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Research Note

**Three new host species of *Plagiorchis micracanthos* (Macy, 1931)
(Trematodes: Plagiorchiidae) among North American bats (Chiroptera: Vespertilionidae)**M. HEDDERGOTT^{1*}, P. STEINBACH²¹Musée National d'Histoire Naturelle, L-2160 Luxembourg, *E-mail: mike-heddergott@web.de; ²Göttinger Straße 28,
D-37308 Heilbad Heiligenstadt, Germany

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Accepted December 9, 2014**Summary**

We report new records of the trematode, *Plagiorchis micracanthos* from three North American bats. For the first time, the parasite is reported to occur in the hoary bat (*Lasiurus cinereus*), California myotis (*Myotis californicus*) and the pallid bat (*Antrozous pallidus*). The western small-footed bat (*Myotis ciliolabrum*), little brown bat (*M. lucifugus*) and the western pipistrelle (*Parastellus hesperus*) are confirmed as host species. The trematodes were isolated from the small intestines of the host individuals. For the first time, we identified *P. micracanthos* in bats originating from Canada and Mexico. The results presented here suggest that the trematode *P. micracanthos* has a much larger host range and geographic distribution than previously recognised. It is likely that further studies will confirm this results and extent both host and geographic ranges even further.

Keywords: Trematodes; *Plagiorchis micracanthos*; bat; *Vespertilionidae*; new host species; U.S.A.; Mexico; Canada; North America

Introduction

Plagiorchis Lühe, 1899 trematodes are a genus of the family Plagiorchiidae Lühe, 1901. Their life-cycle encompasses three hosts, with lymnaeid snails acting as first intermediate hosts, aquatic insects and freshwater crustaceans as second intermediate hosts, and birds and mammals (accidentally amphibians and reptiles) as definitive hosts (Zikmundová *et al.*, 2014). Two *Plagiorchis* species have been described that parasitize bats in North America: *P. micracanthos* (Macy, 1931) and *P. vespertilionis* (Müller, 1780) (cf. McAllister & Bursey, 2008; McAllister *et al.*, 2008). *P. micracanthos* has been described in seven different bat species sampled in the Central United States, as well as Kentucky and New Mexico (Macy, 1931; Williams, 1957 and 1962; Ubelaker, 1966; Nickel & Hansen, 1967; Cain & Studier, 1974; Bowman *et al.*, 2002; McAllister & Bursey, 2008). Here, we report the identification of *P. micracanthos* in new bat host species, leading to a significant increase in the reported distribution range of the trematode parasite.

Material and Methods

Sixteen undetermined North American bats from a private collection of the German entomologist and speleologist Friedrich Mayer (1932 – 2005) were analysed for the presence of helminths. The bats had been sampled in three federal states of the US (Arizona, California, Colorado and Nebraska), Canada (Province Alberta) and Mexico (Federal State Sinaloa) (Table 1). All bats had been stored in ethanol and were well-preserved. Species identity was determined based on morphological characteristics following Harvey *et al.* (2011). Depending on their degree ossification of the bones in the hand, individuals were either classified as adults or juveniles (less than one year old).

All internal organs were removed and stored in 80 % ethanol. Following McAllister and Bursey (2008), the open gastrointestinal tract was immersed in a 0.9 % salt solution and washed out with a cannula. The digestive tract and all other internal organs were examined using a Stemi 2000C stereomicroscope (Carl Zeiss

Table 1. Characteristics of the examined bats

Bat species	sex	Age	MNHN ^a	Date	Country	Federal state/ Province	Location ^b	Coordinates ^c	Number of <i>P. micracanthos</i>	MNHN ^d
<i>Lasiurus cinereus</i>	female	adult	17743	3/8/1964	U.S.A.	Nebraska	North Platte River (Sidney)	51°27' N / 102°32' W	2	17768
<i>Myotis californicus</i>	male	adult	17753	19/6/1961	U.S.A.	Colorado	10 km southwest Leadville Mt Elbert (Elbert Creek)	39°8' N / 106°25' W	-	
<i>Myotis californicus</i>	male	adult	17754	28/8/1955	U.S.A.	Arizona	Colorado River south of Parker	34°6' N / 114°23' W	1	17769
<i>Myotis ciliolabrum</i>	female	juvenile ^e	17755	1959 ^f	Canada	Alberta	Old Man River, 100 km south Calgary	50°2' N / 114°35' W	1	17770
<i>Myotis lucifugus</i>	female	adult	17756	23/7/1961	U.S.A.	Nebraska	Alliance	42°6' N / 102°53' W	1	17771
<i>Perimyotis subflavus</i>	male	adult	17757	8/6/1961	U.S.A.	Nebraska	Chadron	42°49' N / 103°0' W	-	
<i>Perimyotis subflavus</i>	male	juvenile	17758	10/8/1964	U.S.A.	Nebraska	Fremont (Platte River)	41°25' N / 96°32' W	-	
<i>Parastrellus hesperus</i>	female	juvenile	17759	16/7/1974	Mexico	Sinaloa	cave north of El Rosario	23°1' N / 105°52' W	1	17772
<i>Parastrellus hesperus</i>	female	adult	17760	16/7/1974	Mexico	Sinaloa	cave north of El Rosario	23°1' N / 105°52' W	2	17773
<i>Antrozous pallidus</i>	male	adult	17761	10/9/1955	U.S.A.	Arizona	east of Tucson	32°3' N / 110°25' W	1	17774
<i>Antrozous pallidus</i>	male	adult	17762	10/9/1955	U.S.A.	Arizona	east of Tucson	32°3' N / 110°25' W	3	17776
<i>Antrozous pallidus</i>	female	juvenile	17763	10/9/1955	U.S.A.	Arizona	east of Tucson	32°3' N / 110°25' W	-	
<i>Antrozous pallidus</i>	female	adult	17764	12/9/1955	U.S.A.	Arizona	Chemehuevi Point (Cave)	36°10' N / 112°25' W	-	
<i>Antrozous pallidus</i>	female	adult	17765	13/9/1955	U.S.A.	Arizona	Cave in Havasu Creek	36°15' N / 112°41' W	-	
<i>Antrozous pallidus</i>	male	juvenile	17766	8/9/1955	U.S.A.	Arizona	Cave Colorado River	36°16' N / 112°52' W	-	
<i>Antrozous pallidus</i>	female	adult	17767	21/9/1955	U.S.A.	California	south Salton Sea	33°14' N / 115°34' W	-	

^a host specimens collection number of Musée National d'Histoire Naturelle of Luxembourg^b based on original bottle labels^c the coordinates were taken from the collection diaries^d trematodes collection number of Musée National d'Histoire Naturelle of Luxembourg^e less than one year old^f no further information provided

Microscopy GmbH, Jena, Germany). Trematodes were stored in 80 % ethanol until they were stained with Semichon's acetocarmine, dehydrated through a series of graded ethanols, cleared with xylene, and mounted in Canada-balsam. The host specimens and trematodes are in the collection of the Musée National d'Histoire Naturelle of Luxembourg (MNHNL).

Results and Discussion

The sixteen unidentified bats represented seven different species from five genera (Table 1): the boary bat (*Lasiurus cinereus*), the California myotis (*Myotis californicus*), the western small-footed bat (*M. ciliolabrum*), the little brown bat (*M. lucifugus*), the tri-colored bat (*Perimyotis subflavus*), the western pipistrelle (*Parastrellus hesperus*) and pallid bat (*Antrozous pallidus*). We found trematodes in eight of the 16 bats (prevalence: 50 %). The cuticular spines of the individuals were very small and only located on the anterior third of the body, while the testes were located in the middle of the body. Based on the descriptions by Macy (1931), we therefore identified the trematodes as *P. micracanthos*.

Manter and Debus (1945) have been lost, it was not possible to verify the results of these authors (see also McAllister & Bursey, 2008). The detection of *P. micracanthos* in *M. ciliolabrum* from Grasmere, Alberta in Canada moved the known distribution range of the trematode approximately 500 km to the north. Similarly, finding the trematode in a *P. hesperus* from El Rosario, Sinaloa in Mexico moved the known distribution range around 800 km to the south. The results presented here suggest that the trematode *P. micracanthos* has a much larger host range and geographic distribution than previously recognised. It is likely that further studies will confirm this results and extent both host and geographic ranges even further.

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Table 2. *Plagiorchis micracanthos* in North American bats

Family	Genus	Species	Location	Reference
Vespertilionidae	<i>Eptesicus</i>	<i>Eptesicus fuscus</i>	Minnesota	Macy (1931)
		<i>Lasiurus</i>	Nebraska	Present study
	<i>Myotis</i>	<i>Myotis californicus</i>	Colorado	Present study
		<i>Myotis ciliolabrum</i>	South Dakota	McAllister & Bursey (2008)
			Alberta (Canada)	Present study
		<i>Myotis grisescens</i>	Kansas	Ubelaker (1966)
		<i>Myotis lucifugus</i>	New Mexico	Cain & Studier (1974)
			Minnesota	Macy (1931)
			Nebraska	Present study
		<i>Myotis sodalis</i>	Kentucky	Bowman <i>et al.</i> (2002); Williams (1962)
	<i>Parastrellus</i>	<i>Parastrellus hesperus</i>	Nevada	Nickel & Hansen (1967)
			Sinaloa (México)	Present study
	<i>Perimyotis</i>	<i>Perimyotis subflavus</i>	Nebraska	Nickel & Hansen (1967)
			Ohio	Williams (1957)
	<i>Antrozous</i>	<i>Antrozous pallidus</i>	Arizona	Present study

The parasites were located in the small intestine of six different species: *L. cinereus*, *M. californicus*, *M. ciliolabrum*, *M. lucifugus*, *P. hesperus* und *A. pallidus*. All infected individuals – with one exception – were adults (Table 1). We found between one and three trematodes per host individual. So far, *P. micracanthos* has been identified in seven bat species (Table 2). In the present study, we identified a further three bat species (*L. cinereus*, *M. californicus* and *A. pallidus*), giving rise to a total of ten known host species. Manter and Debus (1945) stated that they identified *P. micracanthos* in a California myotis from Louisville, Cass County, Nebraska. However, as already pointed out by McAllister and Bursey (2008), the distribution range of *M. californicus* is located more than 1.000 km further to the west, making it likely that Manter and Debus (1945) misidentified the bat. Since the specimens of

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