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New reports of Acari ectoparasites on lizards of the genus *Plica* (Squamata: Tropiduridae) and a list of parasites known from this genus

SAMUEL CAMPOS GOMIDES¹, RALPH MATURANO², ERIK DAEMON³,
PAULO CHRISTIANO DE ANCHIETTA GARCIA¹ & MIGUEL TREFAUT RODRIGUES⁴

¹) Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, Av. Antônio Carlos, 6627, CEP: 31270-901, Belo Horizonte, Minas Gerais, Brazil

²) Departamento de Parasitologia Animal, Instituto de Veterinária, Universidade Federal Rural do Rio de Janeiro, CEP: 23850-000, Seropédica, Rio de Janeiro, Brazil

³) Departamento de Zoologia, Instituto de Ciências Biológicas, Universidade Federal de Juiz de Fora, CEP: 36036-900, Juiz de Fora, Minas Gerais, Brazil

⁴) Departamento de Zoologia, Instituto de Biociências, Universidade de São Paulo, Caixa Postal 11.461. CEP 05508-090. São Paulo, São Paulo, Brazil

Corresponding author: SAMUEL CAMPOS GOMIDES, e-mail: samuelbio@hotmail.com

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Tropidurid lizards of the genus *Plica* GRAY, 1831 comprise four recognized species, restricted in their distribution to forest areas in the Amazonian basin and the sandstone table mountains (tepui) of Venezuela, South America (ETHERIDGE 1970, DONNELLY & MYERS 1991, ÁVILA-PIRES 1995, MYERS & DONNELLY 2001). They are diurnal and insectivorous sit-and-wait predators (ETHERIDGE 1970, DONNELLY & MYERS 1991, VITT 1991, ÁVILA-PIRES 1995). *Plica plica* (LINNAEUS, 1758) and *P. umbra* (LINNAEUS, 1758) are exclusive to the Amazon rainforest and live usually on tree trunks, although they are occasionally spotted on shrubs, fallen logs, or sleeping on leaves or on the ground (ÁVILA-PIRES 1995). Like in other tropidurid lizards, gular and antegular neck folds harbouring Acari are present in both (RODRIGUES 1987), with the former being continuous with an antehumeral fold, and the latter with a short oblique neck fold (ETHERIDGE 1970, ÁVILA-PIRES 1995).

Symbiotic relationships, such as commensalism and parasitism, are common amongst Acari chelicerates (KRANTZ & WALTER 2009). However, host–parasite relationships between Acari and reptiles or amphibians have received limited attention. Nevertheless, records of more than 400 species of parasitic Acari have been reported from reptile hosts (FAJFER 2012). In this short note we report, for the first time, the genus *Plica* as a host

for the American reptile tick, *Amblyomma rotundatum* KOCH, 1844 (Acari, Ixodidae), and the trombiculid chigger, *Eutrombicula alfreddugesi* (OUDEMANS, 1910) (Acari, Trombiculidae).

During a taxonomic study on this lizard genus, we found specimens that were parasitised by some ectoparasites. The specimens examined (8 *P. umbra* and 12 *P. plica*) are housed in Museu de Zoologia da Universidade Federal de Viçosa (MZUFV). One specimen of *P. plica* from Aripuanã, Mato Grosso state, Brazil (10°09'43" S, 59°27'36" W; 105 m above sea level; MZUFV 0514; snout–vent length (SVL): 116.1 mm, male), had a tick attached to the gular region and additional mites inside its gular and antegular folds. The tick and mites were removed and examined with a stereo-microscope and light microscope, respectively. The tick was identified as a female *A. rotundatum* (IBSP 12.012) according to ONOFRIO et al. (2006) and mites as *E. alfreddugesi* according to BRENNAN & REED (1974) and BRENNAN & GOFF (1977). Two males of *P. umbra* (MZUFV 1034, SVL: 93.8 mm; MZUFV 1023, SVL: 80.8 mm) from Oriximiná, Pará state, Brazil (1°40'08" S, 56°23'53" W; 45 m a.s.l.) examined had *E. alfreddugesi* in their gular and antegular folds. To review published studies reporting the subject of this report we made a series of comprehensive searches using

Table 1. List of all literature records of parasites found in the genus *Plica* Gray, 1831.

Parasite	Host	References
Acari		
Ixodidae		
<i>Amblyomma rotundatum</i> KOCH, 1844	<i>P. plica</i>	This study
<i>Amblyomma humerale</i> KOCH, 1844	<i>P. plica</i> , <i>P. umbra</i>	LABRUNA et al. 2002
Pterygosomatidae		
<i>Geckobiella harrisi</i> DAVIDSON, 1958	<i>P. plica</i>	FAJFER 2012
Trombiculidae		
<i>Eutrombicula alfreddugesi</i> (OUDEMANS, 1910)	<i>P. plica</i> , <i>P. umbra</i>	This study
Trematoda		
Mesocoeliidae		
<i>Mesocoelium monas</i> (RUDOLPHI, 1819)	<i>P. plica</i>	GOLDBERG et al. 2009, ÁVILA & SILVA 2011b
Dicrocoeliidae		
<i>Paradistomum parvissimum</i> (TRAVASSOS, 1918)	<i>P. plica</i>	ÁVILA & SILVA 2011b
Nematoda		
Diplostriaenidae		
<i>Hastospiculum</i> sp. (larvae)	<i>P. umbra</i>	BURSEY et al. 2005, GOLDBERG et al. 2009
Heterakidae		
<i>Strongyluris oscar</i> TRAVASSOS, 1923	<i>P. plica</i> , <i>P. umbra</i>	BURSEY et al. 2005, GOLDBERG et al. 2009, ÁVILA & SILVA 2011b
Molineidae		
<i>Oswaldocruzia vitti</i> BURSEY & GOLDBERG, 2004	<i>P. plica</i> , <i>P. umbra</i>	GOLDBERG et al. 2009
<i>Oswaldocruzia bainae</i> SLIMANE & DURETTE-DESSET, 1996	<i>P. umbra</i>	GOLDBERG et al. 2009
Onchocercidae		
<i>Microfilariae</i> sp.	<i>P. umbra</i>	LAISON et al. 1975
Oswaldofiliariidae		
<i>Oswaldofilaria</i> sp.	<i>P. umbra</i>	ÁVILA & SILVA 2011a
<i>Piratuba</i> sp.	<i>P. plica</i>	ÁVILA & SILVA 2011b
<i>Piratuba digiticauda</i> LENT & FREITAS, 1941	<i>P. plica</i> , <i>P. umbra</i>	BURSEY et al. 2005, GOLDBERG et al. 2009
Pharyngodonidae		
<i>Parapharyngodon sceleratus</i> (TRAVASSOS, 1923)	<i>P. plica</i>	ÁVILA & SILVA 2011b
Physalopteridae		
<i>Physaloptera lutzi</i> CRISTÓFARO, GUIMARÃES & RODRIGUES, 1976	<i>P. plica</i>	ÁVILA & SILVA 2011b
<i>Physaloptera retusa</i> RUDOLPHI, 1819	<i>P. plica</i> , <i>P. umbra</i>	BURSEY et al. 2005, GOLDBERG et al. 2009, ÁVILA & SILVA 2011a, b, ALBUQUERQUE et al. 2012
<i>Physalopteroides venancioi</i> (LENT, FREITAS & PROENÇA, 1946)	<i>P. plica</i>	GOLDBERG et al. 2009
Rhabdiasidae		
<i>Rhabdias</i> sp.	<i>P. umbra</i>	GOLDBERG et al. 2009, ÁVILA & SILVA 2011a
Kinetoplastida		
Trypanosomatidae		
<i>Trypanosoma plicaplicae</i> TELFORD, 1996	<i>P. plica</i>	TELFORD 1996
<i>Trypanosoma plicae</i> LAINSON, SHAW & LANDAU, 1974	<i>P. umbra</i>	LAISON et al. 1975, TELFORD 1996
Sporozoa		
Plasmodidae		
<i>Plasmodium vacuolatum</i> LAINSON, SHAW & LANDAU, 1975	<i>P. umbra</i>	LAISON 2012
Garniidae		
<i>Fallisia audaciosa</i> LAINSON, SHAW & LANDAU 1975	<i>P. umbra</i>	SILVA et al. 2006, LAISON et al. 1975, LAISON 2012
<i>Fallisia simplex</i> LAINSON, SHAW & LANDAU, 1975	<i>P. umbra</i>	LAISON et al. 1975, LAISON 2012
<i>Garnia multiformis</i> LAINSON, SHAW & LANDAU, 1975	<i>P. umbra</i>	LAISON et al. 1975, LAISON 2012
Monera		
<i>Eperythrozoon</i> sp.	<i>P. umbra</i>	LAISON et al. 1975

Google Scholar and Thompson ISI Web of Science (without restrictions to range of years). All studies returned by the database in response to key terms were checked for relevance, namely: “*Plica plica*”, “*Plica umbra*”, “*Plica lumaria*”, “*Plica pansticta*”, “*Tropidurus plica*”, “*Tropidurus umbra*”, “*Tropidurus lumarius*”, “*Tropidurus panstictus*”, alone or together with one of the key words, “parasite”, “ectoparasite”, “hemoparasite”, “tick”, and “trombiculid”. References cited within these papers were also checked. All parasites recorded in the literature for the genus *Plica* are listed in Table 1.

Ticks of the genus *Amblyomma* are represented by about 32 species in Brazil (DANTAS-TORRES et al., 2009, NAVA et al. 2014). The distribution of *A. rotundatum* is vast, and it occurs from northern Argentina to southern U.S.A. (GUGLIELMONE & NAVA 2010). According to GUGLIELMONE & NAVA (2010, and references therein), *A. rotundatum* is a partenogenetic tick recorded on anurans, crocodilians, mammals, snakes, lizards, and turtles. Our new record for *P. plica* plus those previously recorded in the literature (GUGLIELMONE & NAVA 2010) total 75 host species. However, natural free-ranging hosts for *A. rotundatum* encompass 58 species (nine Anura, eight Mammalia, seven Testudines, and 34 Squamata plus *P. plica*) (GUGLIELMONE & NAVA 2010). There are comparatively few records from Mammalia compared to Anura and Squamata, demonstrating the predilection of this parasite for ectothermic animals. During its life cycle, this tick spends 240–250 days on toads (LUZ et al. 2013), while on lizards this data are unknown.

Most species of the globally distributed family Trombiculidae have been reported from the soft parts of the skin of reptile specimens (e.g. axillae, groins, “pocket-like structures”, gular folds) (AUDY 1954, ARNOLD 1986, RODRIGUES 1987, CUNHA-BARROS & ROCHA 1995, VRCIBRADIC et al. 2000, MENEZES et al. 2011). In the Americas, *Eutrombicula alfreddugesi* is one of the most widespread species. It commonly parasitises reptiles, mainly lizards, and snakes (HYLAND 1950, VERCAMMEN-GRANDJEAN & AUDY 1965, ZIPPEL et al. 1996, DANIEL & STEKOL'NIKOV 2004, KLUZOWSKI 2004, CARVALHO et al. 2006). In contrast, *E. alfreddugesi* parasitises different groups of vertebrates from North America to Central and South America, with no apparent species-specific relationships (MENEZES et al. 2011). Only the larvae are parasites whereas later stages will be free-living in the soil (WHARTON & FULLER 1952, BRENNAN & GOFF 1977, BUSH et al. 2001). The peak of activity of *E. alfreddugesi* is during daylight hours, especially in humid areas, which favours its association with *Plica* spp. in the Amazonian rainforest (CLOPTON & GOLD 1993). Some tropidurids are parasitised by *E. alfreddugesi* with a high prevalence (DELFINO et al. 2011).

In conclusion, we report the first record of the tick *A. rotundatum* and the trombiculid *E. alfreddugesi* parasitising members of the genus *Plica*. We also compile in a list all parasites found in the genus *Plica*. More studies are needed to better characterise and understand the relationships between hosts and parasites.

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