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FIRST RECORDS OF *LEPTOTHORAX RUGATUS*  
(HYMENOPTERA: FORMICIDAE) WITH CYSTICERCOIDS OF  
TAPEWORMS (CESTODA: DILEPIDIDAE) FROM THE  
SOUTHWESTERN UNITED STATES

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Ants of the myrmicine tribe Formicoxenini may serve as intermediate hosts of immature stages (cysticercoids) of two genera of dilepidid cestodes. The parasites are thought to enhance the transmission to their final hosts, piciform, galliform or passeriform birds (Gabrion et al. 1976, Péru et al. 1988, 1990) and also shrews (Sawada & Harada 1995), by modifying the behavior and the pigmentation of their hosts. Infected *Leptothorax* are yellowish rather than brown or black as are their unparasitized nestmates, and they also do not flee when the nest is disturbed (Plateaux 1972, Buschinger 1973, reviewed in Moore 1995), thus increasing the probability that they are eaten. The tapeworms mature and reproduce in the intestine of the final host (Péru et al. 1990), and the eggs are still contained in parts of the tapeworm's uterus or in complete proglottids when released with the bird's feces. Ants collect the protein-rich pieces and feed them to their larvae (Gabrion et al. 1976, Péru et al. 1988).

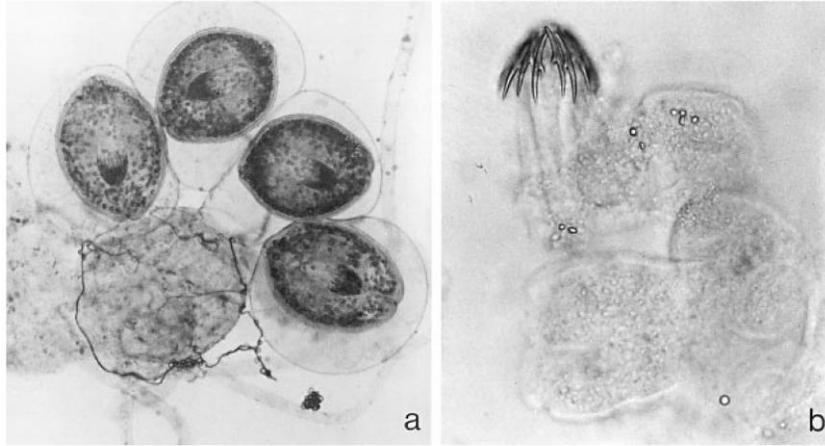
Ants of the subgenus *Leptothorax* (s.str.) infested with *Choanotaenia* cysticercoids and *Leptothorax* (*Myrafant*) infested with *Anomotaenia* cysticercoids have been reported from various parts of Europe and Northern Africa (Germany, Hungary, Italy, France, Spain, Algeria, Morocco, Ukraine (Crimea); Plateaux 1972, Buschinger 1973, Espadaler Gelabert & Riasol Boixart 1983, A. Buschinger, unpublished data) and eastern North America (Illinois, Michigan, Ohio, Quebec; Stuart & Alloway 1988). Here we report on the occurrence of cysticercoids in several populations of *Leptothorax* (*Myrafant*) *rugatulus* in the Chiricahua, Huachuca, and Mimbres Mts. in southern Arizona and New Mexico.

Infested ants were easily recognized by their yellowish coloration, whereas typical *L. rugatulus* workers are reddish brown. Dissection of 24 yellowish workers revealed the presence of one to 28 cysticercoids (mean 7.8, median 6), closely associated with the midgut of the ants (Fig. 1 a). A single cysticercoid was found in a worker with normal, reddish brown coloration. Eleven "normally" colored workers from the same colony, 5 "normally" colored workers from five other colonies with yellowish ants, and 18 from colonies without yellowish ants were not infested.

Whereas *Leptothorax* infested with tapeworms occasionally show morphological aberrations, such as a broadened postpetiole, a stronger petiolar spine etc. (Plateaux 1972, Buschinger 1973, Stuart & Alloway 1988), yellowish *L. rugatulus* were not conspicuously different in morphology from their uninfested nestmates.

By gently squeezing cysticercoids under a microscope, the rostrum evaginated and the number of mouth hooks could be counted (Fig. 1b). Cysticercoids found in *L. rugatulus* had between 18 and 21 hooks in two circles (28 cysticercoids, mean 19.9, me-

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**Fig. 1. a) Four cysticercoids of a dilepidid cestode associated with the midgut of a worker of the ant *Leptothorax rugatulus*. b) Cysticercoide after devagination of the rostrum. The hooks are clearly visible.**

dian 20; compared to *Anomotaenia brevis* with 17 to 22, rarely 26 hooks, and *Choanotaenia* with 18 to 27 hooks, Buschinger 1973, Gabrion et al. 1976). One exceptional cysticercoide from *L. rugatulus* had one circle consisting of 18 large hooks and a second circle of 13 small hooks. Cysticercoids from *L. rugatulus* were similar in size to those from Europe (48 cysticercoids in *L. rugatulus*: mean 224  $\mu$ m, median 216  $\mu$ m, range 180-290  $\mu$ m; compared to *A. brevis* 220-250  $\mu$ m and *Choanotaenia* 170-210  $\mu$ m, Buschinger 1973, Gabrion et al. 1976), but the average length of the hooks by far exceeded that of European specimens (in *L. rugatulus*: 60  $\mu$ m; compared to *A. brevis* 23.5-28.5  $\mu$ m and *Choanotania* 40-45  $\mu$ m). Overall, cysticercoids from *L. rugatulus*

appear to belong to a taxon different from both European species, but closer related to *Anomotaenia* than to *Choanotaenia*. The final host of the tapeworm is unknown.

In addition to yellowish workers, several colonies also contained yellowish dealate queens (Table 1). None of 12 dissected yellowish queens was found to be inseminated, and none of approximately 90 dissected, inseminated queens was infected, suggesting that infestation somehow interferes with the queens' sexual behavior. The ovaries of five yellowish virgin queens contained 1 to 3 developing eggs, but according to the absence of corpora lutea, they had only recently become fertile.

In the Chiricahua, Huachuca, and Mimbres Mts., between 5% and 20% of the inspected colonies contained yellowish workers (Table 1), and in single colonies, up to 50% of the workers were infected (mean appr. 10%). Infestation by tapeworm cysticercoids thus appears to be a rather common phenomenon in the mountain ranges of Southern Arizona and New Mexico. No cysticercoids, however, were found in *L. rugatulus* from several other populations in Arizona, New Mexico, and Colorado. Similarly, a species of *Leptothorax* (s.str.), regularly co-occurring with *L. rugatulus* in Southern Arizona and New Mexico (an as yet undescribed member of the *L.* (s.str.) *m uscorum* complex referred to as *Leptothorax* (s.str.) F, Heinze 1989), was never found infested with cysticercoids. The apparent restriction of the *Anomotaenia*-like cysticercoids to *L. rugatulus* is consistent with the hypothesis that cysticercoids of dilepidid tapeworms are limited to host species from a single *Leptothorax* subgenus (Buschinger 1973, Péru et al. 1990).

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TABLE 1. OCCURRENCE OF *LEPTOTHORAX RUGATULUS* ANTS INFECTED WITH CYSTICERCOCIDS OF A DILEPIDID TAPEWORM. THE TABLE GIVES THE RATIOS OF YELLOWISH DEALATE QUEENS AND WORKERS PER COLONY TO THE TOTAL NUMBER OF DEALATE QUEENS AND WORKERS, AND OF COLONIES CONTAINING INFECTED INDIVIDUALS TO THE TOTAL NUMBER OF COLONIES COLLECTED PER POPULATION.

Mountain Range, County, State	Collecting Site, Elevation	yellowish individuals per colony		colonies with yellowish individuals	
		queens	workers		
Chiricahua Mts., Cochise Co., AZ	Barefoot Lookout, 2630m	0/2	4/18		
		0/16	14/174	4/30	
		3/25	16/137		
		0/3	6/62		
	FSR 40, 0.8km W of Onion Saddle, 2200m	17/19	0/51	1/13	
		0/1	3/139	2/25	
	FSR 40, 1.5km W of Onion Saddle, 2100m	0/18	3/115		
		42/43	49/156	1/5	
	Pinery Campground, 2100m	Onion Saddle, 2280m	0/5	8/104	
			0/1	4/33	
		0/1	3/21	4/84	
		0/0	1/31		
	Rustler Park, 2580m	0/7	1/46	1/5	
Morse Canyon Trailhead, 1980m	1/4	10/342	1/11		
Huachuca Mts., Cochise Co., AZ	Carr Canyon Road, 2400m	0/2	1/79	1/20	
Mimbres Mts., Grant Co., NM	4.8km west of Emory Passm 2200	0/1	2/30		
		0/1	6/17	3/12	
		5/6	1/17		
total number, including additional populations of <i>L. rugatulus</i> in New Mexico, Arizona, and Colorado				18/523	

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SUMMARY

Cysticercoids of a dilepidid cestode were found by dissection of aberrant yellowish workers and virgin queens of the ant *Leptothorax rugatulus* from several mountain ranges in the southwestern United States. The cestode was not positively identified, but cysticercoids are similar to those of the genus *Anom otaenia* previously found in related ants.

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*Scientific Notes*

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