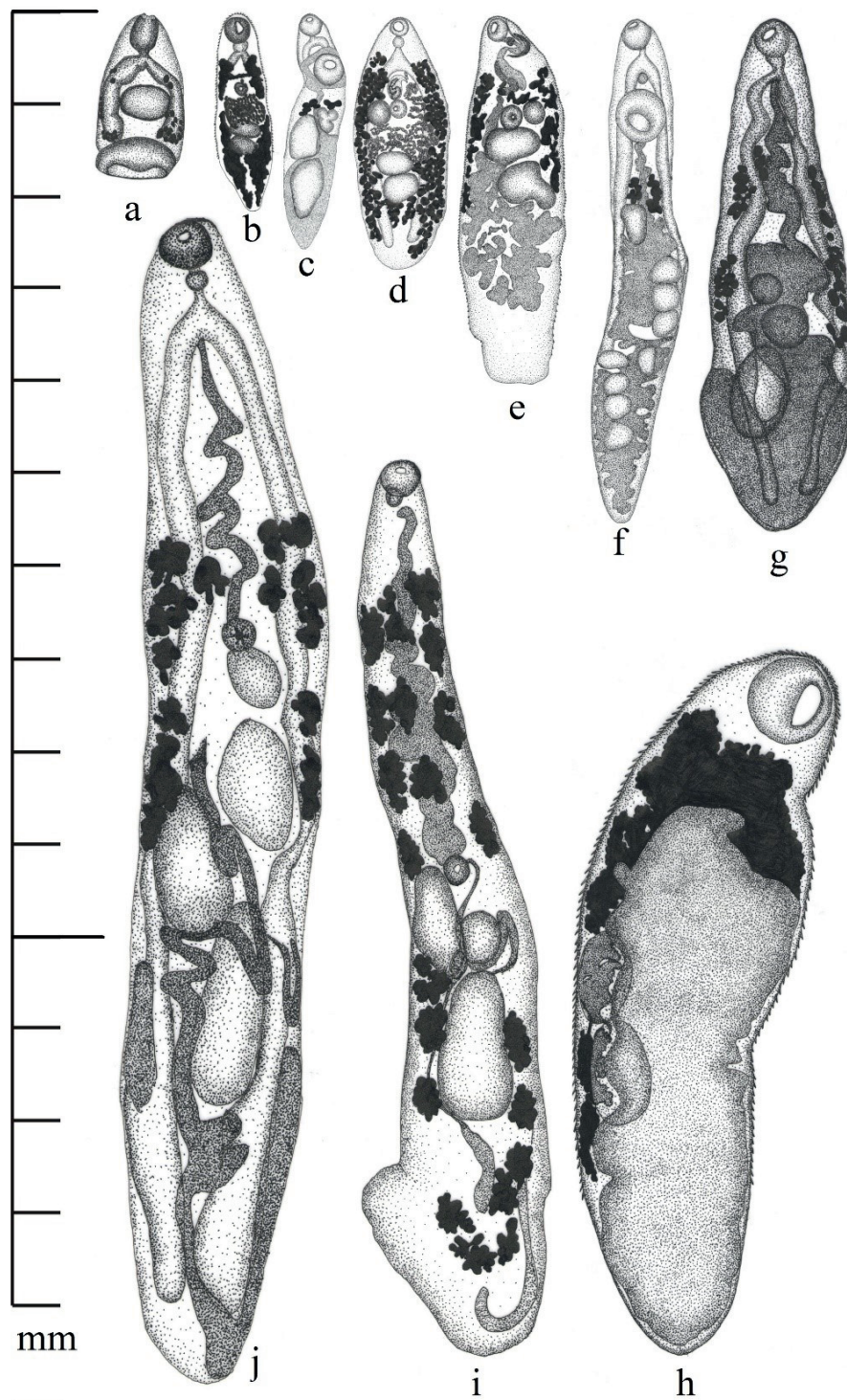


Fig. 2. Digenean parasites of frog from Erzurum (a: *Diplodiscus subclavatus*, b: *Dolichosaccus rastellus*, c: *Gorgoderina vitelliloba*, d: *Opisthioglyphe ranae*, e: *Cephalogonimus retusus*, f: *Gorgodera cygnoides*, g: *Skrjabinoeces breviansa*, h: *Haplometra cylindracea*, i: *Haematoloechus variegatus*, j: *Skrjabinoeces similis*).

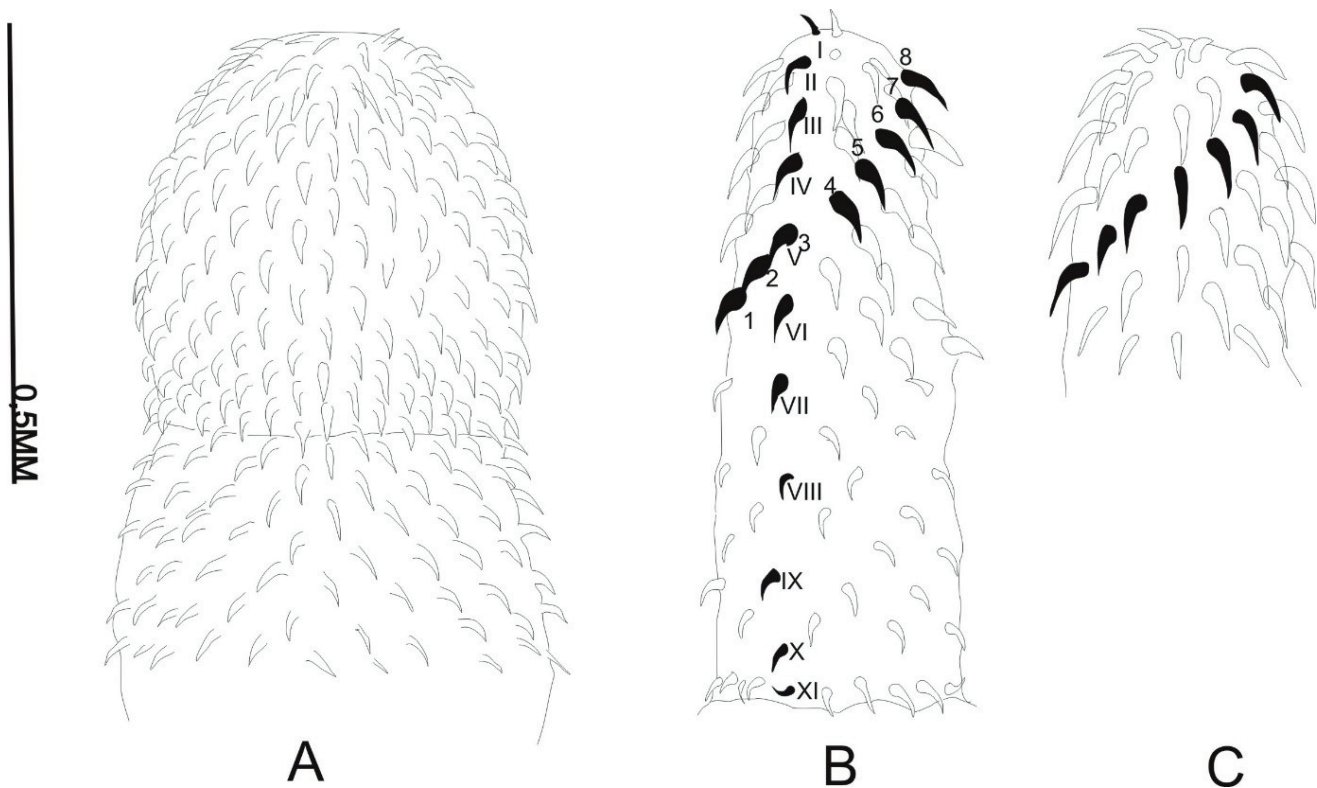


Fig. 3. Structure of proboscis of Acanthocephalans (A: *Centrorhynchus* sp., B: *Pomphorhynchus laevis*, C: *Acanthocephalus ranae*).

Paramphistomidae

Diplodiscus subclavatus (Goeze, 1782)

Synonym: *Planaria subclavatus*, *Amphistomum subclavatum*

Host: *Pelophylax ridibundus*

Site of infection: Large intestine, rectum

Geographic range: Africa, Austria, Bulgaria, Czechoslovakia, England, Iran, Italy, Moldova, Russia, Serbia, Swiss, Tatarstan, Turkey.

Remarks: *Diplodiscus subclavatus* (Goeze, 1782) lives in the rectum and intestine of frogs (Prudhoe & Bray, 1982).

Nonspinous body is 2 mm long. The ventral sucker is very large and located at the posterior end of the body. The single testis is situated at the median line and anterior of the ovary. Vitelline follicles extend along the caeca (Fig. 2a).

It was previously encountered in *Bombina bombina* (Lühe, 1909b; Vojtkova & Vojtek, 1975; Gurtl, 1845; Diesing, 1835; Diesing, 1851); *Bombina variegata* (Vojtkova & Vojtek, 1975); *Bufo* sp. (Skrjabin, 1916); *Bufo bufo* (Dawes, 1946; Vojtkova & Vojtek, 1975); *Bufo cinereus*, (Diesing, 1835); *Bufo viridis*, (Lühe, 1909b; Vojtkova & Vojtek, 1975; Linstow, 1878; Diesing, 1851); *Bufo vulgaris* (Lühe, 1909b; Gurtl, 1845; Linstow, 1878); *Dicroglossus occipitalis* (Maeder, 1973); *Dendrohyas viridis*, (Diesing, 1851); *Esox lucius* (Öztürk et al., 2000); *Hyla arborea*, (Lühe, 1909b; Vojtkova & Vojtek, 1975; Gurtl, 1845; Linstow, 1878; Diesing, 1835); *Hyla savignyi* (Yildirimhan et al., 2012); *Leptodactylus sibilatrix*, (Gurtl,

1845; Linstow, 1878; Diesing, 1835; Diesing, 1851); *Molge alpestris* and *Molge vulgaris* (Lühe, 1909b); *Natrix natrix* and *Natrix tessellata* (Buchvarov et al., 2000); *Pelobates fuscus* (Ruchin et al., 2008; Ruchin et al., 2009; Vojtkova & Vojtek, 1975); *Pelophylax esculentus*, (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Gurtl, 1845; Andre, 1913; Popiolek et al., 2011; Diesing, 1835; Diesing, 1851; Stossich, 1890; Bjelić-Čabrilo et al., 2009; Chikhlyayev et al., 2009b); *Pelophylax lessonae* (Vojtkova & Vojtek, 1975; Popiolek et al., 2011); *Pelophylax bedriagae* (Demir et al., 2015); *Pelophylax ridibundus* (Vojtkova & Vojtek, 1975; Erhan & Gherasim, 2015; Yildirimhan et al., 2005; Düşen & Öz, 2006; Chikhlyayev et al., 2009a; Düşen et al., 2010; Popiolek et al., 2011; Koyun et al., 2015; Rezvantseva et al., 2010; Rezvantseva, 2008; Rezvantseva, 2009; Oğuz et al., 1994; Mashaii et al., 2000; Romanova et al., 2010; Indiryakova et al., 2012); *Phryne vulgaris* (Diesing, 1851); *Rana arvalis* (Vojtkova & Vojtek, 1975; Ruchin et al., 2009); *Rana dalmatina* (Vojtkova & Vojtek, 1975; Düşen et al., 2009); *Rana temporaria* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Gurtl, 1845; Linstow, 1878; Diesing, 1835; Diesing, 1851); *Salamandra maculate* (Gurtl, 1845); *Triton alpestris* (Linstow, 1878); *Triturus vulgaris* (Dawes, 1946).

Diplodiscus subclavatus was recorded in some frogs i.e. *Hyla savignyi*, *Pelophylax bedriagae*, *Pelophylax ridibundus*, *Rana dalmatina*, and in a fish *Esox lucius* from Turkey. Morphological and anatomical features are convenient with that given by Skrjabin

(1949). In the study, *D. subclavatus* was found in the rectum of *P. ridibundus* and the infection rate is 19 %. It is the first record for Erzurum province.

Plagiorchiidae

***Dolichosaccus rastellus* (Olsson, 1876) Travassos, 1930**

Synonym: *Distomum rastellus*, *Distomum endolobum*, *Opisthioglyphe rastellus*, *Opisthioglyphe histrix*, *Lecithopyge rastellus rastellus*, *Lecithopyge rastellus subulatum*, *Lecithopyge rastellus cylindriciforme*

Host: *Rana macrocnemis*

Site of infection: intestine

Geographic range: Czechoslovakia, England, Germany, Greece, Poland, Russia, Turkey

Remarks: Adults of the *D. rastellus* is found in the intestine of the amphibians and reptiles and larvae develops in the limnid snails (Prudhoe & Bray, 1982).

Body covered with dense spines and almost 2 mm long. Oral sucker is larger than the ventral sucker. Testes are oblique, the ovary is median and located at anterior of testes. Vitelline follicles are extending from the pharyngeal region to the posterior end of the body. The uterus lays between the anterior testis and ventral sucker (Fig. 2b).

Dolichosaccus rastellus was encountered before in an ephemeropteran *Cloeon dipterum* (Lühe, 1909b); and in *Bombina bombina* (Vojtkova & Vojtek, 1975); *Bombina variegata* (Vojtkova & Vojtek, 1975; Sattmann, 1990); *Pelophylax esculentus* (Dawes, 1946; Vojtkova & Vojtek, 1975); *Rana arvalis* (Vojtkova & Vojtek, 1975; Ruchin *et al.*, 2009); *Rana camerani* (Yildirimhan *et al.*, 2006a; Düşen, 2007); *Rana temporaria* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Gassmann, 1972); *Triturus alpestris* (Sattmann, 1990).

The length of the *D. rastellus* is smaller than given by Skrjabin (1974), the other features are convenient with the literature. In the study, *Dolichosaccus rastellus* is recorded in the intestine of *R. macrocnemis* from Erzurum for the first time.

***Opisthioglyphe ranae* (Frölich, 1791)**

Synonym: *Fasciola ranae*, *Distoma endolobum*, *Distomum retusum*, *Monostomum histrix*, *Opisthioglyphe endoloba*, *Opisthioglyphe histrix*

Host: *Pelophylax ridibundus*

Site of infection: intestine

Geographic range: Bulgaria, Czechoslovakia, England, Germany, Greece, Iraq, Iran, Hungary, Poland, Russia, Serbia, Turkey,

Remarks: Larvae of *Opisthioglyphe ranae* occur in *Limnea stagnalis* and *L. palustris*, adults harbour in the intestine of anurans (Dawes, 1946).

The body is covered with spines and 3 mm long. Testes are median and disposed one behind other at about hinder a third of the body. The ovary is submedian and adjacent to the ventral sucker. Vitelline glands are located mainly lateral of caeca, extending between

intestinal bifurcation to the posterior end of the body (Fig. 2d).

Bombina bombina and *Bombina variegata* (Vojtkova & Vojtek, 1975); *Bufo bufo* (Dawes, 1946; Vojtkova & Vojtek, 1975); *Bufo calamita* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975); *Bufo viridis*, (Lühe, 1909b; Vojtkova & Vojtek, 1975; Chikhlyayev, 2014); *Bufo vulgaris* (Lühe, 1909b); *Hyla arborea* (Vojtkova & Vojtek, 1975), *Molge cristata* (Lühe, 1909b); *Pelobates fuscus* (Ruchin *et al.*, 2008; Ruchin *et al.*, 2009); *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Erhan & Gherasim, 2015; Andre, 1913; Chikhlyayev *et al.*, 2009a; Popiolek *et al.*, 2011; Chikhlyayev *et al.*, 2009b; Rezvantseva *et al.*, 2010; Bjelić-Cabrilo *et al.*, 2009; Gassmann, 1972); *Pelophylax lessonae* (Vojtkova & Vojtek, 1975; Popiolek *et al.*, 2011); *Pelophylax ridibundus* (Vojtkova & Vojtek, 1975; Yıldirimhan *et al.*, 2005; Düşen & Öz, 2006; Popiolek *et al.*, 2011; Koyun *et al.*, 2015; Saeed *et al.*, 2007; Rezvantseva, 2008; Rezvantseva, 2009; Düşen & Oğuz, 2010; Karakaş, 2015; Mashaii *et al.*, 2000; Romanova *et al.*, 2010; Indiryakova *et al.*, 2012; Sattmann, 1990; Kirin & Buchvarov, 1999); *Rana arvalis* (Vojtkova & Vojtek, 1975; Ruchin *et al.*, 2009); *Rana dalmatina* (Vojtkova & Vojtek, 1975), *Rana temporaria* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Andre, 1913); *Triturus palustris* (Dawes, 1946); *Natrix natrix* (Edelényi, 1963).

The general features of *Opisthioglyphe ranae* are convenient with that given by Skrjabin (1974). The dimension of specimens of the study is larger than that given in the literature. *O. ranae* was encountered only in the intestine of *Pelophylax ridibundus* from Turkey but was newly recorded in Erzurum province in this study.

***Haplometra cylindracea* (Zeder, 1800)**

Synonym: *Distoma cylindraceum*, *Distoma (Dicrocoelium) cylindraceum*,

Host: *Rana macrocnemis*

Site of infection: Lungs

Geographic range: Czechoslovakia, England, Iraq, Iran, Russia, Tatarstan, Turkey

Remarks: *Haplometra cylindracea* is a common parasite of the lung of frogs throughout Europe and Northern Asia, larvae develop in the snails (Prudhoe & Bray, 1982).

The spinous body is almost 8 mm in length. Testes are large and located at the posterior third of the body. The uterus occupies most of the area between the intestinal caeca and extends to the posterior end of the body. Vitelline follicles are located between intestinal bifurcation and hinder the margin of the posterior testis (Fig. 2h).

H. cylindracea was found before in *Bombina bombina* and *Bombina variegata* (Vojtkova & Vojtek, 1975); *Bufo bufo* (Dawes, 1946), (Vojtkova & Vojtek, 1975); *Bufo viridis* (Vojtkova & Vojtek, 1975); *Pelophylax esculentus* (Dawes, 1946), (Vojtkova & Vojtek, 1975; Chikhlyayev *et al.*, 2009a; Rezvantseva *et al.*, 2010); *Pelophylax ridibundus* (Vojtkova & Vojtek, 1975; Saeed *et al.*, 2007; Rezvantseva, 2008; Rezvantseva, 2009); *Rana arvalis* (Vojtkova & Vojtek, 1975; Ruchin *et al.*, 2009); *Rana camerani* (Yildirimhan

et al., 2006a; Düşen, 2007); *Rana dalmatina* (Vojtkova & Vojtek, 1975; Yildirimhan et al., 2016); *Rana lessonae* (Vojtkova & Vojtek, 1975); *Rana macrocnemis* (Düşen, 2007); *Rana macrocnemis pseudodalmatina* (Mashaii et al., 2008); *Rana tavasensis* (Düşen, 2012); *Rana temporaria* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Gurlt, 1845; Andre, 1913; Linstow, 1878; Gassmann, 1972).

All the characteristic features are the same as those given by Skrjabin (1958). *Haplometra cylindracea* is the first record for *Rana macrocnemis* from Erzurum.

***Haematoloechus variegatus* (Rudolphi, 1819)**

Synonym: *Distoma variegatus*, *Distoma variegatum*, *Pneumonoeces variegatus*

Host: *Pelophylax ridibundus*

Site of infection: Lungs

Geographic range: Czechoslovakia, England, Germany, Poland, Russia, Serbia, Tatarstan, Turkey

Remarks: Adults of *Haematoloechus variegatus* are found in the lungs of the various terrestrial anurans and larvae can be found in freshwater snails of all zoogeographical regions (Prudhoe & Bray, 1982).

The body is non-spinous and almost 1 cm. Ventral sucker is smaller than oral sucker and situated in front of the mid-body. Testes are ovoid and situated side by side in the third quarter of the body. The ovary is ovoid and situated in front of the testes. Vitelline glands extend as ten to twelve rosette-like groups of six to seven follicles on each side from the level of the oesophagus almost to the posterior extremity. The uterus is irregularly folded in front of the gonads and extends between the testes and the posterior extremity (Fig. 2i).

It was found in *Bombina bombina* and *Bombina variegata* (Vojtkova & Vojtek, 1975); *Bufo bufo* (Dawes, 1946); *Bufo viridis* (Vojtkova & Vojtek, 1975; Chikhlyayev, 2014); *Pelobates fuscus* (Ruchin et al., 2008); *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Walton, 1949; Vojtkova & Vojtek, 1975; Erhan & Gherasim, 2015; Gurlt, 1845; Andre, 1913; Chikhlyayev et al., 2009a; Popiolek et al., 2011; Chikhlyayev et al., 2009b; Rezvantseva et al., 2010; Bjelić-Čabrilo et al., 2009; Gassmann, 1972); *Pelophylax lessonae* (Vojtkova & Vojtek, 1975; Popiolek et al., 2011); *Pelophylax ridibundus* (Walton, 1949; Vojtkova & Vojtek, 1975; Popiolek et al., 2011; Sağlam & Arıkan, 2006; Rezvantseva, 2008; Rezvantseva, 2009; Indiryakova et al., 2012); *Rana arvalis* (Vojtkova & Vojtek, 1975; Ruchin et al., 2009); *Rana temporaria* (Dawes, 1946; Vojtkova & Vojtek, 1975).

The main differences between the *Skrjabinocetes* and *Haematoloechus* genera are the number and location of the vitelline glands. The vitelline glands of genus *Skrjabinocetes* is located at the mid-body, but the glands of genus *Haematoloechus* lays between laterally intestinal bifurcation and hind-body (Skrjabin, 1962). All the taxonomic characters of the species are convenient with that given by Skrjabin (1962). *Haematoloechus variegatus* is found in many countries of Asia and Europe including Turkey but it has not been

recorded before in Erzurum province so far.

***Skrjabinocetes breviansa* (Loss, 1899) Sudarikov, 1950**

Synonym: *Haematoloechus breviansa*

Host: *Pelophylax ridibundus*

Site of infection: Lungs

Geographic range: Iran, Russia, Turkey, Ukraine

Remarks: *Skrjabinocetes* sp. lives in the lungs of frogs and toads (Prudhoe & Bray, 1982).

The body is 5.5 mm and covered with spines. Testes are located at the posterior third of the body. Ascending and descending limbs of the uterus occupy between the caeca. Large follicles of vitellarine glands extend laterally between the ventral sucker and fore-testis (Fig. 2g).

Skrjabinocetes breviansa was recorded before in *Pelophylax esculentus* (Kovalenko, 2007); *Pelophylax bedriagae* (Demir et al., 2015); *Pelophylax ridibundus* (Yildirimhan et al., 2005; Düşen & Öz, 2006; Koyun et al., 2015; Düşen & Oğuz, 2010; Karakaş, 2015; Mashaii et al., 2000; Romanova et al., 2010; Indiryakova et al., 2012; Kovalenko, 2007).

Morphological and anatomical characteristics of *Skrjabinocetes breviansa* are the same as those given by Skrjabin (1962). *S. breviansa* has been recorded in *P. ridibundus* from Erzurum for the first time.

***Skrjabinocetes similis* (Loss, 1899)**

Synonym: *Haematoloechus similis*, *Haematoloechus similigenus*, *Distoma simile*, *Distoma variegatum*, *Pneumonoeces similis*, *Pneumonoeces similigenus*.

Host: *Pelophylax ridibundus*

Site of infection: Lungs

Geographic range: Bulgaria, Czechoslovakia, England, Germany, Iraq, Iran, Russia, Swiss, Tatarstan

Remarks: *Skrjabinocetes similis* is found in the lung of the frog and toads, larvae develop in the planorbid snails (Prudhoe & Bray, 1982).

The body is covered with spines and 13 mm long. Ventral sucker is smaller than oral sucker and located at mid-region of body. Testes are ovoid, and the ovary is located near the ventral sucker. Vitelline glands are disposed of large follicles, ranging laterally from the anterior of the ventral sucker to the anterior testis (Fig. 2j).

Skrjabinocetes similis was encountered in *Bombina bombina* (Vojtkova & Vojtek, 1975); *Pelophylax esculentus* (Lühe, 1909b; Dawes, 1946; Vojtkova & Vojtek, 1975; Mashaii et al., 2000); *Pelophylax ridibundus* (Vojtkova & Vojtek, 1975; Andre, 1913; Chikhlyayev et al., 2009a; Chikhlyayev et al., 2009b; Rezvantseva et al., 2010; Saeed et al., 2007; Rezvantseva, 2008; Rezvantseva, 2009; Romanova et al., 2010; Indiryakova et al., 2012; Mashaii et al., 2008; Buchvarov & Irikov, 1997); *Rana arvalis* (Ruchin et al., 2009); *Rana temporaria* (Dawes, 1946).

Morphometric characteristics of *Skrjabinocetes similis* are the same as those given by Skrjabin (1962). The species has not been

recorded in Turkey. It is the first record for Erzurum province and parasite fauna of Turkey.

Acanthocephala

Echinorhynchidae

Acanthocephalus ranae (Schrank, 1788) Lühe, 1911

Synonym: *Echinorhynchus ranae*

Host: *Pelophylax ridibundus*, *Rana macrocnemis*

Site of infection: intestine

Geographic range: Brazil, Bulgaria, Germany, Greece, Hungary, Poland, Romania, Russia, Serbia, Swiss, Turkey, USA

Remarks: *Acanthocephalus ranae* lives in the intestine of some frogs and newts generally in Europe and the larva is parasitic in *Asellus aquaticus* (Lühe, 1911).

The trunk is cylindrical. Short and conical proboscis has 5 – 6 hooks at 12 – 16 rows. The proboscis sac is the same length as the proboscis. Testes are oval and located at the mid-region of the body (Fig. 3c).

A. ranae was encountered before in *Anguis fragilis* (Shimalov *et al.*, 2000); *Asellus aquaticus* (Lühe, 1911); *Bombina bombina* (Lühe, 1911); *Bufo bufo* (Gassmann, 1972; Yildirimhan & Karadeniz, 2007; Düşen, 2011; Heckmann *et al.*, 2011); *Bufo viridis* (Karakas, 2015; Lühe, 1911; Yildirimhan, 1999); *Bufo vulgaris* (Lühe, 1911); *Coronella austriaca* (Edelényi, 1963); *Diemyctylus viridescens* (Vancleave, 1922); *Hyla arborea* (Heckmann *et al.*, 2011); *Hyla orientalis* (Düşen & Yaka, 2014; Yakar *et al.*, 2016); *Molge cristata* (Lühe, 1911); *Molge vulgaris* (Lühe, 1911); *Natrix natrix* (Edelényi, 1963); *Pelophylax esculentus* (Andre, 1913; Popiolek *et al.*, 2011; Bjelić-Čabrilo *et al.*, 2009; Gassmann, 1972; Lühe, 1911); *Pelophylax lessonae* (Popiolek *et al.*, 2011); *Pelophylax bedriagae* (Demir *et al.*, 2015); *Pelophylax ridibundus* (Yildirimhan *et al.*, 2005; Düşen & Öz, 2006; Popiolek *et al.*, 2011; Koyun *et al.*, 2015; Sağlam & Arıkan, 2006; Düşen & Oğuz, 2010; Karakas, 2015; Oğuz *et al.*, 1994; Sattmann, 1990; Buchvarov & Irikov, 1997; Heckmann *et al.*, 2011; Iacob, 2021); *Rana camerani* (Yildirimhan *et al.*, 2006a); *Rana dalmatina* (Düşen *et al.*, 2009; Yildirimhan *et al.*, 2016); (Heckmann *et al.*, 2011); *Rana macrocnemis* (Yildirimhan *et al.*, 1997a), (Düşen, 2007), (Heckmann *et al.*, 2011); *Rana tavasensis* (Heckmann *et al.*, 2011; Düşen, 2012); *Rana temporaria* (Andre, 1913; Gassmann, 1972; Lühe, 1911); *Rhinella icterica* (Pilati *et al.*, 2013).

A. ranae, which was found formerly in urodeles and anurans from the countries of Europe, Asia and America have been found in some provinces of Turkey, but it is the first record for Erzurum province.

Centrorhynchidae

Centrorhynchus sp. Lühe 1911

Synonym: *Chentrorhynchus*; *Chentrosoma*; *Gordiorhynchus*; *Paradoxites*; *Travassosina*.

Host: *Pelophylax ridibundus*

Site of infection: intestine

Geographic range: Bulgaria, Porto Rico, Turkey

Remarks: Adults of the acanthocephalan genus *Centrorhynchus* (Polymorphida: Centrorhynchidae) occur primarily in birds of prey (Richardson & Nickol 1995).

The trunk is non-spinous and slender. The proboscis is divided into two regions and the anterior swollen region has 8 hooks per 26 – 28 rows, the posterior region has 3 – 4 hooks per 26 – 28 rows. Testes are in the anterior portion of the trunk (Fig. 3a).

Centrorhynchus sp. was recorded before in *Eupsophus* sp. (Torres & Puga, 1996); *Herpestes javanicus auro punctatus* (Cable & Quick, 1954); *Pelophylax ridibundus* (Yildirimhan *et al.*, 2005).

While it was found only one individual in *P. ridibundus* from Istanbul formerly by Yildirimhan *et al.* (2005), *Centrorhynchus* sp. is the first record for Erzurum province.

Pomphorhynchidae

Pomphorhynchus laevis (Zoega in Müller, 1776) Van Cleave, 1924

Synonym: *Echinorhynchus laevis*; *Echinorhynchus tereticollis*; *Pomphorhynchus tereticollis*; *Echinorhynchus proteus*; *Pomphorhynchus proteus*; *Pomphorhynchus intermedius*.

Host: *Pelophylax ridibundus*

Site of infection: intestine

Geographic range: Iraq, Turkey

Remarks: Species of *Pomphorhynchus* are largely parasites of freshwater fishes (Amin *et al.*, 2003).

The trunk is non-spinous and spindle-shaped.

We recorded at 2010 *P. spindlet truncatus* from some freshwater fish of Erzurum province and marsh frogs of Isparta province (Heckmann *et al.*, 2010). The difference of *P. laevis* from *P. spindlet truncatus* is mainly the number of the proboscis' hooks. The proboscis of *P. spindlet truncatus* is ovoid and 15 – 18 longitudinal rows of 7 – 9 hooks of each and proboscis of *P. laevis* cylindrical to ovoid, with 16 – 18 longitudinal rows of 11 – 12 hooks of each. The neck is moderate length and has a distal bulb (Fig. 3b).

P. laevis was recorded in freshwater fishes as *Abramis brama*, *Abramis sapa*, *Acipenser ruthenus*, *Alburnus alburnus* (Nedeva *et al.*, 2003); *Alburnus baliki* (Aydoğdu *et al.*, 2011); *Anguilla anguilla* (Sures, 2001); *Apollina melanostoma* (Kvach & Skora, 2007; Rolbiecki, 2006; Ondrackova *et al.*, 2005); *Aspius aspius* (Nedeva *et al.*, 2003); *Barbus barbus* (Nedeva *et al.*, 2003; Schludermann *et al.*, 2003; Laimgruber *et al.*, 2005; Brown *et al.*, 1986; Thielen *et al.*, 2004); *Blicca bjorkna* and *Carassius auratus gibelio* (Nedeva *et al.*, 2003); *Crenilabrus tinca* (Akmirza, 2002); *Cyprinus carpio* (Buhurcu, 2006); *Gobius niger* (Zander, 2004); *Gymnocephalus shraetser*, *Lota lota*, *Neogobius cephalarges*, and *Pelecus cultratus* (Nedeva *et al.*, 2003); *Neogobius fluviatilis* and *Neogobius kessleri* (Ondrackova *et al.*, 2005); *Neogobius iljini* (Mineeva, 2013); *Perca fluviatilis* (Sobecka & Słomińska, 2007), (Nedeva *et al.*, 2003); *Phoxinus phoxinus* (Kralova-Hromadova *et al.*, 2003; Dudiňák & Šnábel, 2001); *Platyichthys flesus* (Koie, 1999), (Chib-

ani *et al.*, 2001); *Pomatoschistus minutus* (Zander, 2004); *Rutilus rutilus* (Nedeva *et al.*, 2003); *Salmo gairdneri* (Brown *et al.*, 1986); *Scardinius erythrophthalmus*, *Silurus glanis* (Nedeva *et al.*, 2003); *Squalius cephalus* (Kralova-Hromadova *et al.*, 2003; Bombardova *et al.*, 2007; Dudiňák & Šnábel, 2001; Brown *et al.*, 1986; Dezfuli *et al.*, 1999; Tieri *et al.*, 2006; Galli *et al.*, 2001; Dudiňák & Šnábel, 2001); *Stizostedion lucioperca* (Nedeva *et al.*, 2003); *Symphodus tinca* (Çinar, 2014); *Tinca tinca* (Yildiz, 2003; Yıldiz & Çavuşoğlu, 2003); *Vimba vimba* (Nedeva *et al.*, 2003); in marsh frogs (*Pelophylax ridibundus*) (Düşen & Öz, 2013; Düşen & Oğuz, 2008; Düşen & Oğuz, 2010) and in an otter (*Lutra lutra*) (Dimitrova *et al.*, 2008).

Pomphorhynchus laevis is found in the frog from Erzurum for the first time.

As a result, a total of 149 individuals of parasites of 12 species were found in frogs. As the parasite fauna of *Pelophylax ridibundus* and *Rana macrocnemis* of Erzurum province have not been studied before, our study is very important for contribution to fauna. While all the parasites are the first records for Erzurum, *Skrjabinocoes similis* and *Cephalogonimus retusus* are the first records for parasite fauna of Turkey.

Conflict of Interest

The authors state no conflict of interest.

References

- AKMIRZA, A. (2002): Acanthocephala and Cestoda Parasites Fishes Caught Near Gökçeada. *Türkiye Parazitol Derg.* 26(1) (In Turkish)
- AMIN, O.M., ABDALLAH, S.M.A., MHAISEN, F.T. (2003): Description of *Pomphorhynchus spindletuncatus* n. sp. (Acanthocephala: Pomphorhynchidae) from freshwater fishes in northern Iraq, with the erection of a new pomphorhynchid genus, *Pyriproboscis* n. g., and keys to genera of the Pomphorhynchidae and the species of *Pomphorhynchus* Monticelli, 1905. *Syst Parasitol*, 54: 229 – 235
- ANDRE, E. (1913): Recherches parasitologiques sur les amphibiens de la suisse II [Parasitological research on amphibians in Switzerland II]. *Rev Suisse Zool*, 21: 79 – 200 (In French)
- AYDOĞDU, A., EMRE, Y., EMRE, N., KÜÇÜK, F. (2011): Two new host records for *Pomphorhynchus laevis* (Müller, 1776) (Acanthocephala) recorded from Antalya, Turkey: Small bleak (*Alburnus baliki* Bogutskaya, Küçük & Ünlü, 2000) and Antalya barb (*Capoeta antalyensis* Battalgil, 1944). *Turk Zool Derg.* 35(6): 897 – 900. DOI:10.3906/zoo-0909-32
- BARAN, İ., İLGAZ, Ç., AVCI, A., KUMLUTAŞ, Y., OLGUN, K. (2012). *Türkiye amfibi ve sürüngenleri*, 3 edn. [Amphibians and reptiles of Turkey, 3rd ed] Ankara: TÜBİTAK. 203 pp. (In Turkish)
- BJELIĆ-ČABRILO, O., POPOVIĆ, E., PAUNOVIĆ, A. (2009): Helminthofauna of *Pelophylax* kl. *esculentus* (Linne, 1758) from petrovaradinski rit marsh (Serbia). *Helminthologia*, 46(2): 107 – 111. DOI: 10.2478/s11687-009-0021-z
- BOMBAROVA, M., MAREC, F., NGUYEN, P., SPAKULOVA, M. (2007): Divergent location of ribosomal genes in chromosomes of fish thorny-headed worms, *Pomphorhynchus laevis* and *Pomphorhynchus tereticollis* (acanthocephala). *Genetica*, 131(2): 141 – 149. DOI: 10.1007/s10709-006-9124-3
- BRAY, R.A., WEBSTER, B.L., BARTOLI, P., LITTLEWOOD, D.T.J. (2005): Relationships within the *Acanthocolpidae* Lühe, 1906 and their place among the Digenea. *Acta Parasitologica*, 50(4): 281 – 291
- BROWN, A.F., CHUBB, J.C., VELTCAMP, J.C. (1986): A key to the species of Acanthocephala parasitic in British freshwater fishes. *J. Fish. Biol.*, 28: 327 – 334
- BUCHAROV, G., IRIKOV, A. (1997): Le renseignement de la helminthofaune de la grande grenouille aquatique (*Rana ridibunda* Pall) provenant du region du combinat de la production du cuivre, nomie “G. Damianov” a pirdop [Information on the helminthofauna of the great water frog (*Rana ridibunda* Pall) from the region of the copper production complex, called “G. Damianov” in pirdop]. *Trav. Sci. Univ. Plovdiv, Animalia*, 33(6): 45 – 54 (In French)
- BUCHAROV, G., KIRIN, D., KOSTADINOVA, A. (2000): Platyhelminth parasite assemblages in two species of snakes, *Natrix natrix* and *Natrix tessellata* (Reptilia: Colubridae), from Bulgaria: Seasonal variation. *J. Environ. Prot. Ecol.*, 1(1): 124 – 131
- BUDAK, A., GÖÇMEN, B. (2008). *Herpetology*. Ege University Faculty of Science Books Series, No. 194, Ege University Press, Bornova-Izmir, 226 p. (In Turkish)
- BUHURCU, H.İ. (2006): *Studies on the endoparasite fauna of some fish (Cyprinus carpio Linnaeus, 1758, Alburnus nasreddini Battalgil, 1944) in Lake Akşehir*. Master Thesis, Afyon: Afyon Kocatepe University. (In Turkish)
- CABLE, R.M., QUICK, L.A. (1954): Some Acanthocephala from Puerto Rico with the description of a new genus and three new species. *Trans Am Microsc Soc*, 73(4): 393 – 400
- CHIBANI, M., ZIOKOWSKAY, M., KIJEWSKAY, A., ROKICKI, J. (2001): *Pomphorhynchus laevis* parasite of flounder *Platichthys flesus* as a biological indicator of pollution in the Baltic Sea. *J. Mar. Biol. Ass. U.K.*, 81: 165 – 166
- CHIKHLYAEV, I.V. (2014): On the fauna helminthes of green toad *Bufo viridis* Laurenti, 1768 (Anura, Amphibia) in Samara Region [Russian]. *Samarskaya Luka : Problemy Regionalnoy i Globalnoy Ekologii*, 23(2): 185 – 190
- CHIKHLYAEV, I.V., FAYZULIN, A.I., ZAMALETDINOV, R.I. (2009b): Edible frog helminths - *Rana esculenta* Linnaeus, 1758 (Anura, Amphibia) of the middle Volga region. *Povolzhsky Ecol. J.*, 3: 270 – 274 (In Russian)
- CHIKHLYAEV, I.V., FAYZULIN, A.I., ZAMALETDINOV, R.I., KUZOVENKO, A.E. (2009a): [Trophic relationships and helminthic fauna of green frogs *Rana esculenta* complex (Anura, Amphibia) in urbanized areas of the Volga basin]. *Pratsi Ukrainian Herpetological Association*, 2: 102 – 109. (In Russian)
- ÇINAR, M.E. (2014): Checklist of the Phyla Platyhelminthes, Xenacoelomorpha, Nematoda, Acanthocephala, Myxozoa, Tardigrada, Cephalorhyncha, Nemertea, Echiura, Brachiopoda, Phoronida,

- Chaetognatha, and Chordata (Tunicata, Cephalochordata, and Hemichordata) from the coasts of Turkey. *Turk Zool Derg*, 38: 698 – 722. DOI: 10.3906/zoo-1405-70
- DAWES, B. (1946). *The trematoda with special reference to british and other european forms*. Cambridge Univ. Press. 644 pp.
- DEMİR, S., YAKAR, O., YILDIRIMHAN, H.S., BIRLIK, S. (2015): Helminth parasites of the levantine frog (*Pelophylax bedriagae camerano*, 1882) from the western part of Turkey. *Helminthologia*, 52(1): 71 – 76. DOI 10.1515/helmin-2015-0013
- DEZFULI, B.S., CAPUANO, S., PIRONI, F., MISCHIATI, C. (1999): The origin and function of cement gland secretion in *Pomphorhynchus laevis* (Acanthocephala). *Parasitology*, 119: 649 – 653
- DIESING, C.M. (1835): Monographie der Gattungen *Amphistoma* und *Diplodiscus*. (Tafel 22-24) [Monograph of the genera *Amphistoma* and *Diplodiscus*. (Plate 22-24)]. *Annals of the Vienna Museum of Natural History*, 1: 235 - 260 (In German)
- DIESING, C.M. (1851). *Systema helminthum*. Volume 2. Vindobonae. 588 pp.
- DIMITROVA, Z., TZVETKOV, Y., TODEV, I. (2008): Occurrence of acanthocephalans in the eurasian otter *Lutra lutra* (L.) (Carnivora, Mustelidae) in Bulgaria, with a survey of Acanthocephalans recorded from this host species. *Helminthologia*, 45(1): 41 – 47. DOI: 10.2478/s11687-008-0007-2
- DUDIŇÁK, V., ŠNÁBEL, V. (2001): Comparative analysis of Slovak and Czech Populations of *Pomphorhynchus laevis* (Acanthocephala) using morphological and isoenzyme analyses. *Acta Zool. Univ. Comen.*, 44: 41 – 50
- DÜŞEN, S. (2007): Helminths of the two mountain frogs, banded frog, *Rana camerani* Boulenger, 1886 and Uludağ frog *Rana macrocnemis* Boulenger, 1885 (Anura: Ranidae), collected from the Antalya province. *Türkiye Parazit Derg*, 31(1): 84 – 88
- DÜŞEN, S. (2011): The helminth parasites of the two Bufonid toads, European common toad, *Bufo bufo* (Linnaeus, 1758) and european green toad, *Bufo (Pseudepidalea) viridis* Laurenti, 1768 (Anura: Bufonidae), collected from denizli province, inner-west Anatolia Region, Turkey. *Helminthologia*, 48(2): 101 – 107. DOI: 10.2478/s11687-011-0019-1
- DÜŞEN, S. (2012): First data on the helminth fauna of a locally distributed mountain frog, "Tavas frog" *Rana tavasensis* Baran & Atatür, 1986 (Anura: Ranidae), from the inner-west Anatolian region of Turkey. *Turk. J. Zool.*, 36(4): 496 – 502. DOI: 10.3906/zoo-0909-15
- DÜŞEN, S., OĞUZ, M. (2008): Occurrence of *Pomphorhynchus laevis* (Acanthocephala) in the marsh frog (*Rana ridibunda pallas*, 1771), from Turkey. *Helminthologia*, 45(3): 154 – 156. DOI: 10.2478/s11687-008-0031-2
- DÜŞEN, S., OĞUZ, M.C. (2010): Metazoan endoparasites of three species of anurans collected from the Middle Black Sea region of Turkey. *Helminthologia*, 47(4): 226 – 232. DOI: 10.2478/s11687-010-0035-6
- DÜŞEN, S., OĞUZ, M.C., BARTON, D.P., ARAL, A., ŞULEKOĞLU, S., TEPE, Y. (2010): Metazoan parasitological research on three species of anurans collected from Çanakkale province northwestern Turkey. *North West J Zool*, 6(1): 25 – 35
- DÜŞEN, S., ÖZ, M. (2006): Helminths of the marsh frog, *Rana ridibunda pallas*, 1771 (Anura : Ranidae), from Antalya province, Southwestern Turkey. *Comp Parasitol*, 73(1): 121 – 129. DOI: 10.1654/4162.1
- DÜŞEN, S., ÖZ, M. (2013): Helminth fauna of the eurasian marsh frog, *Pelophylax ridibundus* (Pallas, 1771) (Anura: Ranidae), collected from Denizli province, inner-west anatolia region, Turkey. *Helminthologia*, 50(1): 57 – 66. DOI: 10.2478/s11687-013-0108-4
- DÜŞEN, S., UĞURTAŞ, I.H., AYDOĞDU, A., OĞUZ, M.C. (2009): The helminth community of the agile frog, *Rana dalmatina* Bonaparte, 1839 (Anura: Ranidae) collected from northwest of Turkey. *Helminthologia*, 46(3): 177 – 182. DOI: 10.2478/s11687-009-0033-8
- DÜŞEN, S., YAKA, H. (2014): Helminths of the eastern tree frog, *Hyla orientalis*, Bedriaga, 1890 (Anura: Hylidae), collected from Denizli province, inner-west Anatolia Region, Turkey. *Helminthologia*, 51(1): 37 – 45. DOI: 10.2478/s11687-014-0206-y
- EDELÉNYI, B. (1963): Hazai hüllök néhány újabb belsőélősködő férgé. (einige neuere innere parasitenwürmer der in ungarland lebenden reptilien) [Some new internal parasitic worms of domestic reptiles.] *Az Egri Tanárképző Főiskola tudományos közleményei (1. köt.) = Acta Academiae Paedagogicae Agriensis* 1: 323-342. (In Hungarian)
- ERHAN, D., GHERASIM, E. (2015): Trematodofauna complexului *Pelophylax esculenta* (Amphibia, Anura) din codrii centrali ai republicii Moldova. 1. Familiile Plagiorchiidae, Cephalogonimidae [Trematodofauna of the *Pelophylax esculenta* complex (Amphibia, Anura) from the central forests of the Republic of Moldova. 1. The families Plagiorchiidae, Cephalogonimidae]. *Studia Universitatis Moldaviae. Real and Natural Sciences Series* 81(1): 148 – 159. (In Romanian)
- GALLI, P., CROSA, G., MARINIELLO, L., ORTIS, M., D'AMELIO, S. (2001): Water quality as a determinant of the composition of fish parasite communities. *Hydrobiologia*, 452: 173 – 179
- GASSMANN, M. (1972): Etudes des trematodes et acanthocephales d'amphibiens du jura [Studies of trematodes and acanthocephales of amphibians of the Jura]. *Rev Suisse Zool*, 79(3): 980 – 998 (In French)
- GURLT, E.F. (1845): Verzeichniss der thiere, bei welchen entozoen gefunden worden sind [List of animals in which entozoa have been found]. *Arch. Naturg.*, 1: 223 – 325. (In German)
- HECKMANN, R.A., AMIN, O.M., TEPE, Y., DÜŞEN, S., OĞUZ, M.C. (2011): *Acanthocephalus ranae* (Acanthocephala: Echinorhynchidae) from amphibians in Turkey, with special reference to new morphological features revealed by sem, and histopathology *Sci. Parasitol.*, 12(1): 23 – 32
- HECKMANN, R.A., OĞUZ, M.C., AMIN, O.M., DUSEN, S., TEPE, Y., ASLAN, B. (2010): Host and geographical distribution of *Pomphorhynchus spindletrencatus* (Acanthocephala: Pomphorhynchidae) in Turkey, with enhanced description from new fish and amphibian hosts using SEM, and histopathological notes. *Sci. Parasitol.*, 11:

- IACOB, O.C. (2021): Parasitism with *Acanthocephalus ranae* in frogs (*Pelophylax ridibundus* Pallas 1771), from North-East Romania. *Helminthologia*, 10;58(1):68 – 73. DOI: 552 10.2478/Helm-2021-0008
- INDIRYAKOVA, T.A., ROMANOVA, E.M., INDIRYAKOVA, O.A. (2012): [Assessment of the ecological state of the suburban biotopes of the Sviyaga River according to the parameters of the biodiversity of the parasite fauna *Rana ridibunda* Pallas, 1971]. *Bulletin of the Ulyanovsk State*, 49-54. (In Russian)
- KARAKAŞ, M. (2015): Helminth parasites of *Bufo viridis*, *Rana ridibunda* and *Hyla arborea* collected from the different regions of Turkey. *Manas J. Agric. Life Sci.*, 5(1): 1 – 6
- KIRIN, D. (1994): *Metaleptophallus gracillimus* (Luhe, 1909) (Family Plagiorchiidae, Lurhe, 1901) and *Cephalogonimus retusus* (Djardin, 1845), (Family Cephalogonimidae, Nicol, 1915), new species of the helminth fauna of the Reptiles (Reptilia) in Bulgaria. *Trav. Sci. Univ. Plovdiv, Animalia*, 30(6): 41 – 46 (In Bulgarian)
- KIRIN, D., BUCHVAROV, G. (1999): Larval forms on helminthes on a homes and wilds animals, parasiting in lake frog (*Rana ridibunda* Pall) from region of Plovdiv. *Trav. Sci. Univ. Plovdiv, Animalia*, 35(6): 21 – 28
- KOIE, M. (1999): Metazoan parasites of flounder *Platichthys flesus* (L.) along a transect from the southwestern to the northeastern Baltic Sea. *ICES J Mar Sci*, 56: 157 – 163
- KOVALENKO, M.V. (2007): First Ukrainian record of the frog lung fluke *Skrjabinocoes brevisans* Sudarikov, 1950 (Trematoda: Plagiorchiidae). *J. V.N. Karazin Kharkiv Nat. Univ., Ser. "Biol."*, 93 – 96
- KOYUN, M., BIRLIK, S., SÜMER, N., YILDIRIMHAN, H.S. (2015): Helminth fauna of eurasian marsh frog, *Pelophylax ridibundus* (Pallas, 1771) (Anura: Ranidae) from Bingöl, Eastern Anatolia, Turkey. *Biharean Biol*, 9(2): 128 – 132
- KRALOVA-HROMADOVA, I., TIETZ, D.F., SHINN, A.P., ŠPAKULOVA, M. (2003): Its rDNA sequences of *Pomphorhynchus laevis* (Zoega in Müller, 1776) and P. Lucyi Williams & Rogers, 1984 (Acanthocephala: Palaeacanthocephala). *Syst Parasitol*, 56: 141 – 145. DOI: 10.1023/A:1026127219358
- KVACH, Y., SKORA, K.E. (2007): Metazoa parasites of the invasive round goby *Apollonia melanostoma* (*Neogobius melanostomus*) (Pallas) (Gobiidae: Osteichthyes) in the gulf of Gdansk, Baltic Sea, Poland: A comparison with the Black Sea. *Parasitol Res*, 100(4): 767 – 774. 10.1007/s00436-006-0311-z
- LAIMGRUBER, S., SCHLUDERMANN, C., KONECNY, R., CHOVANEC, A. (2005): Helminth communities of the barbel *Barbus barbus* from large river systems in Austria. *J Helminthol*, 79(2): 143 – 149. DOI: 10.1079/joh2005276
- LINSTOW, O. (1878): *Compendium der helminthologie* Hanover [Compendium of helminthology]. Hanover. 580 pp. (In German)
- LÜHE, M. (1909b): Parasitische plattwürmer. I: Trematodes [Parasitic Flatworms. I: Trematodes]. *Die Süßwasserfauna Deutschlands, eine Exkursionsfauna*, 17: 1 – 217. (In German)
- LÜHE, M. (1911): Acanthocephalans. *Süßwasserfauna* 16. 1 – 60
- MAEDER, A.M. (1973): Monogènes et trématodes parasites d'amphibiens en côte d'ivoire [Monogens and parasitic trematodes of amphibians in the Ivory Coast]. *Revue Suisse Zool*, 80(2): 267 – 322. (In German)
- MASHAI, N., BALOUCH, M., MOBEDI, I. (2000): New records about helminth parasites of the marsh frog, *Rana ridibunda ridibunda* (Anura: Ranidae) from the north of Iran. *Iran. J. Fish. Sci.*, 2(2): 77 – 88
- MASHAI, N., BALOUCH, M., MOBEDI, I. (2008): A report about helminth parasites of some amphibians (Anura: Ranidae, bufonidae) from the north and northeast of Iran. *JSUT*, 33(4): 9 – 13
- MINEEVA, O.V. (2013): Parasitofauna of the goby (*Neogobius iljini* Vasiljeva et Vasiljev, 1996), of the saratov reservoir. *Vestn. Nižegorodskogo univ. im. N.I. Lobačevskogo*, 4(1): 158 – 161
- NEDEVA, I., ATANASSOV, G., KARAIANOVA, E., ČAKIC, P., LENGHARDI, M. (2003): *Pomphorhynchus laevis* (Miller, 1776) from the River Danube. *Exp. Pathol. Parasitol.*, 6(13): 14 – 16
- OĞUZ, M.C., ALTUNEL, F.N., UĞURTAŞ, I.H. (1994): Edirne ve Bursa illeri çevresinde yakalanan ova kurbağası (*Rana ridibunda* Pallas, 1771)'nin parazitleri olan platyhelminth'leri ile *Acanthocephalus rane* (Schrank, 1788, Echinorhynchidae, Acanthocephala) üzerinde araştırmalar [Investigations on platyhelminths and *Acanthocephalus rane* (Schrank, 1788, Echinorhynchidae, Acanthocephala) which are parasites of the marsh frog (*Rana ridibunda* Pallas, 1771) caught around Edirne and Bursa provinces]. *Turk. J. Zool.*, 18: 47 – 51. (In Turkish)
- ONDRACKOVA, M., DAVIDOVA, M., PECINKOVA, M., BLAZEK, R., GELNAR, M., VALOVA, V., CERNY, J., JURAJDA, P. (2005): Metazoan parasites of neogobius fishes in the Slovak section of the River Danube. *J. Appl. Ichthyol*, 21: 345 – 349
- ÖZTÜRK, M.O., OGUZ, M.C., ALTUNEL, F.N. (2000): Metazoan parasites of pike (*Esox lucius* L.) from Lake Uluabat, Turkey. *Isr J Zool*, 46: 119 – 130
- PILATI, C., QUADROS, R.M., BRANCO, K.A.A., ANDRADE, M.A., MARQUES, S.M.T. (2013): *Acanthocephalus ranae* (Echinorhynchidae) infecting *Rhinella icterica* (Bufonidae) in Santa Catarina, Brazil. *Cienc. Anim*, 23(1): 3 – 8
- POPIOLEK, M., ROZENBLUT-KOŚCISTY, B., KOT, M., NOSAL, W., OGIELSKA, M. (2011): Endoparasitic helminths of water frog complex in Poland: Do differences exist between the parental species *Pelophylax ridibundus* and *Pelophylax lessonae*, and their natural Hybrid *Pelophylax esculentus*? *Helminthologia*, 48(2): 108 – 115. DOI: 10.2478/s11687-011-0020-8
- PRITCHARD, M.H., KRUSE, G.O. (1982). *The collection and preservation of animal parasites. Technical bulletin no. 1.* The Harold W. Manter Laboratory, University of Nebraska Press. 141 pp.
- PRUDHOE, S., BRAY, R.A. (1982). *Platyhelminth parasites of the amphibia.* British Museum (Natural History), Oxford University Press. 217 pp.
- REZVANTSEVA, M.V. (2008): [Materials on the helminth fauna of the marsh frog (*Rana ridibunda*) in the vicinity of Tambov]. *TSU Bulletin*, 13(5): 330 – 332. (In Russian)
- REZVANTSEVA, M.V. (2009): [Seasonal and long-term dynamics of

- the number of marsh frog (*Rana ridibunda*) helminths in the vicinity of Tambov]. *TSU Bulletin*, 14(2): 389 – 393. (In Russian)
- REZVANTSEVA, M.V., LADA, G.A., KULAKOV, E.J. (2010): [Age and sex characteristics of the helminth fauna of green frogs (*Rana esculenta* complex) in the east of the central black earth]. *TSU Bulletin*, 15(2): 646 – 659. (In Russian)
- RICHARDSON, D.J., NICKOL, B.B. (1995): The genus *Centrorhynchus* (Acanthocephala) in North America with description of *Centrorhynchus robustus* n. sp., redescription of *Centrorhynchus conspectus*, and a key to species. *J Parasitol*, 81(5): 767 – 772
- ROLBIECKI, L. (2006): Parasites of the round goby, *Neogobius melanostomus* (Pallas, 1811), an invasive species in the Polish fauna of the Vistula lagoon ecosystem. *Oceanologia*, 48(4): 545 – 561
- ROMANOVA, E.M., INDIRYAKOVA, T.A., MATVEEVA, E.A. (2010): [Biotic relationships in parasitocenoses of *Rana ridibunda*]. *UGSKA Bulletin*, 1(11): 69 – 75. (In Russian)
- RUCHIN, A.B., CHIKHLYAEV, I.V., LUKYANOV, S.V., RYZHOV, M.K. (2008): On helminths of common spadefoot toad – *Pelobates fuscus* (the eastern form) in floodlands of some rivers in middle and Lower-Volga Region. *Povolzhsky Ecol. J.*, 1: 48 – 54
- RUCHIN, A.B., CHIKHLYAEV, I.V., LUKYANOV, S.V. (2009): [Study of the helminth fauna of the common garlic *Pelobates fuscus* (laurenti, 1768) and the frog *Rana arvalis* Nilsson, 1842 (Amphibia: Anura) in their joint habitation]. *Parasitology*, 43(3): 240 – 247
- SAEED, I., AL-BARWARI, S.E., AL-HARMANI, K.I. (2007): A metazoan parasitological research of some Iraqi amphibians. *Türkiye Parazit. Derg.*, 31(4): 337 – 345
- SAĞLAM, N., ARIKAN, H. (2006): Endohelminth fauna of the marsh frog *Rana ridibunda* from Lake Hazar, Turkey. *Dis. Aquat. Org.*, 72: 253 – 260. DOI: 10.3354/dao072253
- SATTMANN, H. (1990): Endohelminths of some amphibians from northern Greece (Trematoda, Acanthocephala, Nematoda; Amphibia: *Triturus*, *Rana*, *Bombina*). *Herpetozoa*, 3(1/2): 67 – 71
- SCHLUDERMANN, C., KONECNY, R., LAIMGRUBER, S., LEWIS, J.W., SCHIEMER, F., CHOVANEC, A., SURES, B. (2003): Fish macroparasites as indicators of heavy metal pollution in river sites in Austria. *Parasitology*, 126 Suppl.: S61 – 69. DOI: 10.1017/s0031182003003743
- SHIMALOV, V.V., SHIMALOV, V.T., SHIMALOV, A.V. (2000): Helminth fauna of lizards (Reptilia, Sauria) in the southern part of Belarus. *Parasitol. Res.*, 86: 343
- SKRJABIN, K.I. (1916): Parasitic trematodes and nematodes collected by the expedition of prof. V. Dogiel and i. Sokolov in British east Africa. *Science Research Expedition to British East Africa and Uganda, V. Dogiel and I. Sokolov in 1914*, 4: 1 – 157
- SKRJABIN, K.I. (1947): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 1. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 515 pp. (In Russian)
- SKRJABIN, K.I. (1949): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 3. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 623 pp. (In Russian)
- SKRJABIN, K.I. (1950): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 4. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 495 pp. (In Russian)
- SKRJABIN, K.I. (1952): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 7. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 762 pp. (In Russian)
- SKRJABIN, K.I. (1953): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 8. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 618 pp. (In Russian)
- SKRJABIN, K.I. (1958): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 14. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 934 pp. (In Russian)
- SKRJABIN, K.I. (1962): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 20. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 563 pp. (In Russian)
- SKRJABIN, K.I. (1974): *Trematody zhivotnyh i cheloveka* [Trematodes of animals and man]. Volume 24. Izdatel'stvo Akademii Nauk SSSR, Moscow-Leningrad. 379 pp. (In Russian)
- SOBECKA, E., SŁOMIŃSKA, M. (2007): Species richness, diversity and specificity of the parasites of bream *Abramis brama* (L.) and perch *Perca fluviatilis* L. In the estuary of the Odra River, Poland. *Helminthologia*, 44(4): 188 – 192. DOI: 10.2478/s11687-007-0030-8
- STOSSICH, M. (1890): Elminti veneti raccolti dal dott. Alessandro P. Ninni [Venetian helminths collected by Dr. Alessandro P. Ninni]. *Boll. Soc. Adriatic.*, 12: 49 – 56. (In Italian)
- SURES, B. (2001): The use of fish parasites as bioindicators of heavy metals in aquatic ecosystems: A review. *Aquat Ecol*, 35: 245 – 255
- THIELEN, F., ZIMMERMANN, S., BASKA, F., TARASCHEWSKI, H., SURES, B. (2004): The intestinal parasite *Pomphorhynchus laevis* (Acanthocephala) from barbel as a bioindicator for metal pollution in the Danube River near Budapest, Hungary. *Environ. Pollut.*, 129(3): 421 – 429. DOI: 10.1016/j.envpol.2003.11.011
- TIERI, E., MARINIELLO, L., ORTIS, M., BERTI, M., BATTISTINI, M.L. (2006): Endoparasites of chub (*Leuciscus cephalus*) in two rivers of the Abruzzo region of Italy. *Vet Ital*, 42(3): 271 – 279
- TORRES, P., PUGA, S. (1996): Occurrence of cystacanths of *Centrorhynchus* sp. (Acanthocephala:Centrorhynchidae) in toads of the genus *Eupsophus* in Chile. *Mem Inst Oswaldo Cruz, Rio De Janeiro*, 91(6): 717 – 719
- VANCLEAVE, H.J. (1922): Acanthocephala from the Illinois river, with descriptions of species and a synopsis of the family Neoechinorhynchidae. *Bull. Ill. Nat. Hist. Surv. Urbana, Illinois, U. S. A. (1918 – 1921)*, 13: 225 – 257
- VOJTKOVA, L., VOJTEK, J. (1975): Die trematoden der amphibiien in der tschechoslowakei. II. Die larvestadien (mesocercarien und metacercarien) [The trematodes of the amphibians in Czechoslovakia. II. The larval stages (Mesocercaria and metacercaria)]. *Folia Fac. sci. nat. Univ. Purkyn. Brun., Biol.*, 16: 7 – 84. (In German)
- WALTON, A.C. (1949): Parasites of the Ranidae (Amphibia) VII. *Trans Am Microsc Soc*, 68(1): 49 – 54
- YAKAR, O., DEMIR, S., YILDIRIMHAN, H.S., BIRLIK, S. (2016): Gastrointestinal helminths of the oriental tree frog *Hyla orientalis* Bedriaga, 1890 (Amphibia: Hylidae) from Izmir province, western Turkey.

Acta Zool Bulg, 68(1): 111 – 115

YILDIRIMHAN, H. S., UĞURTAŞ, I. H., ALTUNEL, F. N. (1997a): *Rana macrocnemis* Boulenger 1885 (uludağ kurbağası)'in asalak helminthleri üzerine bir araştırma [A study on parasitic helminths of *Rana macrocnemis* Boulenger 1885 (Uludağ frog)]. *Turk. J. Zool.*, 21: 467 – 473. (In Turkish)

YILDIRIMHAN, H.S. (1999): *Bufo viridis* Laurenti, 1768 (Anura; Amphibia)'in parazitik helminthleri üzerine araştırmalar [Studies on parasitic helminths of *Bufo viridis* Laurenti, 1768 (Anura; Amphibia)]. *Turk. J. Zool.*, 23(1): 177 – 195. (In Turkish)

YILDIRIMHAN, H.S., BURSEY, C.R., GOLDBERG, S.R. (2009): Helminth parasites of the caucasian parsley frog, *Pelodytes caucasicus*, from Turkey. *Comp. Parasitol.*, 76(2): 247 – 257. DOI: 10.1654/4376.1

YILDIRIMHAN, H.S., GOLDBERG, S.R., BURSEY, C.R. (2006a): Helminth parasites of the banded frog *Rana camerani* (Ranidae) from Turkey. *Comp. Parasitol.*, 73(2): 222 – 236. DOI: 10.1654/4229.1

YILDIRIMHAN, H.S., KARADENİZ, E. (2007): Helminth parasites of the common toad, *Bufo bufo* (Linnaeus, 1758) (Anura: Bufonidae) from northeast Turkey. *Comp. Parasitol.*, 74(1): 176 – 178. DOI: 10.1654/4246.1

YILDIRIMHAN, H.S., KARADENİZ, E., GÜRKAN, E., KOYUN, M. (2005): Türkiye'nin değişik bölgelerinden toplanan ova kurbağası (*Rana ridibunda* Pallas, 1771; Anura)'nın metazoon parazitleri [Metazo-

an parasites of marsh frog (*Rana ridibunda* Pallas, 1771; Anura) collected from different regions of Turkey]. *Turkiye Parazitol Derg*, 29(2): 135 – 139. (In Turkish)

YILDIRIMHAN, H.S., SÜMER, N., BURSEY, C.R. (2016): Helminth parasites of the agile frog, *Rana dalmatina* Fitzinger, 1839 (Anura: Ranidae), collected from two localities in Turkey. *Acta Zool Bulg*, 68(3): 425 – 432

YILDIRIMHAN, H.S., SÜMER, N., İNCEDOĞAN, S., BURSEY, C.R. (2012): Helminth parasites of the lemon-yellow tree frog, *Hyla savignyi* (Hylidae), from Turkey. *Turk. J. Zool.*, 36(2): 171 – 184. DOI:10.3906/zoo-1006-9

YILDIZ, K. (2003): Kapulukaya baraj gölü'ndeki kadife balıklarında (*Tinca tinca*) helmint enfeksiyonları [Helminth infections in tench fish (*Tinca tinca*) in Kapulukaya reservoir]. *Turk. J. Vet. Anim. Sci.*, 27: 671 – 675 (In Turkish)

YILDIZ, K., ÇAVUŞOĞLU, K. (2003): *Pomphorhynchus laevis*'in scanning elektron mikroskopik incelenmesi [SEM investigation of *Pomphorhynchus laevis*]. *Turk. J. Vet. Anim. Sci.*, 27: 1357 – 1360 (In Turkish)

ZANDER, C.D. (2004): Four-year monitoring of parasite communities in gobiid fishes of the south-western Balticii. Infracommunity. *Parasitol. Res.*, 93(1): 17 – 29. DOI: 10.1007/s00436-004-1087-7