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

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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 cygnoides*, *Gorgoderina vitelliloba* [Gorgoderidae]; *Haplometra cylindracea*, *Haematoloechus variegatus*, *Opisthioglyphis 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).

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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*

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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>Opisthoglypha 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

Cephalogoniimidae

Cephalogonimus retusus (Dujardin, 1845)

Synonym: *Cephalogonimus europaeus*

Host: *Pelophylax ridibundus*

Site of infection: intestine

Geographic range: Bulgaria, Czechoslovakia and Germany

Remarks: Cephalogoniimideans 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* (Kirin, 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

Gorgoderina 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 *Gorgoderina* 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).

Gorgoderina 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*, *Gorgoderina 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; Yildirimhan *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* (Mashai 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 Skrbabin (1958). *Haplometra cylindracea* is the first record for *Rana macrocnemis* from Erzurum.

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

Synonym: *Distoma variegatus*, *Distoma variegatum*, *Pneumonoecus 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; Rezvantsseva 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 & Arkan, 2006; Rezvantsseva, 2008; Rezvantsseva, 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 *Skrjabinoecus* and *Haematoloechus* genera are the number and location of the vitelline glands. The vitelline glands of genus *Skrjabinoecus* 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 Skrbabin (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.

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

Synonym: *Haematoloechus breviansa*

Host: *Pelophylax ridibundus*

Site of infection: Lungs

Geographic range: Iran, Russia, Turkey, Ukraine

Remarks: *Skrjabinoecus* 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 vitelline glands extend laterally between the ventral sucker and fore-testis (Fig. 2g).

Skrjabinoecus 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; Mashai et al., 2000; Romanova et al., 2010; Indiryakova et al., 2012; Kovalenko, 2007).

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

***Skrjabinoecus similis* (Loss, 1899)**

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

Host: *Pelophylax ridibundus*

Site of infection: Lungs

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

Remarks: *Skrjabinoecus 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).

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

Morphometric characteristics of *Skrjabinoecus similis* are the same as those given by Skrbabin (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 (Schränk, 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* (Karakaş, 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; Karakaş, 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 auropunctatus* (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. spindletuncatus* from some freshwater fish of Erzurum province and marsh frogs of Isparta province (Heckmann et al., 2010). The difference of *P. laevis* from *P. spindletuncatus* is mainly the number of the proboscis' hooks. The proboscis of *P. spindletuncatus* 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; Dezfali 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, *Skrjabinoeces similis* and *Cephalogonimus retusus* are the first records for parasite fauna of Turkey.

Conflict of Interest

The authors state no conflict of interest.

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