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VERSITA

Allopodocotyle tunisiensis sp. nov. (Digenea, Opecoelidae), a parasite of *Solea aegyptiaca* (Teleostei, Soleidae) off Tunisia

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Abstract

Allopodocotyle tunisiensis sp. nov. is described from the intestine of *Solea aegyptiaca* Chabanaud collected from the Gulf of Gabès in the Mediterranean Sea off Tunisia. The new species belongs to the group C of *Allopodocotyle* Pritchard, 1966 species (*sensu* Bray 1987). It differs from its congeners in this group by the shape of the seminal vesicle and the anterior extend of the vitellarium which varies between just posterior to the ventral sucker and anterior margin. A key to the *Allopodocotyle* species of group C is presented. The status of the genera *Allopodocotyle* and *Macvicaria* (Gibson and Bray 1982) are briefly discussed.

Keywords

Digenea, *Allopodocotyle tunisiensis* sp. nov., Opecoelidae, *Solea aegyptiaca*, Pleuronectiformes, Gulf of Gabès, Tunisia

Introduction

Allopodocotyle Pritchard, 1966 was erected by Pritchard (1966) to include *Podocotyle*-like opecoelids with an entire, rather than a lobed, ovary. It currently contains about 24 species (Cribb 2005) and has been reported from shallow-water and deep-sea fishes (Gibson 1995, Bray 2004). It shows considerable diversity in host and geographical distribution. Only three species, *A. pedicellata* (Stossich, 1887), *A. jaffensis* (Fischthal, 1980) and *A. israelensis* (Fischthal, 1980), have been described from the Mediterranean Sea, all are parasites of sparids.

The present study is the description of a new species of *Allopodocotyle* from *Solea aegyptiaca* Chabanaud, 1927 caught in the Gulf of Gabès (Tunisia).

Materials and methods

Fish were caught off the coast of the Gulf of Gabès at Skhira (34°05′N, 10°01′E), Kerkennah (34°45′N, 11°17′E) and Sidi Mansour (34°46′N, 10°48′E) by local fishermen using gill nets. They were identified using Fischer *et al*. (1987) and Whitehead *et al*. (1984). These fish were dissected as soon as they had died and examined for digeneans. Living parasites were partially compressed beneath slide and coverslip and examined using an optical microscope. Some parasites were slightly compressed between a slide and coverslip and fixed with 70% alcohol. Some living specimens were washed in cold saline then fixed in hot saline and preserved in 5% formalin. All fixed specimens were stained with Semichon's acetic carmine. After dehydration using a graded ethanol series, the parasites were cleared in clove oil and mounted in Canada balsam.

Drawings were made using a light microscope equipped with a drawing tube and then scanned and redrawn on a computer with Corel Draw Software. Measurements are given in micrometres as the range followed by the mean and number of measurements in parentheses.

Results

Class: Trematoda Rudolphi, 1808
Subclass: Digenea Carus, 1863
Superfamily: Allocreadioidea Looss, 1902
Family: Opecoelidae Ozaki, 1925
Subfamily: Plagioporinae Manter, 1947
Genus: *Allopodocotyle* Pritchard, 1966

***Allopodocotyle tunisiensis* sp. nov.** (Figs 1–3)

Description based on 16 whole-mounted specimens and 3 live specimens. Body elongate with forebody more tapered than

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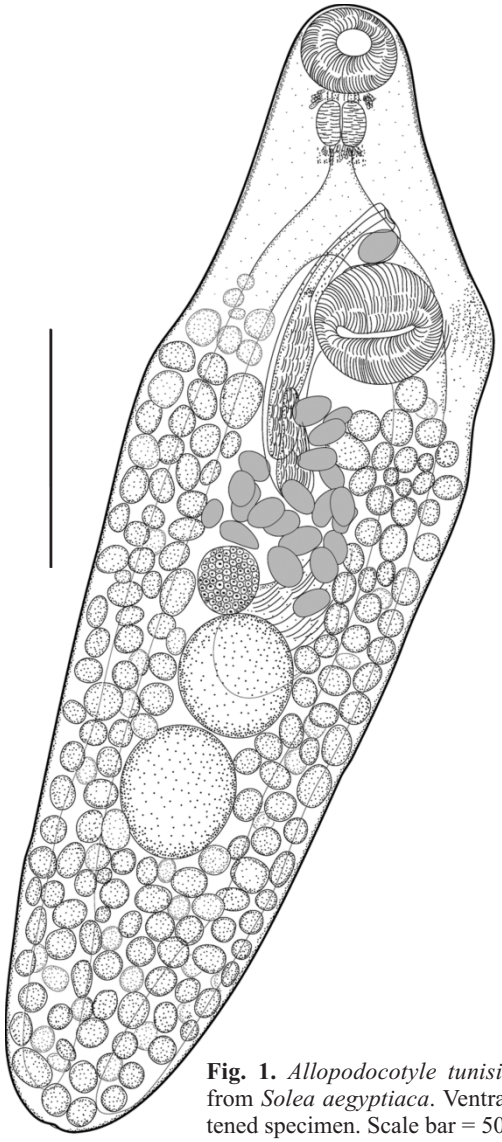

Fig. 1. *Allopodocotyle tunisiensis* sp. nov. from *Solea aegyptiaca*. Ventral view of flattened specimen. Scale bar = 500 μm

hindbody; extremities rounded. Length 950–2,200 (1,631; n = 16); maximum width at level of ventral sucker 300–620 (394; n = 16). Tegument unarmed. Forebody 220–500 (356; n = 16) long, 13–30 (21)% of body length; hindbody 610–1,550 (1,166; n = 16) long; forebody-hindbody length ratio 1:2.3–5.2 (3.4). Small gland-cells accumulated around base of oral sucker and around base of pharynx (Fig. 1). Oral sucker simple, ventro-terminal, relatively small, 60–190 (129; n = 16) × 80–200 (162; n = 16). Ventral sucker 110–250 (205; n = 16) × 100–240 (191; n = 16), rounded, in anterior third of body; slightly protuberant, surrounded by tegumental folds; opening transverse, slit-like. Sucker-ratio 1:1–2.2 (1:0.6) × 1:1–1.3 (1:1.2). Prepharynx short, muscular. Pharynx well-developed, 80–180 (100; n = 15) × 90–220 (113; n = 15), subspherical. Oesophagus always distinct, 40–110 (66; n = 14) long. Intestinal bifurcation just anterior to anterior margin of ventral sucker. Caeca wide, terminate blindly near posterior extremity.

Testes 2, entire, spherical to subspherical, contiguously tandem, intercaecal, in posterior half of body; anterior 90–250 (190; n = 12) × 90–220 (170; n = 12); posterior 110–270 (204; n = 12) × 90–230 (178; n = 12). Post-testicular area 210–600 (338; n = 16) long; 10–45 (22)% of body length. Vasa deferentia unite at base of cirrus-sac. Cirrus-sac long, tubular, frequently recurved, thick-walled, reaches midway between anterior testes and ventral sucker, 290–600 (456; n = 15) by 40–70 (51; n = 15). Seminal vesicle tubular, broad and convoluted with 2 loops proximally, straight distally. Prostatic cells surround short, narrow pars prostatica and long, straight, narrow ejaculatory duct. Genital atrium distinct. Genital pore sinistral to intestinal bifurcation.

Ovary entire, globular, pretesticular; 50–150 (102; n = 14) in diameter; usually contiguous with anterior testis, slightly dextral. Oviduct leaves ovary antero-dorsally, loops postero-dorsally, unites with anterior region of seminal receptacle as it reflexes anteriorly (Fig. 2). Canalicular seminal receptacle large, larger than ovary, overlapping it dorsally, 120–250 (205; n = 8)

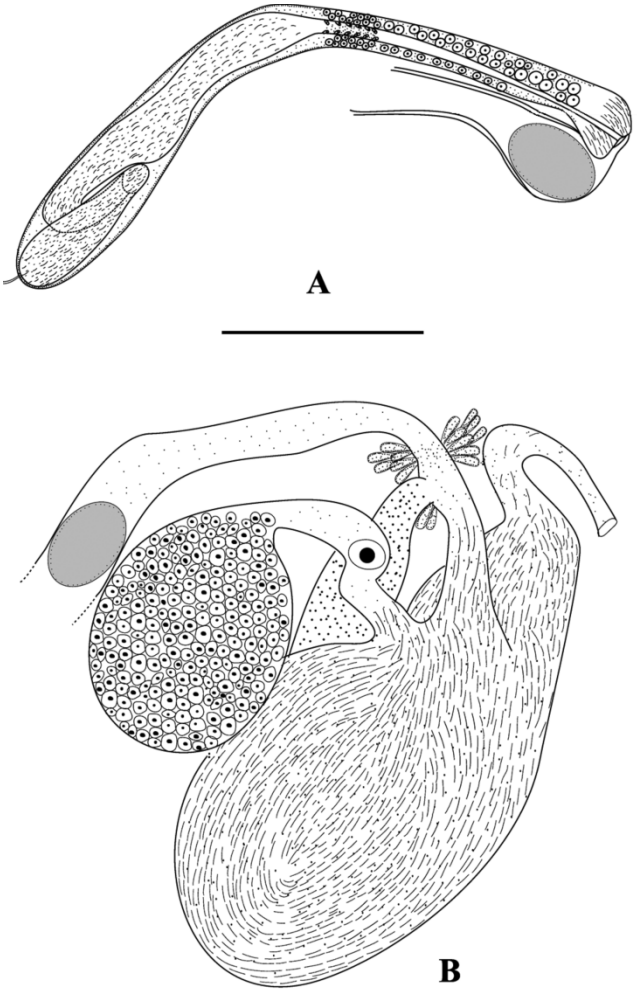

Fig. 2. *Allopodocotyle tunisiensis* sp. nov. from *Solea aegyptiaca*. **A** – ventral view of terminal genitalia. **B** – ventral view of proximal female genitalia. Scale bar = 200 μm

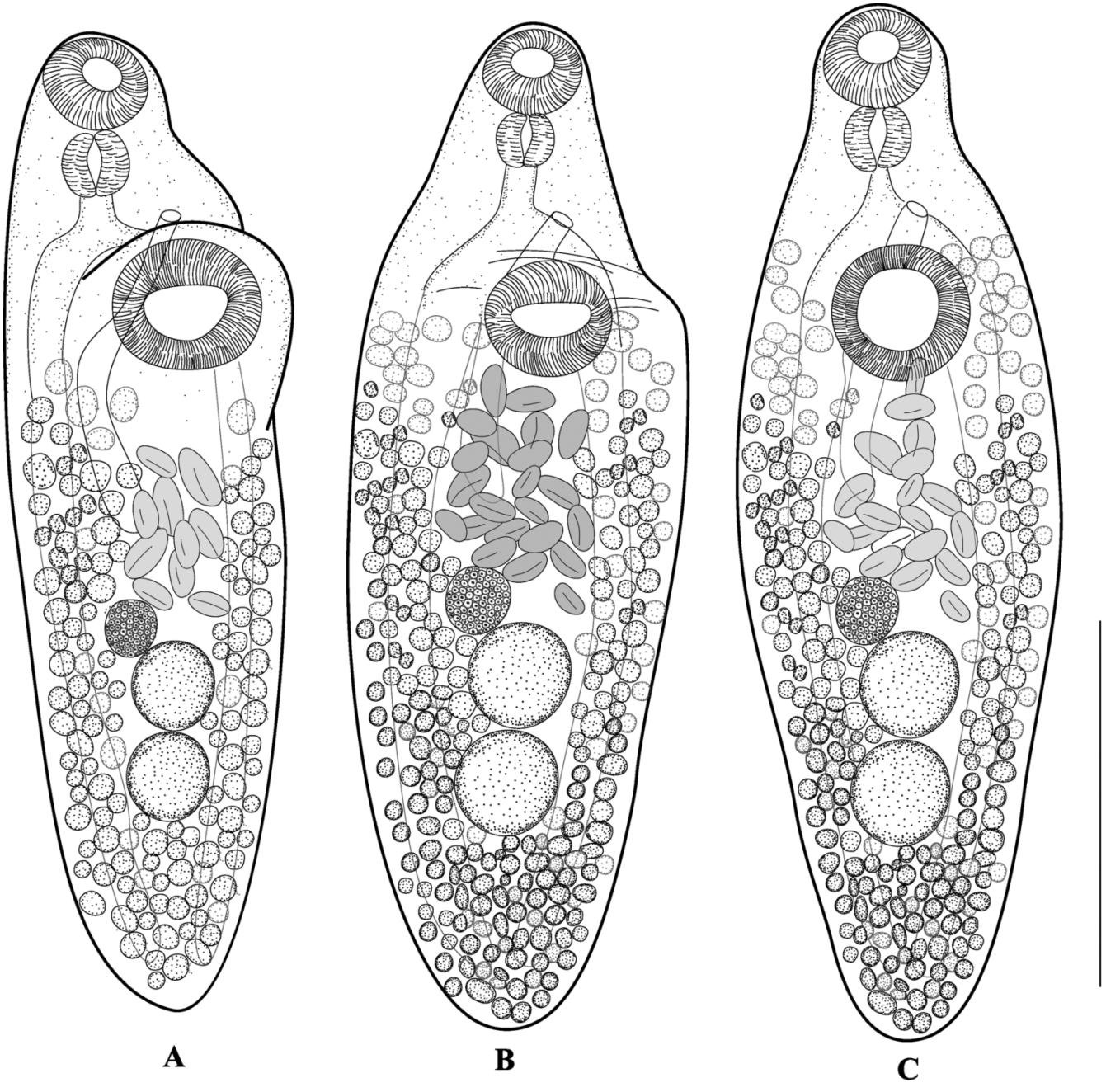

Fig. 3. *Allopodocotyle tunisiensis* sp. nov. from *Solea aegyptiaca*. Ventral view of unflattened specimens. **A –** anterior extend of vitelline follicles just posterior to ventral sucker. **B –** anterior extend of vitelline follicles at level of middle of ventral sucker. **C –** anterior extend of vitelline follicles at level of anterior margin of ventral sucker. The vitelline follicles in the ventral plane are black, those in the dorsal plane are grey. Scale bar = 500 μm

× 90–200 (116; n = 8). Mehlis' gland weakly developed. Laurer's canal present, loops dorsally and opens at level of seminal vesicle. Uterus pretesticular, intercaecal, in hindbody between ovary and ventral sucker. Metraterm differentiated, thin-walled. Eggs large; 80–90 (86; n = 16) × 40–60 (42; n = 16). Vitellarium follicular, confined to hindbody; follicles numerous, dorsal and ventral in lateral fields; confluent dorsally and ventrally in post-testicular region, but not anteriorly; anterior limit posterior to ventral sucker ventrally, varies between just posterior to ventral sucker and anterior margin of ventral sucker dorsally (Fig. 3). Excretory vesicle I-shaped, tubular, reaches level of ovary; pore terminal.

Type-host: *Solea aegyptiaca* Chabanaud, 1927 (Soleidae).

Type-locality: Off Skhira (Tunisia) (34°05′N, 10°01′E).

Others localities: Kerkennah (Tunisia) (34°45′N, 11°17′E), Sidi Mansour (Tunisia) (34°46′N, 10°48′E).

Site: Intestine.

Type-material: Holotype Muséum National d'Histoire Naturelle, Paris, No. HEL 106 Th 205; Paratypes British Museum (Natural History), London, No. 2009.8.12.1.

Material studied: Whole-mounts of 16 flattened adult specimens.

Infection index: Prevalence 13.24%, intensity 1–8.

Etymology: The name "*tunisiensis*" refers to the name of country close to the type locality, Tunisia.

Discussion

The present species belongs to the genus *Allopodocotyle* as originally defined by Pritchard (1966) and recognised by Bray (1987), Bartoli *et al*. (1989) and Cribb (2005). This genus is characterized by a combination of character states, none of which are particularly distinctive. The testes tandem to oblique and well separated from the posterior end of body, the genital pore is sinistral in the mid-forebody, the ovary is entire and the vitelline follicles are essentially restricted to the hindbody (Cribb 2005). It is close to other genera such as *Macvicaria* Gibson et Bray, 1982 which is reported from some Pleuronectiformes. The only difference between *Allopodocotyle* and *Macvicaria* is the anterior limit of the vitelline fields. After Gibson and Bray (1982) *Macvicaria* have "a vitellarium follicular; extending in lateral fields from about level of genital pore to posterior extremity". Cribb (2005) recognized these genera in his key to the Opecoelidae and he indicates that in *Allopodocotyle*, "vitelline follicles usually do not enter forebody" but in *Macvicaria*, "vitelline follicles enter forebody". In our unflattened and uncontracted worms, the vitelline follicles do not confluent anteriorly and reach ventrally to the posterior edge of the ventral sucker but dorsally it varies: in some specimens it is just posterior to the ventral sucker (Fig. 3A); in other specimens it can be reaches to the anterior edge (Fig. 3B, C). Two species of *Allopodocotyle* have a vitellarium extend to the level of the ventral sucker; they are *A. margolisi* and *A. pritchardae*. In *A. margolisi* the anterior limit of vitellarium varies between just posterior to the ventral sucker and middle of the ventral sucker (Gibson 1995). In the description of *A. pritchardae* Madhavi (1975) does not indicate the anterior limit of the vitellarium but his drawn shows a vitellarium reaches to the anterior limit of the ventral sucker. Into the Opecoelidae, the anterior limit of the vitellarium is a problematical character for some genera such as *Opecoelus* Ozaki, 1925 and *Opegaster* Ozaki, 1928. In this case, Cribb (1985) showed that a single species, *Opecoelus variabilis* Cribb, 1985, encompassed both conditions at times, the vitelline follicles enter the forebody or not, and proposed the synonymy of *Opegaster* with *Opecoelus*. This is the case of *Allopodocotyle* and *Macvicaria* which are distinguished in the same way. In fact, extend of the vitelline follicles into the forebody is seen as a useful species level character (Cribb 2005). In view of the above comments, we think that *Macvicaria* and *Allopodocotyle* must be synonymized and we consider the present material is closer to *Allopodocotyle* than *Macvicaria* because the vitellaria do not extend into the forebody.

Bray (1987) placed species of *Allopodocotyle* reported from marine hosts into four groups (A to D) based on the arrangement of the testes, the posterior extent of the cirrus sac and the distribution of the vitelline follicles. *Allopodocotyle tunisiensis* sp. nov. fits into group C (*sensu* Bray 1987), with the testes tandem rather than oblique and a cirrus sac that extends into the hindbody. According to Blend *et al*. (2004), there are nine species of *Allopodocotyle* in this group: *A. pedicellata*, *A. atzi* (Nigrelli, 1939), *A. mecopera* (Manter, 1940), *A. argyropsi* Madhavi, 1975, *A. lutianusi* Gupta et Ahamad, 1976, *A. israelensis*, *A. jaffensis*, *A. recifensis* Bray, 1987 and *A. margolisi* Gibson, 1995. Among these species, *A. margolisi* fits into any of Bray's groups, but it is most similar to the worms in group C except that its cirrus-sac does not extend into the hindbody (Gibson 1995). This condition was also observed by Bartoli *et al*. (1989) in *A. pedicellata*.

Allopodocotyle tunisiensis can be distinguished from the members of this group as follows:

A. margolisi and *A. pedicellata* differ in that the cirrus-sac is short and does not extend into the hindbody.

A. recifensis differs in that the vitellarium extends from the posterior extremity to a level distinctly posterior to the ventral sucker (Bray 1987) and the seminal vesicle has only one loop.

A. jaffensis differs in that the genital pore is only slightly sinistrally submedian and post-bifurcal (Bartoli *et al*. 1989). The anterior limit of the vitellarium is at or just posterior to the ventral sucker.

A. argyropsi differs in that the seminal vesicle is long and straight rather than convoluted and the genital pore is at pharyngeal level (Madhavi 1975).

A. israelensis differs in that the cirrus-sac is very sinuous and frequently has a loop or U-shaped bend in the hindbody and the seminal vesicle is bipartite with a saccular anterior portion (Fischthal 1980).

A. mecopera differs in that the vitellarium reaches only to the ovary and the posterior portion of the cirrus-sac is enlarged (Manter 1940).

A. lutianusi differs in that it has a long, straight seminal vesicle. In the description of Gupta and Ahamad (1976), the vitelline follicles are said to extend to the posterior margin of the ventral sucker, but in the drawing the vitellarium appears as extending from some distance posterior to the ventral sucker.

A. atzi differs in that the posterior part of the cirrus-sac is bulbous (Bray 1987) and the seminal vesicle is saccular proximally (Nigrelli 1939).

According to Bray (1987) *A. atzi* belongs to the group C; but, in the original description of Nigrelli (1939), it was said to have "testes sharply oblique". The photomicrograph of this worm shows also diagonal testes. Thus, this species is most similar to Bray's group A or B where the testes oblique rather than in tandem. In the absence of the type-material, the allocation of *A. atzi* to group C remains uncertain.

Key to the *Allopodocotyle* from Bray's group C

1. Testes distinctly oblique ..... *A. atzi*
– Testes tandem 2
2. Cirrus-sac restricted to forebody 3
– Cirrus-sac very long, extending well into hindbody 4
3. Genital pore sinistrally post-bifurcal ..... *A. pedicellata*
– Genital pore sinistrally sublateral at about mid-oesophageal level ..... *A. margolisi*
4. Vitellarium reaches only to ovary; proximal part of cirrus-sac enlarged ..... *A. mecopera*
– Vitellarium extends beyond ovary; proximal part of cirrus-sac not enlarged 5
5. Seminal vesicle bipartite, with anterior part saccular ..... *A. israelensis*
– Seminal vesicle tubular 6
6. Seminal vesicle straight 7
– Seminal vesicle convoluted 8
7. Genital pore at pharyngeal level ..... *A. argyropsi*
– Genital pore at level of intestinal bifurcation .... *A. lutianusi*
8. Genital pore post-bifurcal ..... *A. jaffensis*
– Genital pore at level of intestinal bifurcation or more anterior 9
9. Vitellarium restricted to hindbody ..... *A. recifensis*
– Anterior extend of vitellarium varies between just posterior to ventral sucker and anterior edge of ventral sucker ..... *A. tunisiensis* sp. nov.

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