First record of *Ixodes ricinus* (*Acari*; *Ixodidae*) in European glass lizard (*Pseudopus apodus*; *Anguidae*) and a review of ectoparasite studies in reptiles in Turkey

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Abstract

Three adult European glass lizards (*Pseudopus apodus* Klembara) were caught in the garden of Faculty of Veterinary Medicine, Ondokuz Mayis University (Samsun, Turkey) and were observed to have a tick infestation. During macroscopic examination, tick samples were collected from the lateral groove on both sides of the lizard by using blunt-tip tweezers. All the samples were examined under the microscope and belonged to *Ixodes ricinus* (Linnaeus) larvae and nymphs. This is the first report of a tick species or infestation in European glass lizard. In addition, we provide a detailed review of all studies conducted to date on reptile ectoparasites in Turkey.

Key words: *ectoparasite; reptile; veterinary herpetoparasitology*

Introduction

European glass lizard (*Pseudopus apodus*) is one of the two members of the Anguidae family present in Turkey. The body is cylindrical, about 1–1.5 metres in length, and is legless and snake-like (Budak and Gocmen, 2008). It has a lateral groove on both sides of its body. Shrubbery, stony and bushy areas make up its habitat. It is distributed through much of Europe and western Asia (Vitt and Caldwell, 2013).

Although Turkey can boast of a high diversity of reptiles (Baran and Atatur, 1998), most studies on reptile ectoparasites have been focused on turtles (Hoogstraal and Kaiser, 1960; Aysul et al., 2010; Kirecci et al., 2013; Yilmaz et al., 2013; Bakirci, 2016; Yilmaz et al.,

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2018; Uslu et al., 2019), while ectoparasite studies on lizards, chameleons and snakes are limited (Hoogstraal, 1959; Aydin et al, 2002; Keskin et al., 2012; Keskin et al., 2013; Jabbarpour, 2016; Yaman and Zerek, 2016). Reptiles are reservoir hosts of parasitic diseases caused by many protozoal, helminthic, and pentastomid agents that pose a public health concern. Increasing human-reptile interactions due to increased urbanisation, feeding exotic reptiles at home, consuming reptiles as a source of food or using them in medical treatments traditionally pose a great risk for human health (da Nóbrega Alves et al., 2008). Recognition of reptile-borne zoonotic parasitoses is very important in the control and prevention of disease (Mendoza-Roldan et al., 2020).

Ixodes ricinus is one of the most important tick species which is well-known and widely studied in Europe, since it also responsible for many tick-borne diseases (Tick-borne encephalitis, Anaplasmosis, Babesiosis, Lyme borreliosis, Louping-ill virus) as a vector in Europe (Piesman and Eisen 2008; Dantas-Torres et al., 2012). *Ixodes* ticks, which are vectors especially for Lyme disease, have increased the spread of the disease in geographies where there is a dense population of reptiles and rodents (Silverstein et al., 1990). While larvae and nymphs feed on small mammals, birds and reptiles, adults prefer large mammals (Nicholson et al., 2009; Medlock et al., 2013). *Ixodes ricinus* is distributed in the western Palearctic, usually in damp areas with deciduous, coniferous or mixed forests (Estrada-Peña et al., 2018). Recent studies have shown that the species has expanded to northern regions and high-altitude mountainous areas due to global climate change (Lindgren et al., 2000; Materna et al., 2008). In addition to suitable habitat, the presence and density of *Ixodes* species are closely related to the density of small mammals for larvae and nymphs and large mammals for adults (Beugnet and Chalvet-Monfray, 2013).

The present study is a review of tick infestation in *Pseudopus apodus* and ectoparasite studies conducted on reptiles in Turkey.

Material and Methods

Three adult European glass lizards were caught in the garden of Faculty of Veterinary Medicine, Ondokuz Mayis University, Samsun, Turkey in May 2020 and the presence of tick infestation was detected. Tick attachment site on the body was photographed with a Nikon Coolpix P610 Compact camera (Figure 1). The ticks were collected from the lateral groove on both sides of the lizard by using blunt tip tweezers (Figure 1A). Subsequently, all three hosts were released unharmed to a safe area. Tick samples were preserved in 70% ethyl

Figure 1. European glass lizard (*Pseudopus apodus*; Anguidae) **A.** Nymph of *Ixodes ricinus*; **B.** Arrow- Outline of lateral groove that was the tick attachment site

Figure 2. Ventral views of *Ixodes ricinus*: (A) larva, (B) nymph, (Scale bar: 100 µm)

Table 1. List of tick species detected from reptiles in Turkey

Ticks (Genus-Species)		Hosts (Species- Family)		Study
Haemaphysalis	*H. concinna*	*Apathya cappadocica*	*Lacertidae*	Jabbarpour, 2016
		Darevskia bendimahiensis		
		Darevskia rudis		
		Eremias suphani		
		Lacerta media		
		Ablepharus bivittatus	*Scincidae*	
		Eumeces schneiderii		
	H. parva	*Stellagama stellio*	*Agamidae*	Aydın et al, 2002
	H. sulcata	*Apathya cappadocica*	*Lacertidae*	Hoogstraal, 1959; Keskin et al., 2013
		Lacerta media		
		Ophisops elegans		
		Myriopholis macrorhyncha	*Leptotyphlopidae*	
		Eumeces schneideri		
		Timon princeps	*Scincidae*	
		Trachylepis aurata		
		Varanus griseus	*Varanidae*	
	Haemaphysalis spp.	*Lacerta trilineata*	*Lacertidae*	Aydın et al., 2002
		Stellagama stellio	*Agamidae*	
Hyalomma	*H. aegyptium*	*Stellagama stellio*	*Agamidae*	Hoogstraal and Kaiser, 1960; Nemenz, 1962; Aydın et al, 2002; Aysul et al., 2010; Yılmaz et al., 2013; Bakirci, 2016; Kireçci et al., 2013; Uslu et al., 2019; Yilmaz et al., 2018; Jabbarpour, 2016
		Acanthodactylus schreiberi	*Lacertidae*	
		Apathya cappadocica		
		Darevskia valentini		
		Trachylepis vittata	*Scincidae*	
		Testudo graeca	*Testudinidae*	
		Testudo hermanni		
	Hyalomma spp.	*Stellagama stellio*	*Agamidae*	Aydın et al., 2002
Ixodes	*Ixodes ricinus*	*Apathya cappadocica*	*Lacertidae*	Keskin et al., 2012; Jabbarpour, 2016
		Darevskia rudis		
		Lacerta media		
	Ixodes spp.	*Lacerta trilineata*	*Lacertidae*	Aydın et al., 2002
		Lacerta viridis		
		Stellagama stellio	*Agamidae*	
Rhipicephalus	*R. kohlsi* *R. calcaratus*	*Chamaeleo chamaeleon*	*Chamaeleonidae*	Yaman ve Zerek, 2016
		Apathya cappadocica	*Lacertidae*	Jabbarpour, 2016
		Eumeces schneiderii	*Scincidae*	
		Ophisops elegans		

alcohol and identified under Nikon SMZ1500 model stereo-microscope according to their morphological characteristics using determination keys of Estrada-Peña et al. (2014, 2018).

Results

A total of 14 larvae and 8 nymphs of the ticks from European glass lizards (*n*=3) were morphologically identified as *Ixodes ricinus* (Figure 2).

Discussion

Studies of tick infestations and host diversities have mostly been conducted on humans, pets, birds and small mammals in Turkey and elsewhere (Hoogstraal et al., 1961; Merdivenci, 1969; Levine et al., 1997; Bursali et al., 2012; Guglielmone et al., 2014; Inci et al., 2016). However, there are limited ectoparasite studies conducted on reptile species. Due to the protozoal, helminthic, viral, bacterial and ricketsial agents carried by ticks, revealing host variety is extremely important in terms of human health, animal health and consequently the one health concept. Therefore, it is very important to also conduct ectoparasite studies in reptilians. There are several studies on ticks infesting 18 different reptiles in Turkey: with *Hyalomma aegyptium, Hyalomma spp., Heamaphysalis (H) concinna, H. sulcata, H. parva, Haemaphysalis spp., Ixodes ricinus, Ixodes spp., Rhipicephalus (R) calcaratus* and *R. kohlsi* species have been reported from reptile hosts (Table 1).

Reports of tick infestation of European glass lizard (*Pseudopus apodus*) or other legless species are very rare in the world. To the best of our knowledge, *Ixodes scapularis* larvae and nymphs have been reported only in *Ophisaurus* (*O*) *attenuates*, *O. compressus*, *O. mimicus* and *O. ventralis* in America (Oliver et al., 1993; Levine et al., 1997). In another ectoparasite study, there was no tick infestation in *Anguis (A) fragilis* and *A. colchica* species in Poland (Bury et al., 2020).

The reason for rare to no tick infestation in legless lizards is believed to be due to the lack of suitable skin points such as armpits or groin where ticks can attach, since the lizard is legless or because moulting takes place in one piece in a short time like snakes, unlike in lizards (Vitt and Caldwell, 2013; Dudek et al., 2016**).**

Since the European glass lizard does not have bone plates in the lateral groove on both sides of the body (Budak and Göçmen, 2008), unlike the other parts of the body, this area may be susceptible for tick and mite attachment. The present report is similar to other study results and supports those conclusions.

Conclusion

In this study, the larvae and nymphs of *Ixodes ricinus* were found for the first time in the lateral groove of three European glass lizards (*Pseudopus apodus*) in Samsun, Turkey. This result is extremely important in terms of revealing the host diversity in *I. ricinus*. This report is the first detailed ectoparasite study in the European glass lizard.

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Prvi zabilježeni slučaj *Ixodes ricinus* (*Acari*; *Ixodidae*) u blavora (*Pseudopus apodus*; *Anguidae*) i studije ektoparazita u reptila od prošlosti do danas u Turskoj

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Tri odrasla blavora (*Pseudopus apodus* Klembara) uhvaćena su u vrtu Veterinarskog fakulteta, Sveučilišta Ondokuz Mayis (Samsun, Turska) te je otkrivena infestacija krpeljima. Tijekom makroskopskog pregleda, uzorci su prikupljeni iz bočnog utora s obje strane guštera uporabom pincete s tupim vrhom. Tijekom stereo-mikroskopske analize otkriveno je da svi uzorci pripadaju ličinkama i nimfama *Ixodes ricinus* (Linnaeus). Ova studija prvi je zapis o vrsti krpelja ili infestaciji blavora. Uz to, ova studija provela je detaljnu analizu do sada provedenih studija na ektoparazitima reptila u Turskoj.

Ključne riječi: *ektoparazit, reptil, veterinarska herpetoparazitologija*