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Helminth parasites of the Mediterranean gecko, *Hemidactylus turcicus* (Sauria: Gekkonidae), from Texas, United States with a summary of helminths of this host

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Abstract

One hundred-thirty six Mediterranean geckos, *Hemidactylus turcicus*, were collected between December 1986 and March 2016 in Hardin (n = 7), Harris (n = 57), and Tom Green (n = 72) counties, Texas, USA., and examined for helminth parasites. Fifty-two *H. turcicus* (38%) were infected with at least one helminth species. Found were a trematode, *Mesocoelium meggitti*, three cestodes, *Mesocestoides* sp. (tetrathyridia), *Oochoristica ameivae* and *Oochoristica scelopori*, and four nematodes, *Cosmocercoides variabilis*, *Oswaldocruzia pipiens*, *Parapharyngodon cubensis*, and larvae of *Physaloptera* sp. *Oochoristica ameivae*, *O. scelopori*, *P. cubensis*, *Physaloptera* sp., and *Os. pipiens* represent new host records for *H. turcicus* and *M. meggitti* is reported from Texas for the first time. A summary of the helminth parasites of both native and non-native *H. turcicus* is presented.

Keywords

Hemidactylus turcicus, Mediterranean gecko, Reptilia, Lacertilia, Gekkonidae, Trematoda, Cestoda, Nematoda, Texas, United States

Introduction

The Mediterranean gecko, *Hemidactylus turcicus* (Linnaeus, 1758), is native to western India, Somalia, the Middle East, and the Mediterranean region (Stebbins 2003; Kraus 2009). This gecko was introduced into the United States in Florida about 1915 (Stejneger 1922) and has since extended its range throughout much of southern North America from Virginia and Florida west to California (Meshaka *et al.* 2006). Indeed, breeding populations have been established in Alabama, Arizona, Arkansas, California, Florida, Georgia, Kansas, Louisiana, Maryland, Mississippi, Missouri, Nevada, New Mexico, Oklahoma, South Carolina, Texas, Utah, and Virginia. Similar patterns of colonization have occurred in the Canary Islands, Chile, Cuba, México, Panama, and Puerto Rico (Stebbins 2003; Kraus 2009).

Information has been published on the helminth parasites of both introduced and native *H. turcicus*, including reports from individuals in Arizona (Goldberg *et al*. 2000b), Florida (Pence and Selcer 1988), Louisiana (Criscione and Font 2001a), Texas (Pence and Selcer 1988; Riley *et al*. 1988; McAllister *et al*. 1993; Caballero *et al*. 2015), Cuba (Baruŝ and Coy Otero 1974; Coy Otero and Baruŝ 1979), Egypt (Groschaft and Moravec 1983; Al-Deen *et al*. 1995), Spain (Roca *et al*. 1985; Roca and Lluch 1986), and Turkey (Tinar 1982, 1983; Yildirimhan *et al*. 2008).

The first report of *H. turcicus* in Texas was from Brownsville, Cameron County (Conant 1955) and since then *H. turcicus* has been reported from at least 63 of 254 (25%) counties of the state (Farallo *et al.* 2009; Dixon 2013). However, to our knowledge, there is no comprehensive helminth parasite survey of any population of *H. turcicus* from Texas. Herein, we provide five new host records for endoparasites of *H. turcicus* and the first comprehensive report of helminth parasites from this host in Texas. In addition, a summation of the helminth parasites reported from native and non-native *H. turcicus* is provided (Table I).

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Table I. Summary of helminths reported from native and non-native *Hemidactylus turcicus*

Helminth	Locality	Prevalence[1]	Reference
Native populations			
Trematoda			
Lecithodendrium sp.	Egypt	1/5 (20%)	Groschaft and Moravec (1983)
Cestoda			
Nematotaenia tarentolae	Spain	1/3 (33%)	Roca *et al.* (1985)
Nematoda			
Pharyngodon inermicauda	Egypt	not given	Al-Deen *et al.* (1995)
P. laevicauda	Turkey	43/79 (54%)	Tinar (1982)
P. mamillatus	Egypt	not given	Al-Deen *et al.* (1995)
Spauligodon anziensis	Egypt	not given	Al-Deen *et al.* (1995)
S. paratectipenis	Spain	2/3 (67%)	Roca *et al*. (1985)
Non-native populations			
Trematoda			
Haematoloechus varioplexus	Louisiana	2/217 (1%)	Criscione and Font (2001a)
Mesocoelium meggitti	Louisiana	2/217 (1%)	Criscione and Font (2001a)[2]
	Texas[4]	2/136 (2%)	This report
Telorchis corti	Louisiana	1/217 (0.5%)	Criscione and Font (2001a)
Cestoda			
Mesocestoides sp.	Texas	1/136 (0.7%)	This report
M. lineatus	Louisiana	7/217 (3%)	Criscione and Font (2001a)
Oochoristica ameivae[3]	Texas	2/136 (2%)	This report
O. javaensis	Louisiana	55/217 (25%)	Criscione and Font (2001a)
	Texas	not given	Caballero *et al.* (2015)
O. macallisteri	Arizona	12/36 (33%)	Goldberg *et al.* (2000b)
O. scelopori[3]	Texas	17/136 (13%)	This report
Nematoda			
acuariid larvae	Louisiana	103/217 (47%)	Criscione and Font (2001a)
Ascarops sp. (larvae)	Texas	9/98 (1%)	McAllister *et al.* (1993)
A. strongylida (larvae)	Arizona	19/36 (53%)	Goldberg *et al.* (2000b)
Cosmocercoides variabilis	Louisiana	6/217 (3%)	Criscione and Font (2001a)
	Texas	1/136 (0.7%)	This report
Cyrnea sp.	Cuba	1/9 (33%)	Coy Otero and Baruŝ (1979)
Oswaldocruzia leidyi	Louisiana	7/217 (3%)	Criscione and Font (2001a)
O. pipiens[3]	Texas	1/136 (0.7%)	This report
Parapharyngodon cubensis[3]	Texas	37/136 (27%)	This report
Physaloptera sp. (larvae)[3]	Texas	2/136 (2%)	This report
Skrjabinoptera sp.	Louisiana	7/217 (3%)	Criscione and Font (2001a)
S. phrynosoma	Cuba	1/9 (1%)	Coy Otero and Baruŝ (1979)
S. californiensis	Cuba	3/3 (100%)	Baruŝ and Coy Otero (1974)
		3/9 (33%)	Coy Otero and Baruŝ (1979)
Unidentified pinworms	Texas	not given	Caballero *et al.* (2015)
Acanthocephala			
Macracanthorhynchus ingens	Louisiana	3/217 (2%)	Criscione and Font (2001a)
Pentastomida			
Raillietiella frenatus	Florida, Texas	210/480 (44%)	Pence and Selcer (1988)
R. indica	Texas	not given	Caballero *et al.* (2015)
R. teagueselfi	Texas	17/86 (20%)	Riley *et al.* (1988)

[1]No. infected/no. examined (%)
[2]Originally reported as *Mesocoelium monas*; reassigned to *M. meggitti* by Calhoun and Dronen (2012)
[3]New host record
[4]New distributional record

Materials and Methods

One-hundred thirty-six individuals of *H. turcicus* (87 males, 49 females; mean ± 1 SD of snout-vent length [SVL] = 47.3 ± 8.3, 28−58 mm) were collected from buildings or a residence by hand between December 1986 and March 2016 from the Houston Zoological Gardens, Harris County (n = 57), Village Creek State Park, Hardin County (n = 7), and San Angelo, Tom Green County (n = 72) (Fig. 1). Geckos from Harris County had previously been reported to be hosts of coccidians (*Eimeria lineri* and *Eimeria turcicus*), larval nematodes (*Ascarops* sp.), and/or pentastomes (*Raillietiella teagueselfi*) (McAllister *et al*. 1988, 1993; Riley *et al*. 1988; Upton *et al*. 1988). Geckos were killed with an intraperitoneal injection of sodium pentobarbital (Nembutal ®), measured for snout-vent length (SVL) and the body cavity was opened by longitudinal incision beginning at the throat and ending at the cloaca. The entire gastrointestinal tract (including the liver and gall bladder) was removed and each organ was placed in a Petri dish, opened longitudinally, and the lumen examined for parasites under a stereomicroscope. The spleen, urinary bladder, reproductive organs, and coelomic cavity were also examined. Trematodes and cestodes were fixed in near boiling distilled water without coverslip pressure, transferred to 70–95% ethanol, stained with acetocarmine, destained briefly with 70% acid-ethanol, dehydrated through a series of increased concentrations of ethanols to absolute grade, cleared in xylene, and mounted with damar gum or Canada balsam. Nematodes were fixed in hot ethanol and placed in a drop of glycerol on microscopic slides and identifications were made from these temporary mounts. Parasites were deposited in the United States National Parasite Collection (USNPC), Beltsville, Maryland, United States (now replaced by the National Museum of Natural History [NMNH] at the Smithsonian Institution in Washington, D.C.) or the Harold W. Manter Laboratory of Parasitology (HWML), University of Nebraska, Lincoln, Nebraska, United States. Host voucher specimens are deposited in the Arkansas State University Museum of Zoology, Herpetological Collection, State University, Arkansas, United States as follows: ASUMZ 6329–6334, 6392–6402, 6442–6463, 8649–8666, 28625, 28630. Amphibian taxonomy follows Frost (2015) and reptile taxonomy follows the TIGR Reptile Database (Uetz and Hošek 2015). Prevalence and mean intensity of infection were calculated according to Bush *et al*. (1997)

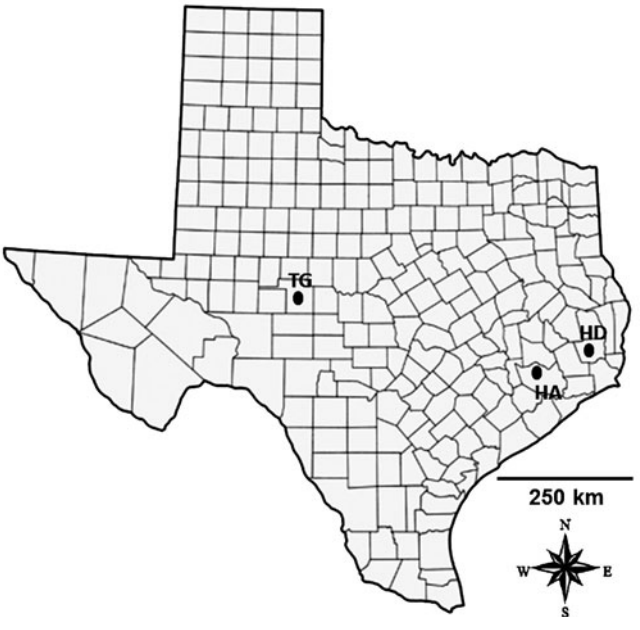

Fig. 1. County map of Texas showing three counties (•) where *Hemidactylus turcicus* were collected. Abbreviations: HD (Hardin County); HA (Harris County); TG (Tom Green County)

Results

Found were a digenean, *Mesocoelium meggitti*; three species of cestodes, *Mesocestoides* sp. (tetrathyridia), *Oochoristica ameivae* and *Oochoristica scelopori*; and four nematode species, *Cosmocercoides variabilis*, *Oswaldocruzia pipiens*, *Parapharyngodon cubensis*, and *Physaloptera* sp. Fifty-two of 136 (38%) *H. turcicus* were infected; of the infected geckos, 42 (81%) harbored one species of helminth; 3 (6%) harbored two parasite species, and one (2%) harbored five helminth species. Detailed data on these infections are presented below.

Trematoda

Digenea: Mesocoeliidae
***Mesocoelium meggitti* Bhalerao, 1927 (Dronen, Calhoun, and Simcik, 2012), USNPC 103055**

Two *H. turcicus*, a male (44 mm SVL) collected on 23 January 1987 had 14 worms and a female (56 mm SVL) collected on 18 March 1987, both from the Houston Zoological Gardens, Harris County (29°42′48.33″N, 95°23′31.17″W) possessed three worms in their small intestine. Dronen *et al*. (2012) previously reported this digenean from *H. turcicus* from Louisiana. Other reported hosts include the cane toad (*Rhinella marina*), greenhouse frog (*Euhyas planirostris*), common Puerto Rican anole (*Anolis cristatellus*), lion anole (*Anolis lionotus*), spotted anole (*Anolis stratulus)*, Brook's house gecko (*Hemidactylus brookii*), African five-lined skink (*Trachylepis quinquetaeniata*) and rhombic night adder (*Causus rhombeatus*) (Calhoun and Dronen 2012; Dronen *et al.* 2012).

The geographic range of *M. meggitti* in the United States includes Louisiana (Criscione and Font, 2001a; Dronen *et al*. 2012) and Texas (this report). Outside of North America, this fluke has been reported from Ghana, Jamaica, Myanmar, Panama, Puerto Rico, and Zimbabwe (see Calhoun and Dronen 2012; Dronen *et al.* 2012).

As noted recently by Calhoun and Dronen (2012), the differentiation of species within *Mesocoelium* is "rife with challenges." Indeed, Criscione and Font (2001a) previously reported *Mesocoelium monas* Rudolphi, 1819 in *H. turcicus* from Louisiana. However, their voucher specimen (USNPC 90335) has been found to be consistent with *M. meggitti*, redescribed by Calhoun and Dronen (2012). This digenean was apparently introduced into the Western Hemisphere over 40 yr ago (Dronen *et al*. 2012). We document a new distributional record for this trematode.

Cestoda

Cyclophyllidea: Mesocestoididae, *Mesocestoides* sp. Vaillant, 1863 (tetrathyridia), USNPC 103056

A single male *H. turcicus* (56 mm SVL) collected on 15 June 2004 from Village Creek State Park, Hardin County (30°15′6.5″N, 94°9′32.60″W) harbored 20 tetrathyridia in its coelomic cavity. There are several reports of *Mesocestoides* from Texas herpetofauna including, coastal plain toad, *Incilius nebulifer* (McAllister *et al*. 1989), Rio Grande leopard frog, *Lithobates berlandieri* (McAllister and Conn 1990), Strecker's chorus frog, *Pseudacris streckeri* (McAllister 1987), gray-checkered whiptail, *Aspidoscelis dixoni* (McAllister *et al*. 1991a), marbled whiptail, *Aspidoscelis marmorata* (McAllister *et al*. 1991b), plateau spotted whiptail, *Aspidoscelis septemvittata* (McAllister *et al*. 1991b), western whiptail, *Aspidoscelis tigris* (McAllister *et al*. 2003), greater earless lizard, *Cophosaurus texanus* (McAllister 1988), Texas spiny lizard, *Sceloporus olivaceus* (McAllister 1988), western diamondback rattlesnake, *Crotalus atrox* (Bolette 1997) and coachwhip, *Coluber flagellum* (Conn and McAllister 1990). Bursey *et al*. (2012) provided a summary of other hosts including amphibians and reptiles from the Asian, Australo-Papuan, Ethiopian, Nearctic, Neotropical, and Palearctic zoogeographical regions.

Criscione and Font (2001a) reported *Mesocestoides lineatus* Goeze, 1782 from introduced *H. turcicus* in Louisiana. However, there are no morphological characteristics that allow assignment of tetrathyridia to a given species, and because at least seven species have been identified within the United States, we consider their specific assignment to be premature.

Cyclophyllidea: Linstowiidae, *Oochoristica ameivae* (Beddard, 1914) Baer, 1924, USNPC 103057

Two *H. turcicus*, a male (56 mm SVL) and a gravid female (53 mm SVL) collected on 15 June 2004 from Village Creek State Park, Hardin County (30°15′6.5″N, 94°9′32.60″W) possessed one and two worms in their small intestines, respectively. This tapeworm has been previously reported from Texas reptiles, including desert spiny lizard, *Sceloporus magister*, Texas spiny lizard, *Sceloporus olivaceus*, Merriam's canyon lizard, *Sceloporus merriami* (Goldberg *et al*. 1995a), crevice spiny lizard, *Sceloporus poinsettii* (Goldberg *et al*. 1993), and eastern mudsnake, *Farancia abacura* (Harwood 1932). Other reported hosts of *O. ameivae* were summarized by Bursey *et al*. (2005a). Since then additional hosts include the lined gecko, *Gekko vittatus* (Goldberg *et al*. 2010), keeled Indian mabuya, *Mabuya carinata* (Yesmin *et al*. 2006), Bocage's wall lizard, *Podarcis bocagei* and Carbonell's wall lizard, *Podarcis carbonelli* (Galdon *et al*. 2006), and no common name, *Sphenomorphus jobiensis* (Bursey *et al*. 2005b).

There are two previous reports of species of *Oochoristica* in *H. turcicus*: Goldberg *et al*. (2000b) reported *Oochoristica macallisteri* Bursey and Goldberg, 1996 from *H. turcicus* collected in Arizona; Criscione and Font (2001a) reported *Oochoristica javaensis* Kennedy, Killick, and Beverley-Burton, 1982 in *H. turcicus* from southeastern Louisiana. In a followup study, Criscione and Font (2001b) examined artifactual and natural variation in a sample of 15 individuals of *O. javaensis* in order to address the effects of the assumptions of strict host specificity and geographic isolation on the taxonomy of the genus. Lack of strict host specificity was established by Kennedy *et al*. (1982) in which the original description of *O. javaensis* listed three gekkonid hosts (stump-toed gecko, *Gehyra mutilata* [type host], flat-tailed house gecko, *Hemidactylus* = *Cosymbotus*) *platyurus*, and common house gecko, *Hemidactylus frenatus*) from Java, Indonesia; Criscione and Font (2001a) confirmed that lack of strict host specificity by infecting Indo-Pacific gecko, *Hemidactylus garnotii* and prairie lizard, *Sceloporus consobrinus*. Criscione and Font (2001a) did not indicate why they selected *O. javaensis* to represent their species nor did they speculate on how, what is thought to be an Oriental cestode, came to infect a Palearctic lizard in the New World; however, they did make a valid point that many lizard species colonized new areas long before various species of *Oochoristica* were described. Criscione and Font (2001a) rightly point out that *Oochoristica vanzolinii* Rêgo and Oliveira Rodrigues, 1965 is considered a Neotropical species without regard to the fact that it was described from the introduced house gecko, *Hemidactylus mabouia*, collected in Rio de Janeiro, Guanabara, Brazil (Rêgo and Oliveira Rodrigues 1965). It has been hypothesized that *H. mabouia* colonized the New World via rafting or transport during the slave trade (Kluge 1969). In either case, there is an opportunity for these lizard hosts to transport and disperse to newly colonized sites with their parasites. Thus, because there has been the assumption of strict host specificity and geographic isolation for species of *Oochoristica*, many synonymies likely exist. We have examined published descriptions of 93 species of *Oochoristica* and a list of species of *Oochoristica* exhibiting characteristics within the range established by Criscione and Font (2001b) for the cestode infecting *H. turcicus* (i.e., proglottid number 86–164, circular suckers, strobila with neck, 17–46 testes in one cluster, and ovary with 5–9 lobules per lobe) would include: *O. ameivae* (Beddard, 1914); *O. americana* Harwood, 1932; *O. anolis* Harwood, 1932; *O. scelopori* Voge and Fox, 1950; *O. celebesensis* Yamaguti,

1954; *O. gallica* Dollfus, 1954; and *O. javaensis* Kennedy, Killick and Beverley-Burton, 1982. If these species were found to be synonymous, *O. ameivae* would have priority. Although Kennedy *et al*. (1982) indicated that *O. javaensis* was most similar to *O. vanzolinii*, the ovary of *O. javaensis* has 5–7 lobules/lobe while the margin of the ovary of *O. vanzolinii* is entire. Given the similarity of the seven species listed above, we propose the synonomy noted above and assign our specimens to *O. ameivae*.

***Oochoristica scelopori* Voge and Fox, 1950, HWML 101968**

A total of 17 *H. turcicus* (10 males, 7 females, 31–57 mm SVL), all collected between November 2012 and March 2016 from San Angelo, Tom Green County (31°22′3.31″N, 100°28′4.79″W), were infected in their small intestine with this tapeworm. Additional Texas records of *O. scelopori* include three sceloporine lizards, *S. magister*, *S. olivaceus*, and *S. poinsettii* (see Goldberg *et al.* 1993, 1995a, 1996). Goldberg *et al.* (1996) summarized the North American hosts of *O. scelopori*; it is a common cestode of lizards and has been found in several other North American phrynosomatids in Arizona, California, Idaho, Oregon, and Texas, and Chihuahua, Coahuila, Durango, Guanajuato, Hidalgo, Oaxaca, Querétaro, and Zacatecas, México.

Our specimens possessed 22–27 testes in a single cluster, many lobules in the ovary lobes, a triangular vitellarium, a cirrus pouch length of 136µm, and a scolex measuring 300 µm with a circular sucker 125 µm in diameter. These measurements and morphologies most closely match those of *O. scelopori*, which has 22–43 testes in a single cluster, many lobules in the ovary lobes, a triangular vitellarium, a cirrus pouch length of 120–166 µm, and a scolex measuring 299–431 µm with a circular sucker 100–130µm in diameter (Voge and Fox 1950). However, additional work (including DNA sequences) is needed to determine if our form actually represents a new species.

Nematoda

Oxyurida: Pharyngodonidae, *Parapharyngodon cubensis* (Baruŝ and Coy Otero, 1969) Baruŝ, 1973, USNPC 84263

The most common helminth found in *H. turcicus* was this nematode, which occurred in the rectum of 37 *H. turcicus*, all collected between 30 December 1986 and 18 March 1987 from the Houston Zoo, Harris County (29°42′48.33″N, 95°23′31.17″W); the mean intensity was 3.4 ± 2.3, range 1–10 worms. The only previous report of *P. cubensis* from Texas was McAllister *et al*. (1991c) who reported it in the roughtail gecko, *Cyrtopodion scabrum*. There are numerous other hosts as this nematode is broadly distributed in the Caribbean (see recent host list in Bursey *et al*. 2012). In addition, a more recent report by Falk and Perkins (2013) reported *P. cubensis* from Saint Croix's anole, *Anolis acutus*, *Anolis cristatellus*, emerald anole, *Anolis evermanni*, yellow chinned anole, *Anolis gundlachi*, Puerto Rican bush anole, *Anolis pulchellus*, spotted anole, *Anolis stratulus*, and big-scaled least gecko, *Sphaerodactylus macrolepis*.

As noted above, the only previous report of *P. cubensis* from the United States was that of McAllister *et al.* (1991c) who reported it from 13 of 35 (37%) introduced *C. scabrum* collected in Galveston, Galveston County, Texas. *Hemidactylus turcicus* represents a new host record and the second host ever reported with *P. cubensis* from Texas. Both *C. scabrum* and *H. turcicus* are Old World gekkonid lizards; *C. scabrum* was first collected at the Port of Galveston, Texas, in the 1980's (Selcer and Bloom 1984) and *H. turcicus* migrated from Florida around the 1900's (Meshaka *et al*. 2006). To our knowledge, these are the only two hosts of *P. cubensis* reported from the continental United States. This pinworm is strictly monoxenous and is characterized by a direct life cycle with fecal-oral transmission. Thus, it would seem logical that *P. cubensis* was transported to Texas and later acquired by *H. turcicus*.

In addition, Falk and Perkins (2013) generated nuclear and mitochondrial sequence data of *P. cubensis* from several *Anolis* spp. lizards from the Caribbean. Their data showed that *P. cubensis* is comprised of multiple cryptic species (termed A, B, and C) that exhibit limited population structure. However, without molecular analysis, we are unsure what group our specimens may belong.

Ascaridida: Cosmocercidae, *Cosmocercoides variabilis* (Harwood, 1930) Travassos, 1931, USNPC 103058

A single *H. turcicus* (adult male, 56 mm SVL) collected on 15 June 2004 from Village Creek State Park, Hardin County (30°15′6.5″N, 94°9′32.60″W) was infected in its rectum with a single *C. variabilis*. There are additional reports from Texas reptiles including *H. turcicus* (Harwood 1930), slender glass lizard, *Ophisaurus attenuatus* (Harwood 1930), *P. fasciatus* (Harwood 1932); *S. consobrinus* (Goldberg *et al*. 1995), ground skink, *Scincella lateralis* (Harwood 1932; McAllister *et al*. 2014), eastern hognose snake, *Heterodon platirhinos*, Texas coral snake, *Micrurus tener*, brown snake, *Storeria dekayi*, three-toed box turtle, *Terrapene carolina triunguis*, and ornate box turtle, *Terrapene ornata* (Harwood 1932). McAllister *et al*. (2013) recently summarized additional hosts of *C. variabilis* and its geographic range includes four states in the United States, four provinces of Canada, Baja California Norte, México, Costa Rica, and Panama (see Bursey *et al*. 2012; McAllister *et al*. 2013).

This is the third report of *C. variabilis* from *H. turcicus* (Harwood 1930; Criscione and Font 2001a) and the second from a population of *H. turcicus* in Texas (Harwood 1932). Some uncertainty exists for hosts of the two North American species of *Cosmocercoides*: *C. dukae* (Holl, 1928) and *C. variabilis*. Vanderburgh and Anderson (1987) demonstrated that these two species were distinct. The major difference in the two species is the number of rosette papillae of the male: *C. dukae*

has 12 pairs; *C. variabilis* has 14 to 20 pairs. The male specimen collected in this study had 16 pairs of rosette papillae.

Spirurida: Physalopteridae, *Physaloptera* sp. Rudolphi, 1819 (third-stage larvae), USNPC 84262

Two *H. turcicus*, a female (51 mm SVL) collected on 30 December 1986 from the Houston Zoo, Harris County (29°42′48.33″N, 95°23′31.17″W) and a male (56 mm SVL) collected on 15 June 2004 from Village Creek State Park, Hardin County (30°15′6.5″N, 94°9′32.60″W) harbored third-stage larvae of this nematode in its stomach. Additional hosts from Texas were summarized by McAllister *et al*. (2013). Adult *Physaloptera* spp. are parasites of reptiles, birds and mammals with a cosmopolitan distribution (Yamaguti 1961). Species of *Physaloptera* infect mammals, birds, and reptiles and require an insect intermediate host; larvae of species of *Physaloptera* are most common in amphibians (Anderson 2000). Any insectivorous animal could be expected to harbor physalopteran larvae sometime during their life cycle and any predator feeding of insectivores might harbor physalopteran larvae. In our experience, encysted physalopteran larvae have not been found in hosts; thus, the presence of physalopteran larvae may simply represent an artifact of diet. This is the first report of physalopteran larvae in *H. turcicus*.

Strongylida: Molineidae, *Oswaldocruzia pipiens* Walton, 1929, USNPC 103059

A single *H. turcicus* (male, 56 mm SVL) collected on 15 June 2004 from Village Creek State Park, Hardin County (30°15′6.5″N, 94°9′32.60″W) was infected with a female *Os. pipiens* in its small intestine. Additional Texas records in reptiles include *P. fasciatus* (Harwood 1932), *S. consobrinus* (Harwood 1932; Goldberg *et al.* 1995b), *S. lateralis* (Harwood 1932; McAllister *et al*. 2014), *T. carolina* and *T. ornata* (Harwood 1932). McAllister *et al*. (2014) provided a summary of the hosts known to harbor *Os. pipiens*.

Criscione and Font (2001a) reported *Os. leidyi* Steiner, 1924 from *H. turcicus* from Louisiana. Ben Slimane and Durette-Desset (1997) validated *Os. leidyi* but as a parasite of the anurans of the family Hylidae, and McAllister *et al*. (2013) recently reported *Os. leidyi* from the Cajun chorus frog, *Pseudacris fouquettei* from Arkansas. This is the first time *Os. pipiens* has been reported from *H. turcicus*.

Discussion

What is most striking about the helminths of these three Texas populations of *H. turcicus* is that they have acquired some of the most common of Western Hemisphere herptile helminths; there are many hosts each reported for several of the helminths reported herein for the Mediterranean gecko. Interestingly, not one helminth was found that could be considered to have been transported from the Palearctic region.

There are several studies focusing on helminth communities of introduced lizards (Goldberg *et al*. 1995b; Hanley *et al*. 1995; Barton 1997; Goldberg and Bursey 2000a; Criscione and Font 2001a; Anjos *et al*. 2005; Burke 2007). Goldberg *et al* (1995b) reported the introduced Bermudian lizards *Anolis leachi* and *A. grahami* to harbor *P. cubensis* and *A. grahami* and *A. roquet* to harbor *Atractis scelopori*, both common helminths of Caribbean lizards. Goldberg and Bursey (2000a) reported Hawaiian specimens of the Caribbean lizard, *Anolis sagrei* to harbor *M. monas*, *Platynosomum fastosum*, *A. scelopori*, *Physaloptera squamatae*, *Acanthocephalus bufonis* and *Raillietiella frenatus*; *A. scelopori* and *P. squamatae* which were previously unknown in Hawaii, the other parasites had previously been reported in Hawaiian reptiles. The additional reports, Hanley *et al*. (1995), Barton (1997), Criscione and Font (2001a), Anjos *et al*. (2005) and Burke *et al.* (2007) and, to some extent the report of Goldberg and Bursey (2000a), support the conclusion of Barton (1997) that introduced herptiles acquire parasites from local hosts. However, the question remains, why are parasites acquired rather than transported? Part of the answer might lie in the host life stage imported (i.e., egg, neonate, juvenile or adult). Perhaps ecological factors such as absence of appropriate intermediate hosts or suitable substrates for egg survival may contribute to lack of parasite survival. Furthermore, introduced *H. turcicus* would certainly encounter new food items that could serve as intermediate hosts for helminths that differ considerably from those of their native origin (see Sousa *et al*. 2014).

We have added five new helminth records for *H. turcicus*, a new distributional record, and the first comprehensive survey of this host from Texas. In addition, a summary of the helminth parasites of *H. turcicus* has been provided (Table I). The non-native populations of *H. turcicus* surveyed from Arizona, Florida, Louisiana, Texas and Cuba have helminth species that far outnumber the number of taxa reported in native populations from Egypt, Spain and Turkey (26 *vs.* seven). In addition, only one trematode and cestode each and five species of nematodes have been documented in native populations (*vs.* three trematodes, six cestodes, and 12 nematodes in non-native populations); no acanthocephalans or pentastomids have been reported in the native populations whereas one and three species of acanthocephalan and pentastomids are known from non-native populations, respectively. At this point in time, few helminth species can be associated with transport by *H. turcicus*. Instead, *H. turcicus* mostly acquires local parasites. We therefore believe Criscione and Font (2001a) characterized *H. turcicus* correctly as "the guest playing host".

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