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# *Telosentis exiguus* (von Linstow, 1901) (Palaeacanthocephala: Illiosentidae), a generalist parasite of fishes in the Mediterranean basin

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**Abstract** The morphology of material of the acanthocephalan genus *Telosentis* van Cleave, 1923 from different parts of the Mediterranean basin is examined in order to assess the validity of *T. molini* van Cleave, 1923. A redescription of *T. exiguus*, a generalist species of fishes in the Mediterranean basin, is presented especially in relation to the number of proboscis hooks. The main characteristic of *T. exiguus* is a cylindrical or club-shaped proboscis, which is covered with 12 longitudinal rows of 14–19 hooks in males and 16–20 in females. Males and females differ in both body size and the number of proboscis hooks.

*T. molini* is considered a junior synonym of *T. exiguus*. A key to the species of *Telosentis* is presented.

## Introduction

The acanthocephalans of the genus *Telosentis* van Cleave, 1923 (Palaeacanthocephala: Illiosentidae) are parasitic in marine and brackish water fishes and distributed in the Mediterranean basin (two species) and in Indian (two species) and Western Australian waters (one species) (Golvan, 1969; Gupta & Gupta, 1990). *T. exiguus* (von Linstow, 1901) Kostylew, 1926 is a common parasite of a wide spectrum of fishes, such as atherinids, gobiids, labrids, blenniids, syngnathids, etc., in the Black and Adriatic Seas (Meyer, 1932; Florescu, 1942; Florescu & Ieniştea, 1984; Petrochenko, 1956; Golvan, 1969; Dezfuli & Sbrenna, 1990; Belofastova & Korniyuchuk, 2000; Kvach, 2002). Another species, *T. molini* van Cleave, 1923, was originally described from the sand-smelt *Atherina hepsetus* L. in Italian coastal waters. It has also been recorded from the garpike *Belone belone* (L.) in French Mediterranean coastal waters and the ginger goby *Neogobius eurycephalus* (Kessler) in the Sea of Azov, Ukraine (Golvan, 1969; Naidenova, 1974). According to Meyer (1932), Yamaguti (1963) and Golvan (1969), this parasite also occurred in other fish species (*Dicentrarchus labrax* (L.), *Gobius niger* L., *Anguilla anguilla* (L.), *Lophius piscatorius* L., *Pomatomus saltatrix* (L.), etc.) in the Mediterranean basin.

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Existing data indicate that *T. exiguus* and *T. molini* are generalist parasites because they were found in a large number of fish hosts. However, they have been recorded from the same hosts and regions. Since both species are very similar in their morphology and differ only in the number of hooks on the proboscis (van Cleave, 1947; Golvan, 1969; Petrochenko, 1956), their validity remains questionable. These species are characterised by variation in their morphological characteristics. Monks (2001) found a variation in the number of cement glands in both *T. molini* and *T. exiguus*, and noted that *Telosentis* is in need of revision. The aim of the present work was to study the morphology of *Telosentis* species in different regions of the Mediterranean basin and to assess the validity of *T. molini*.

## Materials and methods

The acanthocephalans were collected in three localities: north-western Black Sea (NWBS) (Tuzly's Lagoons—45°48'N, 30°02'E; Gulf of Odessa—46°26'N, 30°46'E; Adzhalyk Lagoon—46°37'N, 30°54'E; Tyligul Estuary—46°39'N, 31°10'E; Hryhorivsky Estuary—46°37'N, 31°00'E), Southern Crimean coastal waters of the Black Sea (Sevastopol Bay—44°35'N, 33°28'E), and the Mediterranean coast of France (Salses-Leucate Lagoon—42°50'N, 2°57'E). The acanthocephalans were fixed in 70% ethanol for morphological study. In total, 46 specimens with a fully-everted proboscis (24 males and 22 females) were studied (Table 1).

Measurements are given in micrometres as the range followed by the mean in parentheses; for two-dimensional measurements, length is given before breadth. A total of 21 morphometric parameters were

measured: length of body (Lb); length and width of trunk (Lt, Wt); length and width of neck (Ln, Wn); length and width of proboscis (Lp, Wp); length and width of proboscis sac (Lbs, Wps); length of lemnisci (Ll); length and width of testes (Lts, Wts); length and width of Saeftigen's pouch (Lsp, Wsp); length and width of embryophore (Le, We); length and width of acanthor (La, Wa); length of tegumental spines (Lst); length of hooks in individual row with its maximal number (Lh). The number of cement glands (Ncg), number of hook rows (Nhr) and number of proboscis hooks in six rows (Nh) were also counted.

The acanthocephalans were studied in temporary glycerine mounts under light microscopy with phase contrast using an Olympus BX51. Embryophores were studied under the magnification of  $\times 100$  with immersion oil. Illustrations were made using Olympus drawing attachment.

Voucher specimens of *T. exiguus* (entire worms preserved in 70% ethanol) are deposited in the Helminthological collection of the Institute of Parasitology, BC AS CR, České Budějovice, Czech Republic (Coll. No. A-80) and in the Helminthological collection of the National Museum of Natural History, Paris, France (Coll. Nos. HEL64, HEL65).

## Results

Considering the morphological characteristics of the parasites studied, we considered that all the specimens belong to *Telosentis exiguus*. Below, we consider *T. molini* as a junior synonym of *T. exiguus*.

### Family Illiosentidae Golvan, 1960

**Table 1** A list of hosts and the numbers of acanthocephalans studied from different localities

Locality	Host	Number of acanthocephalans studied	
		Males	Females
Salses-Leucate, France	<i>Atherina boyeri</i> Risso	4	5
NWBS, Ukraine	<i>A. boyeri</i>	1	1
	<i>Zosterisessor ophiocephalus</i> (Pallas)	6	5
	<i>Neogobius fluviatilis fluviatilis</i> (Pallas)	1	3
	<i>Neogobius ratan</i> (Nordmann)	4	2
	<i>Aidablennius sphyinx</i> (Valenciennes)	2	1
Sevastopol Bay, Ukraine	<i>Atherina hepsetus</i> L.	6	5

***Telosentis exiguus* (von Linstow, 1901)**

Syns *Echinorhynchus exiguus* von Linstow, 1901; ?*E. atherinae* Rudolphi, 1819; ?*E. acanthosoma* We-strumb, 1821; ?*E. lateralis* Molin, 1858; *Telosentis molini* van Cleave, 1923 (new synonym)

*Type-locality*: Gulf of Yalta, Black Sea.

*Other localities*: The Black Sea, including lagoons, estuaries and river deltas; lagoons of the Adriatic Sea; Mediterranean Sea (coasts of France and Sardinia).

*Type-host*: *Engraulis encrasicolus* (L.) (Engraulidae).

*Other hosts*: *Atherina boyeri* Risso, *A. hepsetus* L. (Atherinidae), *Alosa kessleri* (Grimm) (Clupeidae), *Belone belone* (L.) (Belonidae), *Anguilla anguilla* (L.) (Anguillidae), *Gasterosteus aculeatus* L. (Gasterosteidae), *Syngnathus abaster* Risso (Syngnathidae), *Zosterisessor ophiocephalus* (Pallas) (Gobiidae), different species of gobiids, labrids and blenniids.

*Material studied*: Tables 1, 2.

**Description (Figs. 1–3, Table 2)**

Small worms with body divided in 2 parts, praesoma (proboscis and neck) and metasoma (trunk). Males and females differ in body size and in number of hooks on proboscis. Trunk cylindrical, tapers toward posterior end, covered with spines anteriorly and also posteriorly around subterminal gonopore. Spines on anterior region distributed in parallel rows, 12–23 long (mean 18), more numerous on ventral side. Spines around gonopore smaller, 6–13 (9). Cerebral ganglion located in central region of proboscis sac, sometimes closer to anterior region. Proboscis cylindrical or club-shaped, covered with 12 longitudinal rows of hooks of same type; hooks smaller on posterior part of proboscis, largest in central part. Roots of all hooks have long, anteriorly directed appendix (Fig. 3). Basal parts of most hooks covered with tegument. Neck without hooks, but with 2 openings connected to sensory organs.

***Male* (n = 24)**

Body smaller than for females, 2,635–5,410 (4,074). Trunk 2,114–4,499 × 296–644 (3,281 × 438). Proboscis sac 625–1,657 × 296–644 (1,039 × 192). Lemnisci with same length as proboscis sac or slightly shorter, 518–1,295 (916).

Two oval testes are in third quarter of trunk, occasionally more towards central but always close to

cement glands, 188–749 × 103–368 (414 × 237). Eight pyriform cement glands, always located in posterior region of body. Saeftigen's pouch variable in size, 396–1,052 × 65–205 (681 × 126).

Proboscis 441–850 × 87–239 (689 × 152), armed with 12 longitudinal rows of 14–19 (16) hooks; lower hook numbers occurred in specimen with 14–16 hooks per row and in 2 specimens with 15–17 hooks per row; maximum hook number occurred in specimen with 17–19 hooks per row; other specimens had 16–18 hooks per row. Hooks are of different sizes, length 16–52 (34); longest hooks are in middle of proboscis; basal hooks measure 16–24 (19); apical hooks are intermediate in size, 22–44 (34).

***Female* (n = 22)**

Females larger than males; body 3,221–7,387 (5,098). Trunk 2,168–6,276 × 333–902 (4,141 × 514). Proboscis sac 950–1,708 × 123–280 (1,287 × 209). Lemnisci almost as long as proboscis sac, 716–2,290 (1,187).

Proboscis is 620–994 × 102–250 (834 × 175), covered by 12 longitudinal rows of 16–20, usually 16–18 (17) hooks; maximal hook number was found in 3 specimens, which had 17–20 hooks per row. Size of hooks 15–61 (37) in length; longest hooks in middle of proboscis; basal hooks 15–26 (21); apical hooks intermediate in size, 27–49 (36).

Embryophore 39–60 × 14–21 (49 × 17), with polar prolongations of median membrane; membrane may be indistinct and only acanthor clearly seen. Acanthor 25–39 × 9–14 (32 × 11).

**Discussion**

*Telosentis exiguus* was described as *Echinorhynchus exiguus* by von Linstow (1901) from the anchovy *Engraulis encrasicolus* caught in the Black Sea near the City of Yalta. Van Cleave (1923) created a new genus, *Telosentis*, with the type-species, *T. molini*, from the sandsmelt *Atherina hepsetus* in Italian waters (the locality is not mentioned more precisely). The description was based on large specimens (6.0–8.6 mm long), but the sex of the specimens was not mentioned. Van Cleave (1923) noted that the proboscis of *T. molini* has 12 longitudinal rows of hooks with about 20 hooks in each. Later, Kostylew (1926) moved *Echinorhynchus exiguus* to *Telosentis*

**Table 2** Measurements of *Telosestis exiguus* from different localities

Region	Salses-Leucate Lagoon, France		NWBS, Ukraine		Crimean near-shores, Ukraine	
	Males (4) <i>Atherina boyeri</i>	Females (5)	Males (14) <i>Atherina boyeri</i> , <i>Zosterisessor ophiocephalus</i> , <i>Neogobius fluviatilis</i> , <i>N. ratan</i> , <i>Aidablennius sphynx</i>	Females (12)	Males (6) <i>Atherina hepsetus</i>	Females (5)
Lb <sup>a</sup>	3,882	6,469	4,226	4,855	3,848	4,309
	2,880–5,048	5,376–7,387	3,013–5,410	3,221–7,246	2,635–4,653	3,445–5,782
Lt	3,103	5,360	3,390	3,909	3,145	3,477
	2,148–4,201	4,239–6,276	2,266–4,499	2,168–6,233	2,114–3,872	2,734–4,816
Wt	401	699	445	470	448	434
	324–477	574–902	315–644	334–788	296–583	333–591
Lp	666	962	737	837	594	699
	574–741	897–994	638–850	732–909	441–693	620–812
Wp	176	205	155	171	130	153
	137–239	161–249	126–195	102–243	87–167	132–182
Ln	114	147	106	119	109	132
	86–162	127–171	55–162	63–179	74–130	91–213
Wn	184	219	178	174	141	153
	136–219	192–241	130–233	135–223	96–171	129–175
Lps	1,029	1,617	1,086	1,258	936	1,023
	888–1,215	1,534–1,708	732–1,567	979–1,496	625–1,094	950–1,115
Wps	186	254	205	209	166	165
	130–242	240–280	141–315	157–256	110–194	123–205
Ll (longer)	859	1,618	959	1,074	845	989
	702–1,154	1,229–2,290	657–1,295	817–1,477	611–1,079	759–1,199
Ll (shorter)	847	1,342	911	981	837	965
	673–1,154	1,185–1,514	518–1,229	716–1,323	608–1,055	757–1,148
Lsp	813		638		696	
	743–904		396–1,052		417–941	
Wsp	188		106		128	
	161–205		65–142		75–170	
Ncg	8		8		8	

Table 2 continued

Region	Salses-Leucate Lagoon, France		NWBS, Ukraine		Crimean near-shores, Ukraine	
	Males (4) <i>Atherina boyeri</i>	Females (5)	Males (14) <i>Atherina boyeri</i> , <i>Zosterisessor ophiocephalus</i> , <i>Neogobius fluviatilis</i> , <i>N. ratan</i> , <i>Aidablennius sphynx</i>	Females (12)	Males (6) <i>Atherina hepsetus</i>	Females (5)
Lts (anterior)	433		417		398	
Wts (anterior)	319–545		245–747		242–604	
	290		214		250	
Lts (posterior)	225–365		108–368		173–323	
	454		354		408	
Wts (posterior)	331–673		188–588		256–591	
	270		189		226	
	187–324		103–333		186–258	
Le		48.5		49.5		49.0
		42.0–52.5		39.0–59.5		42.5–58.5
We		17.5		17.5		17.5
		15.5–19.5		14.0–21.0		15.0–20.5
La		32.0		32.5		32.0
		27.5–34.5		25.5–39.0		28.0–38.0
Wa		11.5		11.5		11.5
		10.0–12.5		9.0–14.0		10.0–13.5
Lst (anterior)	14.5	16.0	18.0	19.5	15.0	19.0
	12.5–16.5	15.5–16.5	14.0–22.5	15.5–22.5	12.0–18.5	15.5–21.0
Lst (posterior)	7.0	8.5	9.0	9.5	10.5	10.0
	7.0–7.5	7.0–10.0	5.5–12.5	7.5–13.0	9.5–12.0	9.0–10.5
Lp	666	962	737	837	594	699
	574–741	897–994	638–850	732–909	441–693	620–812
Wp	176	205	155	171	130	153
	137–239	161–249	126–195	102–243	87–167	132–182
Nhr	12	12	12	12	12	12
Nh	16	18	17	17	15	16
	15–17	16–20	16–19	16–20	14–17	16–17

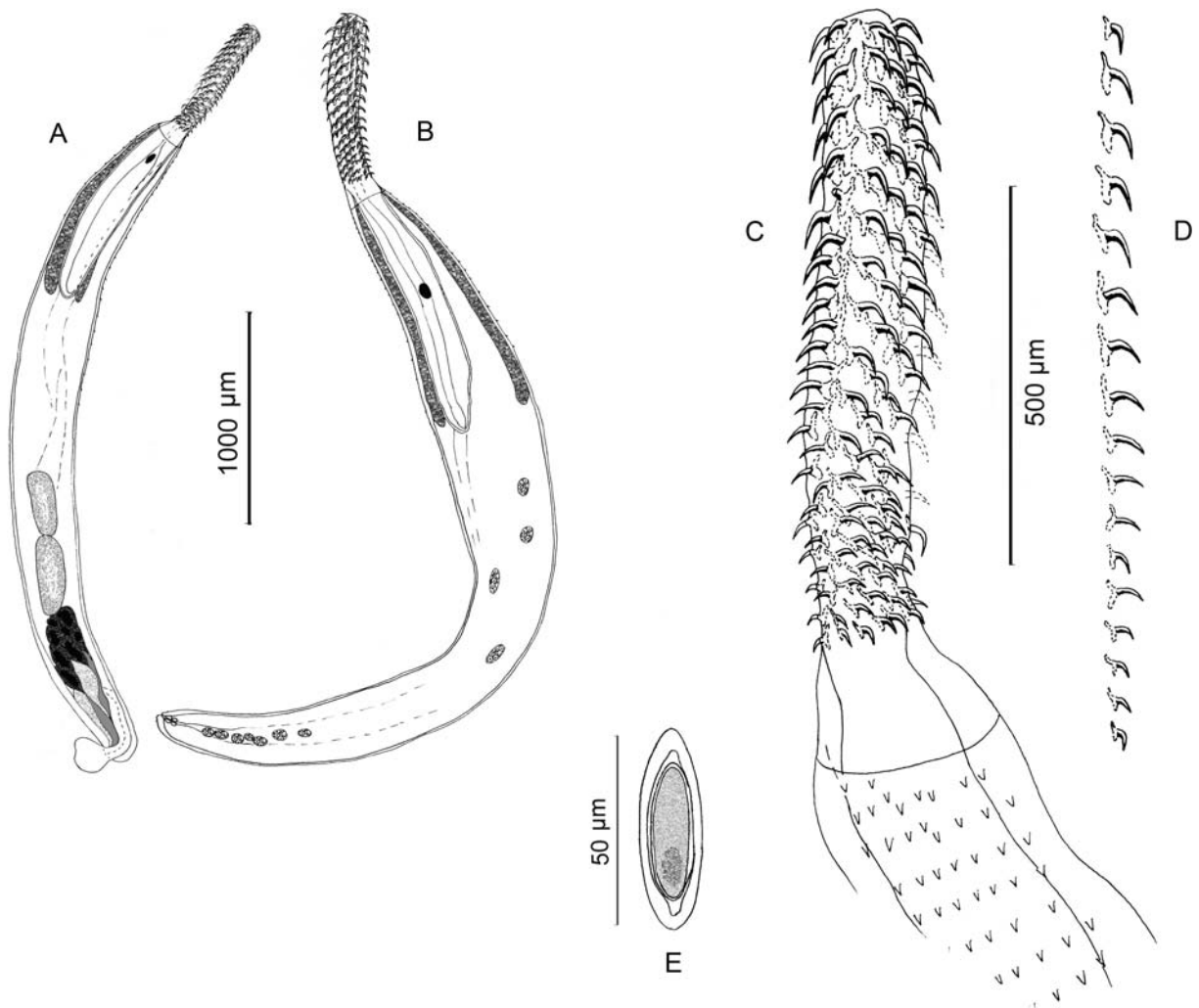
Table 2 continued

Region	Salses-Leucate Lagoon, France		NWBS, Ukraine		Crimean near-shores, Ukraine	
	Males (4) <i>Atherina boyeri</i>	Females (5)	Males (14) <i>Atherina boyeri</i> , <i>Zosterisessor ophiocephalus</i> , <i>Neogobius fluviatilis</i> , <i>N. ratan</i> , <i>Aidablennius sphynx</i>	Females (12)	Males (6) <i>Atherina hepsetus</i>	Females (5)
Lh	36.0	39.5	35.0	38.5	31.5	32.5
Lh (basal)	18.0–52.5	17.5–61.5	17.0–56.5	15.5–56.0	16.0–53.0	15.5–52.0
Lh (apical)	20.5	21.5	19.5	20.5	19.0	19.0
	18.0–23.0	17.5–26.0	17.0–24.0	15.5–26.0	16.0–21.0	15.5–22.0
	36.5	35.5	35.0	38.5	29.5	33.5
	32.5–43.5	27.0–41.0	22.0–44.0	28.5–48.5	24.5–37.0	28.0–37.5

<sup>a</sup> For abbreviations see 'Materials and methods'

based on a redescription of acanthocephalans from the sandsmelt *Atherina boyeri* in Crimean coastal waters, Ukraine. All other authors (e.g. Petrochenko, 1956; Golvan, 1969) then repeated the data of Kostylew (1926). In the north-western Black Sea, in Ukrainian waters, *T. exiguus* was first reported by Florescu (1942), who noted that the proboscis of this species has 17–18 hooks in each row and that the smaller body-size of *T. exiguus* was the main differentiating feature with respect to *T. molini* from the Mediterranean Sea. Van Cleave (1947) mentioned that many of the proboscis hooks of *T. exiguus* protruded from a tegumental theca, which is absent in *T. molini*. Golvan (1969) made a new description of *T. molini* based on two males and two females from the garpike *Belone belone* from off Sète, France. He found a tegumental theca present at the base of the hooks, 20–22 hooks per row and smaller sizes of specimens (males 2.34–2.95 and females 3.2–3.9 mm long). Therefore, the only difference between *T. exiguus* and *T. molini* was the number of hooks.

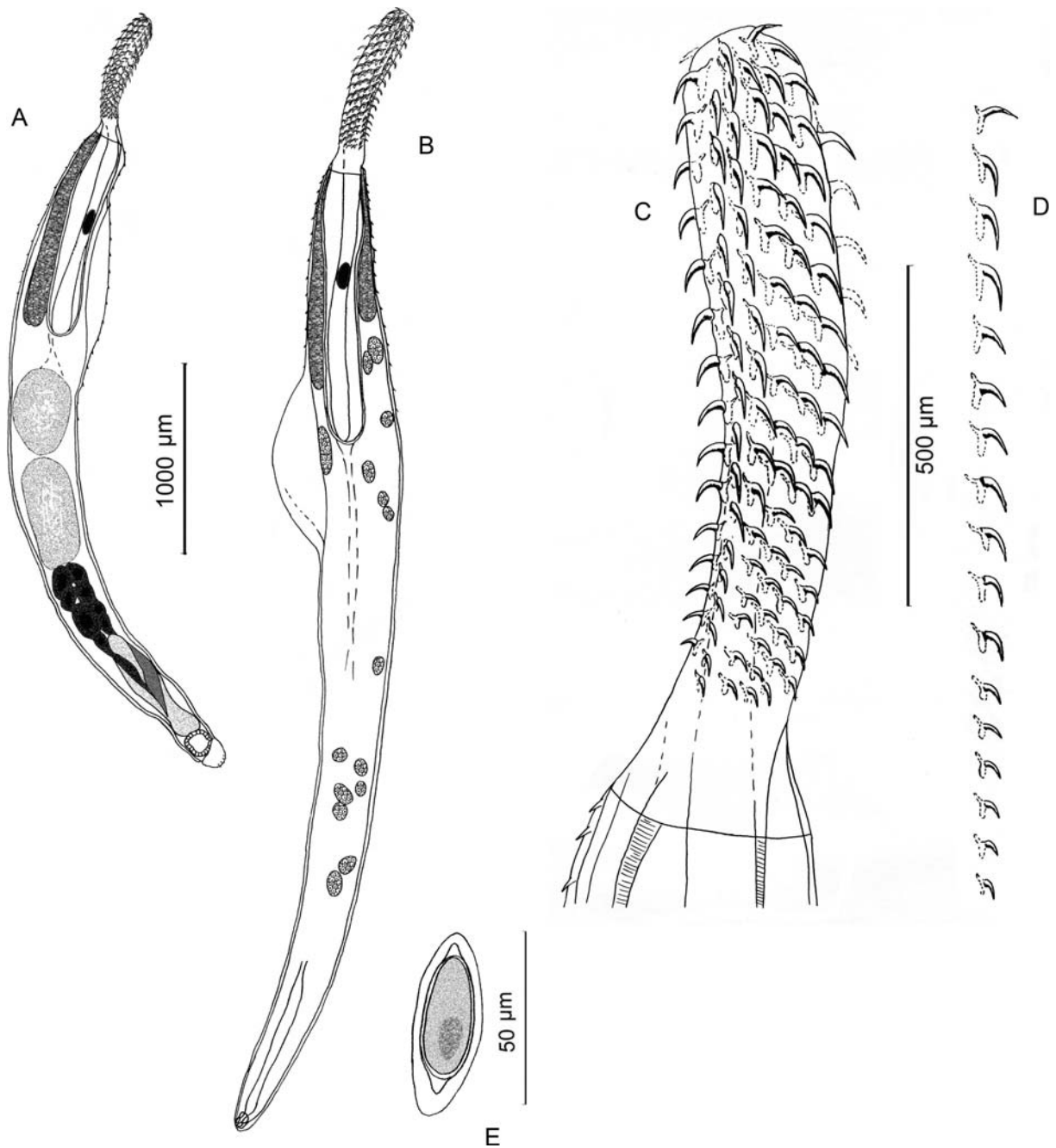
However, one species (*T. molini*) was indicated as being Mediterranean and the other (*T. exiguus*) as Pontic (Florescu, 1942). Nevertheless, Naidenova (1974) reported a specimen of *T. molini* in the ginger goby *Neogobius eurycephalus* from the Sea of Azov. The first record of *T. exiguus* outside the Black Sea basin was mentioned by Dezfuli et al. (1989), who found cystacanths in gammarids from the Sacca di Scardovari in the northern Adriatic Sea. It was later recorded from *A. boyeri* in the Mediterranean Sea off Tirso, western Sardinia (Dezfuli & Rossi, 1991). According to Dezfuli & Sbrenna (1990), the only difference between *T. exiguus* and *T. molini* from *A. boyeri* in the Adriatic Sea at Sacca di Scardovari was the number of hooks in each row on the proboscis (i.e. 16–18 in *T. exiguus* and 20 in *T. molini*). Later, Oğuz (1991) reported *T. exiguus* in the flounder *Platichthys flesus* (L.) from Ekinli Lagoon, Sea of Marmara, Turkey. He mentioned that the proboscis had 10–14 rows with 17–19 hooks each row, but a subsequent and more detailed analysis of these samples revealed the presence of 12 rows of hooks (M.C. Oğuz, pers. comm.). The most recent description of *T. exiguus* was that given by Belofastova & Korniychuk (2000), who mentioned 16–18 hooks per row in worms from different fish species caught in Crimean coastal waters (Ukraine).



**Fig. 1** A general view of *Telosentis exiguus* (specimens from the NWBS, Ukraine): A, male; B, female; C, proboscis; D, a single hook row; E, egg

While studying specimens from fishes in French and Ukrainian brackish waters, we found that the number of hooks could vary from 16 to 20 in females and from 15 to 17 (sometimes 14–16) in males. Females were always larger than males (Table 2). The largest specimens were found in the Salses-Leucate Lagoon on the French coast; the specimens from the north-west Black Sea (NWBS) were of almost the same size, but the mean size of the males was greater. The Mediterranean specimens had a proboscis with 15–17 hooks in males and 16–20 in females (Table 2), whereas in the NWBS no specimens had fewer than 16 hooks, but we found females with 17–20 hooks. The specimens from Crimean

coastal waters were usually small and had fewer hooks per row (specimens with 20 hooks were not found). The males in some cases had low numbers of hooks, i.e. 14–16 or 15–17 per row, but this number of hooks never occurred in females (Table 2). So the main characteristic of *T. exiguus* is a cylindrical or club-shaped proboscis covered with 12 longitudinal rows of 14–19 of hooks in males and 16–20 in females. Males and females differ in the body size and the number of proboscis hooks. Therefore, based on the high variability of *T. exiguus* in term of hook number and size, we believe that *T. molini* was described from large specimens and should be considered a junior synonym of this species.

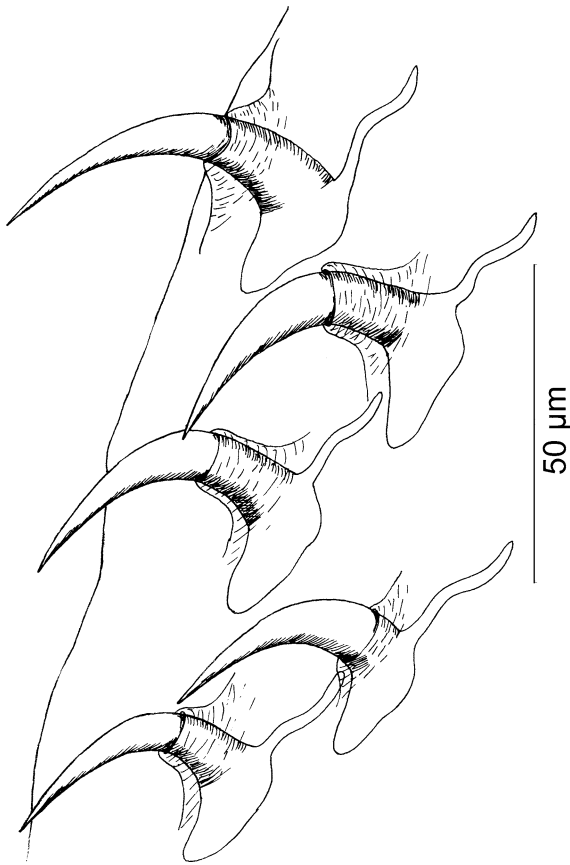


**Fig. 2** *Telosentis exiguus* (specimens from the Salses-Leucate Lagoon, Mediterranean Sea, France): A, male; B, female; C, proboscis; D, a single hook row; E, egg

*Telosentis exiguus* is the only generalist species of the genus, being found in different fish hosts in the Mediterranean basin. Three other species are specialists. One species, *T. australiensis* Edmond, 1964, was described from the speckled longfin eel *Anguilla*

*reinhardtii* Steindachner (Anguillidae) off Brisbane, Australia (Edmonds, 1964; Golvan, 1969). This species differs from *T. exiguus* in that the proboscis is armed with 16 longitudinal rows of 23–26 hooks and in the lack of spines on the posterior part of the





**Fig. 3** The hooks showing the appendices of roots and with the theca visible in the basal region

body. The second species, *T. mizellei* Gupta & Fatma, 1988, was described based on a single badly fixed male from the John's snapper *Lutjanus johnii* (Bloch) (Lutjanidae) off the southern Indian state of Tamil Nadu (Gupta & Fatma, 1988). Gupta & Fatma (1988) noted that this specimen had a proboscis armed with 16 hook rows (the same as *T. australiensis*) with 20 hooks in each, but this is not visible in the illustration, so the number of hooks per row may be different. According to its description, *T. mizellei* differs from *T. australiensis* in the presence of genital spines and fewer hooks in each row. And the third species, *T. lutianusi* Gupta & Gupta, 1990, was described from the onspot snapper *Lutjanus monostigma* (Cuvier) (as *L. lioglossus* Bleeker) (Lutjanidae) off the eastern Indian state of Orissa (Gupta & Gupta, 1990). This species has a proboscis armed with 20 longitudinal rows of 15 hooks. The differences between the species of *Telosentis* are summarised in the following key.

#### Key to the species of *Telosentis*

1. Proboscis armed with 12 longitudinal rows of hooks; generalist.....*T. exiguus* (von Linstow, 1901)
- Proboscis armed with more than 12 longitudinal rows of hooks.....2
2. Proboscis armed with 20 longitudinal rows of hooks; parasitic of lutjanid fishes off India.....*T. lutianusi* Gupta & Gupta, 1990
- Proboscis armed with 16 longitudinal rows of hooks.....3
3. Proboscis armed with 23–26 hooks per row; genital spines absent; cement glands pressed close together; parasitic in Australian eels.....*T. australiensis* Edmond, 1964
- Proboscis armed with 20 hooks per row; genital spines lacking; cement glands not pressed together; parasitic in lutjanid fishes off India.....*T. mizellei* Gupta & Fatma, 1988

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