

Helminth Parasites of the Mediterranean Chameleon *Chamaeleo chamaeleon* (Linnaeus, 1758) (Reptilia: Chamaeleonidae) from Turkey

Sezen Birlik¹, Hikmet Sami Yıldırımhan¹, Can Yılmaz², Elif Yıldırım^{3,4}, Kamil Candan³,
Yusuf Kumluta^{3,4} & Çetin Ilgaz^{3,4*}

¹ Department of Biology, Faculty of Arts and Sciences, Uludağ University, Nilüfer, Bursa, Turkey

² Medical Laboratory Techniques, Vocational School of Health Services, Hakkari University, 30000 Hakkari, Turkey

³ Department of Biology, Faculty of Science, Dokuz Eylül University, Buca – İzmir, Turkey

⁴ Fauna and Flora Research Centre, Dokuz Eylül University, 35610 Buca – İzmir, Turkey

Corresponding author: cetinilgaz@gmail.com

Abstract: The helminth fauna of thirty nine Mediterranean Chameleon, *Chamaeleo chamaeleon* (Linnaeus, 1758) (22♂♂, 17♀♀) was examined. Specimens collected from Adana, Hatay, Antalya, Aydın, Gaziantep, Muğla and İzmir provinces in Turkey. The trematodes recovered included *Plagiorchis elegans* (Rudolphi, 1802) Braun, 1902, *P. molini* Lent & Freitas, 1940 and *Pseudosonsinotrema chamaeleonis* Dollfus, 1951. The nematode recovered was *Physaloptera* sp. Turkey is a new geographical record for *Pseudosonsinotrema chamaeleonis*. *C. chamaeleon* represents a new host record for *P. elegans*, *P. molini* and *Physaloptera* sp.

Key words: *Chamaeleo chamaeleon*, Helminth, Trematoda, Nematoda, Turkey

Introduction

Mediterranean Chameleon, *Chamaeleo chamaeleon* (Linnaeus, 1758) occurs in southern Europe – Malta, Crete, Samos and Chios (Greece), southern coastal Spain and Portugal, Sicily, Apulia (Italy) as well as in northern Africa (along the Atlantic coast of Western Sahara, Morocco, northern Algeria, northern and central Tunisia, northern Libya and northern Egypt) and southwestern Asia (Cyprus, Turkey, western Syria, Lebanon, Israel and western Jordan, western and southwestern Saudi Arabia and northern Yemen) (GLAW 2015). It is widespread in Turkey, from İzmir in the north and southwards to Aegean coastal region, the whole Mediterranean coastal region and as isolated populations in the Marmara region (BA-

RAN & ATATÜR 1998, SINDACO et al. 2000). It is associated with a wide range of shrublands, plantations, open pine woodlands, orchards (such as almonds and olive groves) and gardens where it is a diurnal generalist feeder, eating mainly invertebrates. It can be found from sea level up to 1,850 m a.s.l. (BARAN et al. 2012).

Although there are extensive published data on the presence of helminth parasites in chameleons in the world (e.g. GENDRE 1909, GEDOELST 1916, BAYLIS 1920, BAER 1933, MORGAN 1945, DOLLFUS 1951, SPASSKII 1951, CHABAUD & BRYGOO 1960, CAPRON et al. 1961, FITZIMMONS 1961, BRYGOO 1963, CABALLERO 1968, HERING-HAGENBECK & BOOMKER 2000, GOLDBERG & BURSEY 2004, 2008, BOUAMER & MORAND 2006, LHERMITTE-VALLARINO

et al. 2010, McALLISTER et al. 2011, MASOVA et al. 2012, MORSY et al. 2012), there apparently have been no detailed investigations of the prevalence or intensity of helminth infections in this species in Turkey.

Materials and Methods

All chameleons were sexually mature (22♂♂, 17♀♀). The specimens of chameleons were collected from Adana, Hatay, Antalya, Aydın, Gaziantep, Muğla and İzmir provinces in Turkey (Fig. 1). They were deposited in Flora Fauna Research and Application Centre, Dokuz Eylül University, Turkey. The hosts were dissected under a stereomicroscope and the body cavity, lung, stomach, small intestine and large intestine of each was searched for helminths. They were placed in separate petri dishes with 9% saline solution and carefully dissected further under a stereomicroscope. The body cavity was also inspected for parasites. Helminths were removed from the gastrointestinal tract, counted, rinsed in saline and fixed with different hot solutions: nematodes were fixed in 70% ethanol and digeneans were fixed in 70% ethanol or acetic acid. All fixed worms were stored in 70% ethanol until identified. For taxonomic identification, nematodes were cleared with glycerine : ethanol (2:1). Digeneans were stained with acetocarmine. Parasites were identified, when possible, at the species level. The number and the site of infection of parasite individuals of each species per host specimen were recorded. Diversity and infection parameters proposed in BUSH et al. (1997) were used to describe the parasite burden. Thus, prevalence is defined as the number of infected hosts divided by the total number of hosts sampled; mean intensity – as the total number of helminths divided by the number of infected hosts; mean abundance, as the total number of worms divided by the total number of hosts sampled. Helminths were examined with a light microscope and identification was based on the morphological and anatomical descriptions given by ANDERSON (2000), ANDERSON et al. (2009), SCHAD et al. (1960), YAMAGUTI (1961), SCHMIDT (1986), PETTER & QUENTIN (1976) and SKRYABIN (1991). Finally, representative helminth specimens were deposited in the helminth collection of Uludağ University Museum of Zoology, Bursa, Turkey. The research related to animals use has been complied with all the relevant national regulations and the institutional policy for the care and use of animals. The study protocol no. 2013-04/08 was approved by Republic of Turkey, Uludağ University Experimental Animals Local Ethics Committee.

Results

Mean snout-vent length of host specimens was 50.32 ± 6.14 mm, with a range from 40.70 to 61.50 mm. A total of four species of helminths were recovered comprising three species of digeneans and one species of nematode (Table 1). The trematodes recovered include: *Plagiorchis elegans* (Rudolphi, 1802) Braun, 1902, *P. molini* Lent & Freitas, 1940 and *Pseudosonsinotrema chamaeleonis* Dollfus, 1951. The nematode recovered was *Physaloptera* sp. All the helminths were found in the digestive tract (small intestine). Of the species found, *P. chamaeleonis* was the most common, with 5.12% of all hosts infected. Detailed infection parameters for individual species of parasite are given in Table 1. Overall, 12% of hosts were parasitized by at least one species of helminth. In a total, 19 individuals of four parasites species were collected from 5 of the 39 chameleons examined. Of all the chameleons analysed, 34 were not infected. Of the infected individuals, three harboured one helminth species and 2 harboured two helminth species. The helminth species, site of infection, prevalence, mean intensity, abundance, number of infected host, total helminth number and range are given in Table 1. Turkey is a new geographical record for *P. chamaeleonis*. *C. chamaeleon* represents a new host record for *P. elegans*, *P. molini* and *Physaloptera* sp.

Discussion

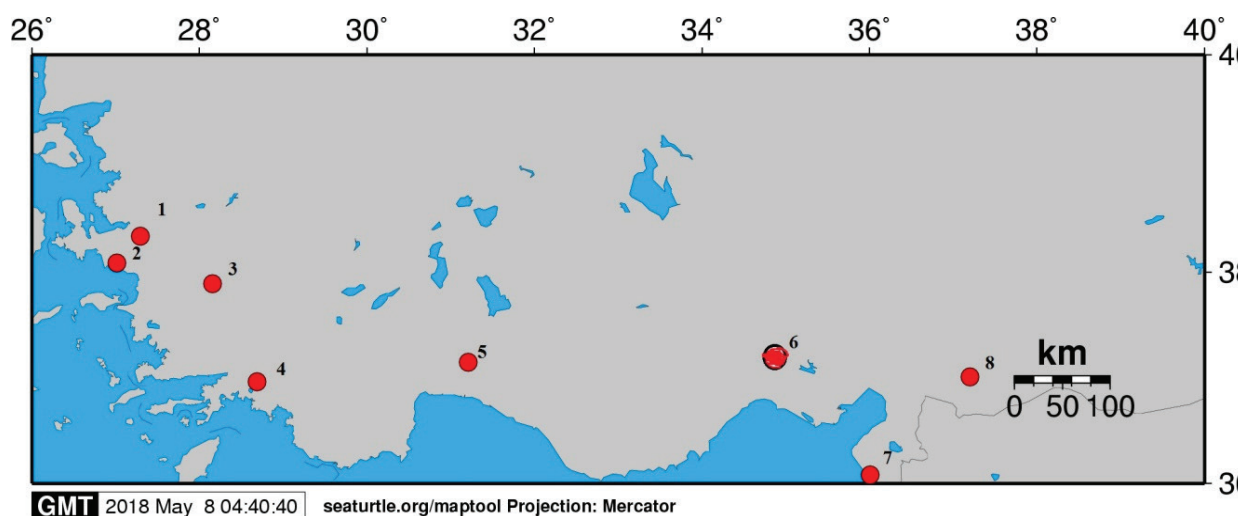
The species of the genus *Plagiorchis* are hosted by many different animal groups, including amphibians, reptiles, birds and mammals, since they have a wide distribution range in the world (BOYCE et al. 2014). *Plagiorchis elegans* was found in the samples of *Lacerta trilineata* Bedriaga, 1886 for the first time considering the herpetofaunistic diversity in Turkey (YILDIRIMHAN et al. 2001). The distribution range of this parasite covers northern hemisphere (YILDIRIMHAN et al. 2001). The other amphibian and reptile species infected by *P. elegans* are as follows: *Bombina variegata* (see PROKOPIC & KRIVANEC 1975), *Pelophylax lessonae* (see PROKOPIC & KRIVANEC 1975), *Rana temporaria* (see CAPUSE 1971), *Lacerta agilis* (see SHEVECHENKO & BARABASHOVA 1958, MORAVEC 1963, CAPUSE 1971, LEWIN 1992a, SHIMALOV et al. 2000, SHARPILO et al. 2001, BORKOVCOVA & KOPRIVA 2004), *L. viridis* (see CAPUSE 1971), *Zootoca vivipara* (see LEWIN 1992b, SHIMALOV et al. 2000), *Podarcis muralis* (see YILDIRIMHAN & SÜMER 2019) and *Natrix natrix* (see CAPUSE 1971). *C. chamaeleon* represents new

Table 1. Helminth species, site of infection, prevalence, mean intensity and mean abundance in studied specimens of *Chamaeleo chamaeleon*.

Helminth species	Site of infection	Prevalence (%)	Mean intensity	Mean abundance
Digenea				
<i>Pseudosonsinotrema chamaeleonis</i>	Small intestine	5.12	2	0.130
<i>Plagiorchis molini</i>	Small intestine	2.56	2	0.051
<i>Plagiorchis elegans</i>	Small intestine	2.56	2	0.051
Nematoda				
<i>Physaloptera</i> sp.	Small intestine	2.56	11	0.280

Table 2. Helminth fauna of *Chamaeleo chamaeleon*.

Group	Helminth species	Literature
Trematoda	<i>Pleurogenoides tacapensis</i>	CANARIS & GARDNER (2003)
	<i>Postorchigenes</i> sp.	MORSY et al. (2012)
	<i>Malagashitrema</i> sp.	MORSY et al. (2012)
	<i>Plagiorchis molini</i>	Present study
	<i>Plagiorchis elegans</i>	Present study
	<i>Pseudosonsinotrema chamaeleonis</i>	DOLLFUS (1951), Present study
Nematoda	<i>Physaloptera algeriensis</i>	CANARIS & GARDNER (2003)
	<i>Spinicauda sonsinoi</i>	CANARIS & GARDNER (2003)
	<i>Physaloptera</i> sp.	Present study

**Fig. 1.** Localities with populations of *Chamaeleo chamaeleon* in Turkey: 1. Buca, İzmir; 2. Gümüldür, İzmir; 3. Sultanhisar, Aydın; 4. Köyceğiz, Muğla; 5. Beşkonak, Manavgat, Antalya; 6. Akyatan, Adana; 7. Sutaşı, Samandağ, Hatay; 8. Burç Village, Gaziantep.

host record of *P. elegans*. In addition, Mediterranean chameleon is the third host for this parasite in the Turkey.

The occurrence of *P. molini* was previously reported in the different lizard species: *Podarcis muralis* (see CAPUSE 1971, ROCA & NAVARRO 1983, SHARPILO et al. 2001), *Lacerta schreiberi* (see ROCA & FERRAGUT 1989), *Zootoca vivipara* (see LEWIN 1992b, SANCHIS et al. 2000), *Algyroides marchi* (see LAFUENTE & ROCA 1994) and *Asaccus barani* (men-

tioned as *Asaccus elisae*) (see YILDIRIMHAN et al. 2018) in the Romania, Spain, Poland and Turkey. *C. chamaeleon* represents new host record of *P. molini*. ROCA (2017) stated that high mountains and linked to humid environment habitat are suitable for the life cycle of this parasite.

DOLLFUS (1951) erected the genus *Pseudosonsinotrema*, with *P. chamaeleonis* as the type species, for intestinal trematodes of chameleons in Tunisia. Subsequently, new species of the genus *Pseudosonsinotrema*

were identified in different hosts (*Pseudosonsinotrema megametrum* – *Bufo regularis*; *P. japonicus* – *Rana nigromaculata*; *P. echinophallus* – *Rana pipiens*; *P. megalorchis* – *Gastrotheca pseustes*) (YAMAGUTI 1936, MANTER & PRITCHARD 1964, CHRISTIAN 1971, SULLIVAN 1971, FLOWERS ET AL. 2011). The present finding is the first record of *P. chamaeleonis* in Turkey and extends its geographical range.

Some reptiles, birds, mammals and occasionally amphibians are infected by the parasitic nematodes of the genus *Physaloptera* (IRWIN-SMITH 1921, ORTLEPP 1922, YAMAGUTI 1961, CHABAUD 1975). Members of the genus *Physaloptera* use insects such as coleopterans, dermapterans, dictyopterans and orthopterans as intermediate hosts (ANDERSON 2000, TEZEL et al. 2015). *Physaloptera* shares some generic characters with the genus *Turgida*, characterised by having two to four uteri (ANDERSON et al. 2009, PEREIRA et al. 2012). In our study, *Physaloptera* sp. is detected in one chameleon, represented by eleven individuals; all parasite specimens were females and the identification was possible at the generic level. *Physaloptera* spp. were earlier reported in some lizard species from Turkey: *Lacerta viridis* (see SCHAD et al. 1960), *L. trilineata* (see YILDIRIMHAN et al. 2011) and *Eremias suphani* (DÜŞEN et al. 2013). In addition, this parasitic nematode was reported from *Buteo buteo* in Bursa Province (TEZEL et al. 2015). Mediterranean chameleon is the fifth host for this parasite in Turkey. At present, 100 species of *Physaloptera* are known (PEREIRA et al. 2012). Among these, three have been described infecting chameleons (*Physaloptera chamaeleontis*, *P. ortleppi* and *P. algeriensis*), hosted by five species (*Chamaeleo gracilis*, *C. dilepis*, *C. chamaeleon*, *Trioceros deremensis* and *Bradypodion fischeri*) worldwide (CANARIS & GARDNER 2003, PEREIRA et al. 2012). A summary of the helminth fauna of *C. chamaeleon* is given in Table 2.

Studies on helminth parasites associated with animals from different groups are important because they generate relevant information on the diversity of parasites, aiming to understanding the biology and ecology of their hosts. The present study contributes to the knowledge of gastrointestinal helminth species of chameleons in Turkey.

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