First finding of *Ityogonimus lorum* and *I. ocreatus* co-infection in the Iberian mole, *Talpa occidentalis*

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Abstract

The *Ityogonimus lorum-I. ocreatus* co-infection is reported for the first time in the Iberian mole *Talpa occidentalis* in Asturias (NW Spain). Both *Ityogonimus* species are stenoxenous helminths of insectivores of the genus *Talpa* and they have often been found parasitizing the Iberian mole and also the European mole *T. europaea*, but a mixed infection had not been previously reported. The present study also highlights the main differential morphometric characteristics between *I. lorum* and *I. ocreatus* such as the body length, the ventral sucker diameter, the ratio between suckers and the distance between suckers.

Keywords: *Ityogonimus* co-infection, Brachylaimidae, Ityogoniminae, *Talpa*, morphometric data.

The Iberian mole, *Talpa occidentalis* Cabrera, 1907 (Eulipotyphla: Talpidae) is a hypogean insectivore endemic to the Iberian Peninsula that is widely distributed in this region, except for north-eastern Spain (Román 2007). The parasitic helminth fauna of *T. occidentalis* is well known and includes digeneans, cestodes, nematodes and acanthocephalans (Casanova et al., 1996; Ribas and Casanova, 2006). Among digeneans, the species *Ityogonimus lorum* (Dujardin, 1845), *I. ocreatus* (Goeze, 1782) (Brachylaimidae) and *Omphalometra flexuosa* (Rudolphi, 1809) (Omphalometridae) are frequently found parasitizing the Iberian mole. Considering brachylaimids, both *Ityogonimus* species are stenoxenous helminths of insectivores of the genus *Talpa* and they have also been found in the European mole, *Talpa europaea* Linnaeus, 1758 (see Davies, 1932; Frankland, 1959; Chiriac and Popescu, 1973; Ribas and Casanova, 2005, 2006). Moreover, *I. ocreatus* has also been cited parasitizing the Italian mole, *Talpa romana* (Thomas, 1902), in Calabria (Southern Italy) (Milazzo et al. 2002).

Mixed digenean infections of *I. lorum* and *O. flexuosa* or *I. ocreatus* and *O. flexuosa* have frequently been observed by several authors in the genus *Talpa*. For example, Frankland (1959) described the occurrence of *I. lorum, I. ocreatus* and *O. flexuosa* in *T. europaea* in the United Kingdom, but no co-infection of both *Ityogonimus* species was described. Other helminthological studies of the European mole describe only one of the *Ityogonimus* species. Chiriac and Popescu (1973) and Shimalov and Shimalov (2001) found only *I. ocreatus* (described as *I. talpae*) in Romania and Belarus, respectively. Ribas and Casanova (2005) found only *I. lorum* and also the digenean *Nephrotrema*

truncatum (Leuckart, 1842) in the helminthological survey of *T. europaea* in Southwestern Europe (France and Spain).

Regarding the Italian mole, *T. romana*, Milazzo et al. (2002) analysed its parasite community in Southern Italy and they found six helminth species, with the presence of only one digenean, *I. ocreatus*.

Previous studies on the parasitic helminth fauna of the Iberian mole were carried out by Casanova (1993) and Casanova et al. (1996), who found only three digeneans (*I. lorum*, *I. ocreatus* and *O. flexuosa*). The prevalences of *Ityogonimus* spp. were 11.0% for *I. lorum* and 1.9% for *I. ocreatus*, and a co-infection of both brachylaimids was never found by these authors. In this sense, Frankland (1959) and Casanova (1993) hypothesised about an apparent negative interaction between *I. lorum* and *I. ocreatus* at the level of the individual host, since both European moles and Iberian moles parasitized by *Ityogonimus* harboured exclusively one of the species.

Here we report for the first time the co-infection of *I. lorum* and *I. ocreatus* in the Iberian mole *T. occidentalis* in Asturias (NW Spain). Moreover, the present finding constitutes the first record of mixed infections of *Ityogonimus* spp. not only in the Iberian mole, but also for the genus *Talpa*.

The present study was based on six Iberian moles trapped accidentally during a vole pest control campaign in four localities of Asturias (Spain): Coceña (3 specimens), Oles (1), Priesca (1) and Vegadali (1). After host necropsies, the recovered live digeneans were fixed between slides and coverslips with Bouin and posteriorly rinsed in 70º ethanol. Then, specimens were stained with Semichon carmine, differentiated with 50% acid alcohol solution, dehydrated in an ethanol series (80º, 90º, 96º) and isopropyl alcohol, cleared with clove oil, and finally mounted on slides with Canada balsam (Figs. 1A and

B). Measurements of both gravid *Ityogonimus* species are shown in Table 1 in order to establish the differential characters for specific classification.

In this study, *I. lorum-I. ocreatus* co-infection was detected in two of the six studied hosts (33.3%). In these two moles the individual intensities of each brachylaimid were: 18 *I. lorum* + 7 *I. ocreatus* and 4 *I. lorum* + 13 *I. ocreatus*. On the other hand, in the whole sample, prevalences of *I. lorum* and *I. ocreatus* were respectively 50% and 83.3% (see Table 2).

Within the Brachylaimidae, the genus *Ityogonimus* belongs to the subfamily Ityogoniminae, which also includes the genus *Scaphiostomum*. Species of *Ityogonimus* are distinguished by their reduced suckers and by the presence of a short oesophagus (Pojmańska, 2002). Both *I. lorum* and *I. ocreatus* are filiform digeneans with two small suckers clearly separated from each other. This is the most evident difference when comparing to *Scaphiostomum* species, which presents oral and ventral suckers close together. In all *Ityogonimus* specimens, the prepharynx and the oesophagus are very reduced whereas the pharynx is well-developed. The two caeca extend up to the posterior end of the body. Gonads are situated near the posterior extremity. Testes are well separated and the ovary is located between them. Both ovary and testes are intracaecal and sub-spherical to oval in shape. The two testes are disposed in tandem. The genital pore is localised between the ovary and the posterior testis, at the anterior level of the posterior testis. The vitellarium is formed by two lateral and extracaecal vitelline fields that extend from the ventral sucker to the level of the anterior testis (Fig. 1A and B). The main morphometric differences between *I. lorum* and *I. ocreatus* are: (i) the body length (4.18 mm vs 15.02 mm), (ii) the ventral sucker diameter (432 µm vs 106 µm), (iii) the ratio between suckers (OS/VS) (0.81 vs 3.48), and (iv) the distance between suckers (976 µm vs 3,846 µm) (see Table 1).

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Legends of figures

Fig. 1A and B. *Ityogonimus* spp. after Semichon's acetic carmine staining. **A** – *Ityogonimus lorum*; **B** – Genital region of *Ityogonimus ocreatus*

Abbreviations: C – caeca, CS – cirrus sac, GP – genital pore, Ov – ovary, Oo – ootype, OS – oral sucker, Ph – pharynx, T1 – anterior testis, T2 – posterior testis, U – uterus, V – vitelline fields, VS – ventral sucker

Table 1. Morphometric data of *Ityogonimus* spp. from *Talpa occidentalis* in Asturias, Spain

	Ityogonimus lorum	*Ityogonimus ocreatus*
	Average (range) (n=8; n=80 for eggs)	Average (range) (n=7; n=40 for eggs)
Body length	4,176.7 (2,704–5,624)	15,022.1 (14,044–16,996)
Maximum width	614.0 (433–784)	848.7 (712–970)
Ph Ø	147.7 (112–165)	151.0 (135–168)
OS Ø	350.2 (232–480)	352.3 (307–455)
VS Ø	432.1 (289–511)	106.1 (67–125)
OS/VS ratio	0.81 (0.75–0.96)	3.48 (2.64–4.75)
VS/OS ratio	1.25 (1.04–1.34)	0.30 (0.21–0.38)
OS–VS	976.4 (784–1,218)	3,846.5 (2,910–4,932)
T1 Ø	215.5 (168–271)	470.6 (374–573)
T2 Ø	246.8 (177–359)	520.71 (464–576)
T1–T2	597.2 (268–929)	1,230.5 (877–1,496)
T1–Ov	153.5 (41–237)	322.4 (237–433)
Ov–T2	298.0 (113–526)	822.9 (619–1114)
T1–Posterior end	981.4 (402–1,393)	2,499.8 (2,043–3,137)
T2–Posterior end	122.5 (62–299)	268.3 (217–340)
Ov Ø	152.8 (125–180)	382.2 (341–454)
CS Ø	60.7 (48–73)	138.2 (86–176)
GP–Posterior end	326.8 (155–464)	874.4 (216–1238)
Right V–VS	250.2 (93–423)	-121.2 (-960–506)
Left V–VS	261.8 (124–310)	-598.5 (-877–-258)
VS–right V	1,607.2 (495–2,456)	5,716.8 (1,579–7,646)
VS–left V	1,645.9 (444–2,580)	6,204.4 (2,456–7,946)
Eggs Ø	13.0 x 28.4 (11–26 x 15–30)	13.6 x 30.8 (13–30 x 14–32)

All measurements (except sucker ratios) are given in micrometres. CS – cirrus sac, GP – genital pore, OS – oral sucker, Ov – ovary, T1 – anterior testis, T2 – posterior testis, V – vitelline fields, VS – ventral sucker

Table 2. Prevalence, mean intensity and mean abundance of *Ityogonimus* spp. from *Talpa occidentalis* in Asturias, Spain (n=6)

	n	Prevalence	Mean Intensity (range)	Mean Abundance
Ityogonimus lorum	3	50.0	8.0 (2-18)	4.0
Ityogonimus ocreatus	5	83.3	10.6 (2-17)	8.8
Co-infection *I. lorum-I. ocreatus*	2	33.3		

Figure

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