DOI: 10.2478/s11686-009-0003-9

Acta Parasitologica, 2009, 54(1), 53–56; ISSN 1230-2821

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Occurrence of cystacanths of *Plagiorhynchus cylindraceus* (Acanthocephala) in the terrestrial isopods *Trachelipus squamuliger* and *Armadillidium vulgare* (Oniscidea) in Bulgaria

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Abstract

In total, 2097 individuals of *Trachelipus squamuliger* and 20 individuals of *Armadillidium vulgare* from four habitats (three woodland sites and one pasture) in the region of Stara Zagora, Bulgaria, were examined for the presence of cystacanths of *Plagiorhynchus cylindraceus*, a common acanthocephalan parasite of passerine birds. In *T. squamuliger* from woodland habitats, cystacanths were found with prevalence 4.0–9.3%, intensity 1–5 (mean 1.22–1.57) and mean abundance 0.057–0.113. No significant differences were observed between infections in males and females of *T. squamuliger*. None of the *T. squamuliger* individuals from the pasture examined was infected. Out of 48 infected females of *T. squamuliger*, only one had developed eggs (in agreement with previous studies revealing the negative effect of the cystacanths on the development of female gonads of woodlice). One individual of *A. vulgare* was infected with a single cystacanth. The occurrence of *P. cylindraceus* in *T. squamuliger* is a new host record.

Keywords

Plagiorhynchus cylindraceus, cystacanths, terrestrial isopods, prevalence, Bulgaria

Introduction

Adults of *Plagiorhynchus* (*Prosthorhynchus*) *cylindraceus* (Goeze, 1782) Schmidt et Kuntz, 1966 are cosmopolitan intestinal parasites of various hosts, mostly birds of the order Passeriformes (Khokhlova 1986, Amin *et al*. 1999, Dimitrova *et al*. 2000, Smales 2003). In Bulgaria, this species has been reported from various birds, most frequently from the Eurasian blackbird (*Turdus merula* L.) and the common starling (*Sturnus vulgaris* L.) (Dimitrova *et al*. 2000). Its cystacanths develop in terrestrial isopods; as demonstrated by previous studies (Schmidt and Olsen 1964, Moore 1983, Lisitsina 1993, Lisitsina and Tkach 1994, Lisitsina and Sharpilo 1996, Levri and Coppola 2004), the species range of intermediate hosts exhibits substantial geographical variation. Since no studies on the life cycle of *P. cylindraceus* have been carried out in South-East Europe, the aim of the present study is to reveal the range of intermediate hosts of this parasite species in this region.

Materials and methods

In total, 2117 woodlouse individuals were collected during the period April 2006-April 2007 from four sites in the region of the city of Stara Zagora, Bulgaria. The sites were: (A) woodland in the vicinity of the Thracian University, Stara Zagora (42°24´N, 25°33´E, altitude 235 m); (B) woodland near to the village of Starozagorski Mineralni Bani (42°27´N, 25°30´E, altitude 450 m); (C) woodland near the village of Dabovo (42°36´N, 25°39´E, altitude 300 m); (D) pasture near the village of Dabovo (42°36´N, 25°39´E, altitude 300 m). Terrestrial isopods were identified using the keys of Vandel (http://pagesperso-orange.fr/zenza/cloportes/cleVandel.html) and Schmidt (1997). The crustaceans were individually examined, each being placed in saline under stereoscope and dissected from its ventral side (Siddikov 1987). Cystacanths were held in water in order to evaginate their proboscides (for identification purposes) and then fixed and preserved in 70% ethanol.

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Table I. Infection of *Trachelipus squamuliger* (Isopoda) with cystacanths of *Plagiorhynchus* (*Prosthorhynchus*) *cylindraceus* in the region of the city of Stara Zagora

Site	Sample size	Sex ratio (males:females)	Prevalence (%)	Intensity		Mean abundance
				range	mean	
A	786	397:389	4.1	1–4	1.32 ± 0.77	0.057 ± 0.31
B	524	158:366	4.0	1–5	1.57 ± 1.08	0.063 ± 0.37
C	345	136:209	9.3	1–3	1.22 ± 0.56	0.113 ± 0.39
D	442	217:225	0.0	–	–	–

Voucher specimens are deposited in the Parasitic Worms Collection, The Natural History Museum, London, accession no. 2008.10.22.1-2.

Results

Woodlice were found at all the sites studied. Two woodlouse species, *Trachelipus squamuliger* (Verhoeff, 1907) (Trachelipodidae) and *Armadillidium vulgare* (Latreille, 1804) (Armadillidiidae) were identified. The former was represented by abundant populations in all the habitats examined while a few individuals of the latter were recorded at two sites only.

In total, 2097 individuals of *T. squamuliger* were examined (Table I). Cystacanths of *Plagiorhynchus cylindraceus* (Fig. 1) were found in the body cavity of individuals of this species from the three examined woodland habitats. The prevalence of infection at these sites ranged between 4.0% and 9.3%. The mean abundance did not exceed 0.113. The intensity of infection varied between 1 and 5 parasites, with mean intensity 1.22–1.57. None of the *T. squamuliger* individuals from the pasture habitat was infected.

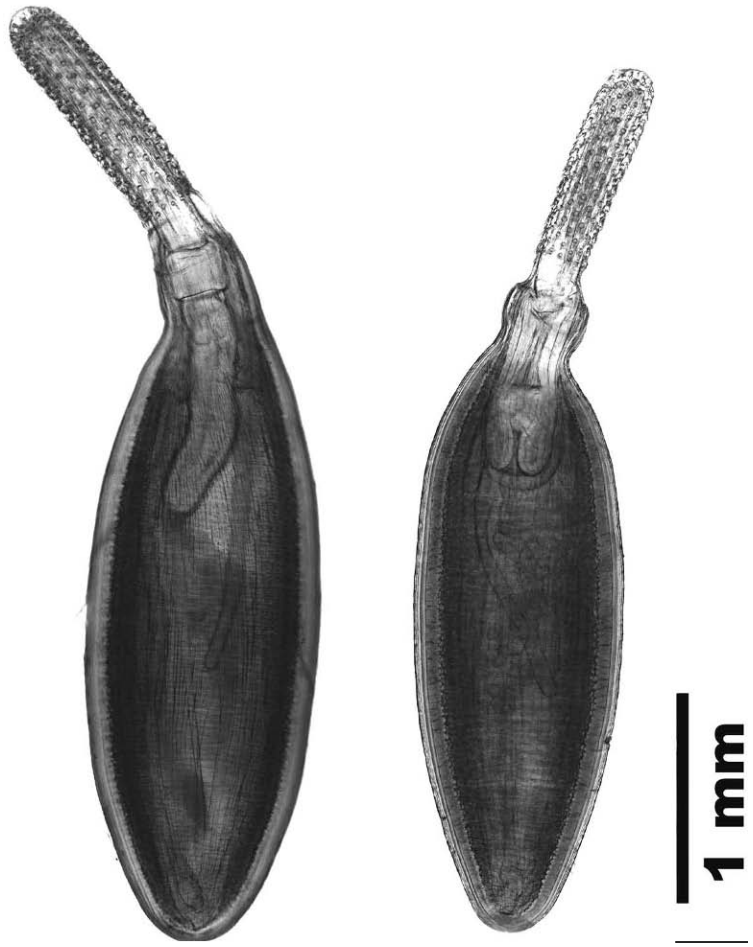

Fig. 1. Cystacanths of *Plagiorhynchus cylindraceus* with everted proboscis (after being held in water) from the body cavity of *Trachelipus squamuliger* from Bulgaria

Out of the infected 85 individuals of *T. squamuliger*, 37 were males and 48 were females. The total prevalence of infection in woodland habitats was 5.4% in males and 5.0% in females. There were no significant differences in the mean intensity in males and females (1.27 ± 0.75 and 1.42 ± 0.92, respectively).

Among the infected females of *T. squamuliger*, only one (infected with two cystacanths) from site A had numerous ripe eggs. No developed eggs were observed in the remaining 47 infected females.

Armadillidium vulgare was represented in samples by 13 individuals (7 males and 6 females) from site A and 7 individuals (6 males and 1 female) from site B. A single cystacanth of *P. cylindraceus* was found in one male individual from site B.

Discussion

Six woodlouse species have been reported as hosts of cystacanths of *P. cylindraceus*, five of them recorded from natural infections (Table II). Experimental studies using *Armadillidium vulgare*, *Porcellio scaber* Latreille, 1804 and *P. laevis* Latreille, 1804 as intermediate hosts were carried out by Schmidt (1964, cited after Schmidt 1985), Schmidt and Olsen (1964), Wanson and Nickol (1975) and Nickol and Dappen (1982) in North America and by Lisitsina (1993) in the Ukraine. The present results demonstrate for the first time the role of *Trachelipus squamuliger* as intermediate host of *P. cylindraceus* and constitute a new host record. In view of the abundance of *T. squamuliger* in the habitats examined, it can be assumed that it has much more significant role for the circulation of *P. cylindraceus* than *Armadillidium vulgare*. Though reported many times as intermediate host of *P. cylindraceus* (Sinitsin 1929; Dollfus and Dalens 1960; Schmidt and Olsen 1964; Dappen and Nickol 1981, cited after Schmidt 1985; Moore 1983; Lisitsina 1993; Lisitsina and Tkach 1994; Lisitsina and Sharpilo 1996; Coady and Nickol 2000), the latter species has been represented with very low numbers in the examined habitats and, therefore, its role is probably of secondary importance.

The low prevalence of *P. cylindraceus* in the studied populations is not surprising. Previous studies on woodlice as intermediate hosts of this species also recorded low values of the prevalence. Thus, Lisitsina (1993), Lisitsina and Tkach (1994) and Lisitsina and Sharpilo (1996) reported prevalence of 0.87–17.8% in *Armadillidium vulgare* in various habitats in the Ukraine. In *A. versicolor* in the Ukraine, the prevalence was 0.19% (Lisitsina and Tkach 1994). Low prevalence were described by Siddikov (1983, 1987) for the intermediate hosts in Uzbekistan, *Hemilepistus fedtschenkoi* (0.98–2.17%) and *H. reductus* (0.20%), as well as by Levri and Copolla (2004) for *Porcellio scaber* (2.3%) in Pennsylvania, USA.

Cystacanths of *P. cylindraceus* have been demonstrated to cause behavioural modifications in infected individuals of *Armadillidium vulgare* thus making them easy prey for avian predators; this parasite also affects the reproductive potential of the infected female woodlice by suppressing the development of their ovaries (Moore 1983). Our observations have revealed developed eggs in only one of 48 infected females of *Trachelipus squamuliger*. Therefore, the present results corroborate with the previous studies about the effect of *P. cylindraceus* on the reproduction of infected woodlice.

Table II. Terrestrial isopods recorded as natural intermediate hosts of *Plagiorhynchus* (*Prosthorhynchus*) *cylindraceus* (Goeze, 1782)

Terrestrial isopods	Locality	References
Family Armadillidiidae		
Armadillidium vulgare (Latreille, 1804)	USA	Sinitsin (1929), Schmidt and Olsen (1964), Dappen and Nickol (1981, cited after Schmidt 1985), Moore (1983), Coady and Nickol (2000)
	France	Dollfus and Dalens (1960)
	Ukraine	Lisitsina (1993), Lisitsina and Tkach (1994), Lisitsina and Sharpilo (1996)
	Bulgaria	present study
Armadillidium versicolor Stein, 1859	Ukraine	Lisitsina and Tkach (1994)
Family Porcellionidae		
Porcellio scaber Latreille, 1804	USA	Levri and Coppola (2004)
Family Trachelipodidae		
Hemilepistus fedtschenkoi (Uljanin, 1875) (= *Porcellio fedtschenkoi*)	Uzbekistan	Siddikov (1983, 1987), Ikramov and Kabilov (1991)
Hemilepistus reductus Borutzkii, 1945	Uzbekistan	Siddikov (1987)
Trachelipus squamuliger (Verhoeff, 1907)	Bulgaria	present study

Acknowledgements. Dr B.B. Georgiev (Central Laboratory of General Ecology, Bulgarian Academy of Sciences, Sofia) provided critical comments on an early version of the manuscript. This study was supported by the Faculty of Agriculture, Thracian University, Stara Zagora, Grant E3/06/2006.

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(Accepted October 24, 2008)