

Description of Two Cestode Parasites: *Oochoristica mutabilis* and *Oochoristica* Sp. Nov. (Eucestoda: Cyclophyllidea) from the Rough Tail Rock *Agama stellio* (Agamidae) in Egypt

Fathy Abdel Ghaffar, Abdel Rahman Bashtar, Amira Kamal Ahmed,
Kareem Morsy and Rowida Helmi Mohamed

Department of Zoology, Faculty of Science, Cairo University, Egypt

Abstract: In the present study, the morphological and morphometric characterization of *Oochoristica mutabilis* and a new species of the same genus *Oochoristica* sp.nov., anoplocephalid cestode parasites infecting the small intestine of the rough tail rock *Agama stellio* (f:Agamidae) in South Sinai, Egypt were described by means of light microscopy as a first description from this host in Egypt. Two species of cestode parasites of the genus *Oochoristica* were recovered with no mixed infection between them. The first species was *Oochoristica mutabilis* with a percentage of 29.6% (8/27), it was characterized by the presence of a strobila which was 14.6 mm (11.5-22.3) long; each composed of 33(28-39) proglottids. Scolex was wide with four large circular suckers, no hooks or crown; neck region is evident. Testes in median mass situated in posterior half of proglottid extended laterally to vitellarium. The ovary was bilobed, vitellaria entire. Gravid proglottids contained in a uterine capsule with numerous oncospheres. *Oochoristica* sp.nov. was the second species isolated with a percentage of 22.2% (6/27) and it was described for the first time and no records regarding the description of this species were previously recorded in Egypt, the average length of longest complete adult worm was 16.3 mm (13.5-26.8) and composed of 36(29-41) proglottids. This species shared most of the morphological characteristics of the first species except for the followings: a narrow scolex with 4 small suckers, non hooked cap like crown in the top, the testicular mass was less in number, the genital atrium was largely muscular with a wide, lipped and projected genital pore. By comparison, this species possessed new morphological characteristics which should consider this species as a new one with a new host record in Egypt.

Key words: *Oochoristica mutabilis* • *Oochoristica* Sp. Nov. • Cyclophyllidea • *Agama stellio* • Agamidae
• Light Microscopic Study

INTRODUCTION

Cestodes are dorsoventrally flattened parasites. Generally the adults inhabit the intestines of their hosts, being anchored to the intestinal wall by means of type-specific holdfast organs [1]. The genus *Oochoristica* Luhe [2] is a species parasitizing more than 56 species of reptiles and mammals [3-8]. According to Bursey [6], 75 nominal species of *Oochoristica* Luhe [2] have been described from reptiles worldwide: 5 from Australian realm, 9 from Ethiopian realm, 14 from Nearctic realm, 6 from Neotropical realm, 24 from Oriental realm and 17 from Palearctic realm. Seven species have been described from anneliid, gekkonid, iguanid and scincid lizards of North America. These include: *Oochoristica anolis* [9] in the

green anole (*Anolis carolinensis*) from Texas; *Oochoristica eumecis* [9] in the five-lined skink (*Eumeces fasciatus*) from Texas; *Oochoristica parvula* [10] in the banded gecko (*Coleonyx elegans*) from the Yucatan, Mexico; *Oochoristica parvovaria* [11] in the Texas horned lizard (*Phrynosoma cornutum*) from Oklahoma; *Oochoristica bivitellobata* [12] in the prairie-lined racerunner (*Cnemidophorus sexlineatus viridis*) from Kansas; *Oochoristica anniellae* [13] in the black legless lizard (*Anniella pulchra nigra*) from California and *Oochoristica scelopori* [14] in the north western fence lizard (*Sceloporus occidentalis occidentalis*) from California. These anoplocephalid cestodes predominantly parasitize lizards, but also snakes, turtles and a few marsupials [15, 16]. For the diagnosis of

genera and species of cestode parasites, number of morphological criteria that are of considerable importance should be considered, including the position and number of paruterine capsules, as well as the terminal genitalia morphology [12]. The present study identified and described two species of *Oochoristica* from the rough tail rock *Agama stellio* from South Sinai desert, Egypt. These cestodes represented new host records and the diagnosis was based in part on the morphology and morphometry of the scolex and segments using light microscopy.

MATERIALS AND METHODS

Twenty seven specimens of *Agama stellio* (F: Agamidae) were examined for cestode parasites. Lizards were collected by hand or noose from south Sinai desert, Egypt during the year 2013. Animals were transported to Parasitology laboratory, Faculty of Science, Cairo University, Egypt and kept alive in glass cages with sand and alluvium in animal room at 25-30°C and fed once a week with insect and insect larvae. Identification of species was carried out according to Arnold [17] and AL-Sadoon [18]. Each lizard was killed within 8-24 h after capture with an intraperitoneal injection of a dilute solution of sodium pentobarbital. Specimens were dissected and the cestode worms were isolated in an isotonic saline solution (7%) in a Petri dish, where they were left to relax between two slides within the fixative (10% formalin). After fixation, the worms were washed with distilled water to remove excess fixative. Acetic acid alum carmine was used for staining according to Carleton [19] for 5-10 min for permanent whole mount preparations. Dehydration was done by passing the specimens in ascending series of ethyl alcohol. Specimens were cleared in clove oil and xylene then mounted in Canada balsam [20]. Drawings were made with the help of a Zeiss microscope supplied by a phase contrast unit. Prevalence, mean abundance and morphometric measurements followed the guidelines of Bush *et al.* [21], arithmetic mean were given followed by minimum and maximum values in parentheses. Measurements are in micrometers unless otherwise stated.

RESULTS

Two species of cestode parasites of the genus *Oochoristica* were recovered. The first species was *Oochoristica mutabilis* Morsy *et al.*, 2013 with a percentage of 29.6% (8/27). *Oochoristica* sp.nov. was the second species isolated with a percentage of 22.2% (6/27).

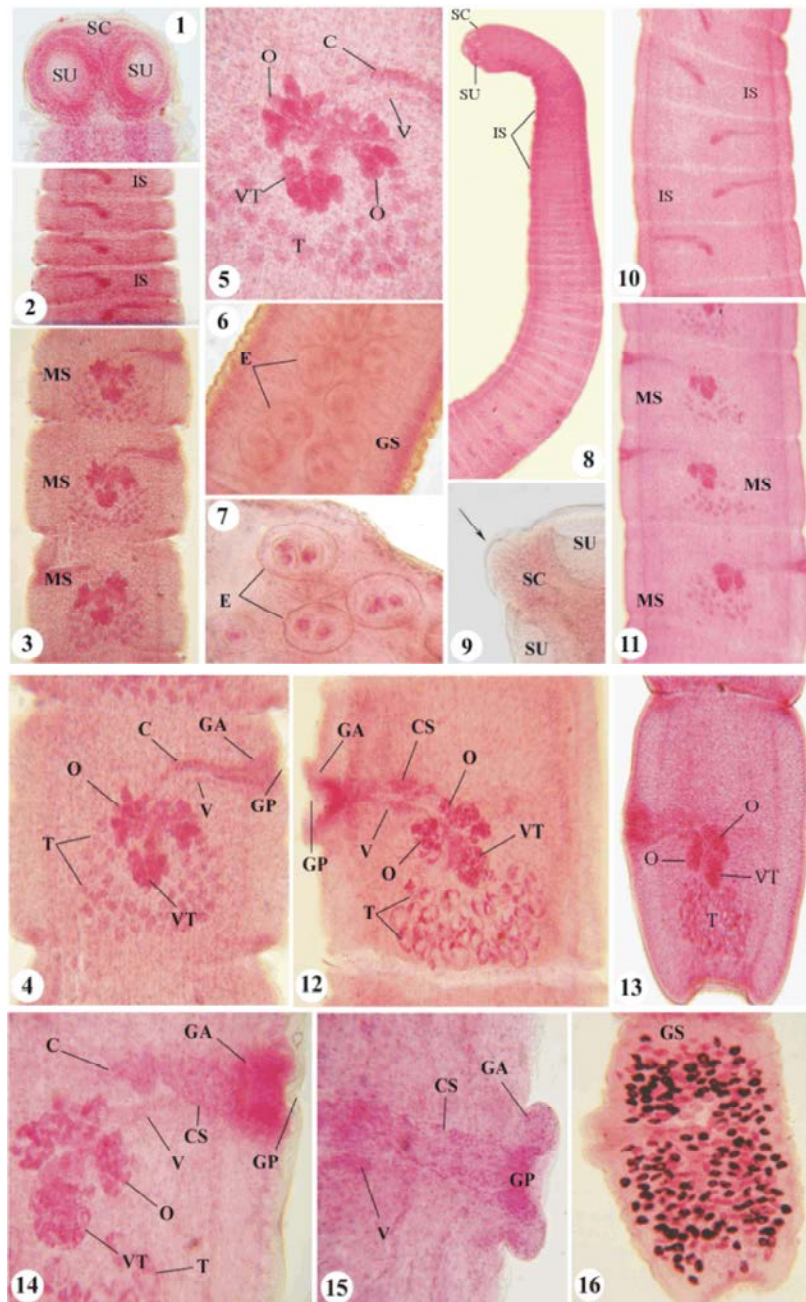
The infection was recorded in the small intestine of the rough tail rock *Agama stellio* (f: Agamidae). No mixed infection was recorded.

Oochoristica mutabilis Morsy *et al.* (2013) (Figs. 1-7):

Description (Based on 10 Specimens): Strobila flat with a total length of 14.6 mm (11.5-22.3); composed of 33(28-39) proglottids; 6 (4-10) undifferentiated, 7 (5-12) contain sexual primordia, 13 (10-18) mature and 7 (4-10) gravid. Scolex 324 µm (300-360) wide, with four large circular suckers, 100 µm (97-124) in diameter; neck region was evident. undifferentiated proglottids distinctly wider than long; mature proglottids (n = 20), 527 µm (445-746) long by 511 µm (455- 657) wide. Genital pores were irregularly alternated, situated in anterior quarter of proglottid; genital atrium was somewhat muscular. Testes (n = 14), 30 (22-39) in median mass situated in posterior half of proglottid, 33 µm (29-42) in diameter, extended laterally to vitellarium. Vas deferens, initially coiled, runs laterally to middle of segment then turned posteriorly to pass between lobes of ovary. Ovary was bilobed and situated in centre of proglottid. Gravid proglottids (n = 5), 863 µm (609-1,022) long by 344 µm (317-343) wide, contained numerous oncospheres (n = 10), 36 µm (32-41) long by 23 µm (20-29) wide.

Oochoristica sp. Nov. (Figs. 8-16)

Description (Based on 3 Specimens): These tapeworms were dorsoventrally flattened. Length of longest complete adult worm was 16.3 mm (13.5-26.8) and composed of 36 (29-41) proglottids; 7 (6-12) undifferentiated, 8 (6-14) contain sexual primordia, 14 (11-19) mature and 6 (4-9) gravid. Four small oval suckers 276 µm (260-344) wide. Neck was short. Ratio of mature proglottid length to width was 1:0.4–0.6. Gravid proglottids were (n = 5), 763 µm (623-1,052) long by 334 µm (326-335) wide. Large Genital openings alternated irregularly, each situated in the first third of proglottid and it was lipped and projected outward. Testes were subspherical, mostly posterior to ovary and vitelline gland, occupied the central region; some testes reached midovarian level. Testes was (n = 4), 22 (18-28) per proglottid, 25 µm (20-35) in diameter. Ovary was bilobed and occupied the central region of proglottid; each lobe divided into numerous sublobes. Irregular vitelline gland situated on midline immediately behind ovary; vagina opened into a genital atrium, posterior to cirrus pouch, extended posterolaterally to Mehlis' gland. Uterine ovigerous capsules contained a single egg and oncosphere, two dorsal and 2 ventral excretory canals and latter developing a plexus were observed.



Figs. 1-7: Photomicrographs of *O. mutapilis* showing high magnifications of: 1 Scolex (SC) equipped by circular suckers (SU) (X400). 2 Immature segments (IS) immediately behind scolex with a development of sexual primordia (X170). 3 Mature segments (MS) (X170). 4 Mature proglottid (MS) with a bilobed ovary (O), laterally to vitellaria (VT), mass of testis (T), vagina (V), cirrus (C), cirrus sac (CS) and a genital pore (GP) (X270). 5 Part of a mature segment, (X400). 6,7 A gravid segment (GS) full of eggs (E) (X170, X400)

Figs. 8-16: Photomicrographs of *Oochoristica* sp.nov. showing high magnifications of: 8 A part of the adult worm including its anterior part, a scolex (SC) followed by the long neck (N) and equipped by the small circular suckers (SU) (X20). 9 Scolex (SC) equipped by two large suckers (SU), arrow referred to the pointed anterior end (X400). 10 The immature proglottids (IS) with the sexual primordial slightly developed (X170). 11-14 Detailed view of mature proglottids (MS) (X170, X270, X150, X400). 15 The genital pore (GP) (X400). 16 A gravid segment with eggs (X170)

Table 1: Comparison between some important parameters of the previously recorded species of *Oochoristica* and those of the current study (measurements are in micrometers unless otherwise stated)

Structure	Number of proglottids	Strobila length (mm)	Neck (mm)	Scolex width	Suckers (L x W)	Number of testes	Testes diameter	Host
<i>O. anolis</i> (Harwood 1932)	-	70	appears long	350	160 x 300	(20-35)	300	<i>Anolis carolinensis</i>
<i>O. eumecis</i> (Harwood 1932)	-	103	2.0	500	220 x 260	(40-55)	-	<i>Eumeces fasciatus</i>
<i>O. parvula</i> (Stunkard 1938)	(60-65)	(20-25)	(3.0-5.0)	240-250	(70-86)	(20-30)	(20-28)	<i>Coleonyx elegans</i>
<i>O. parvovaria</i> (Steelman 1938)	(5-7)	13.1 (5-22)	≤ 1.6	350(320-380)	120 (1 10-130)	69 (52-87)	27 (23-33)	<i>Phrynosoma cornutum</i>
<i>O. bivittellobafa</i> (Loewen 1940)	21	66 (15-150)	0.43	369(300-525)	140 (1 15-178)	76 (48-106)	50 (30-92)	<i>Cnemidophorus sexlineatus viridis</i>
<i>O. anniellae</i> Stunkard and Lynch (1944)	(28-30)	(6-1 5)	none	370-400	(100-124) x (153-173)	(60-70)	(20-34)	<i>Anniella pulchra nigra</i>
<i>O. scelopor</i> (Voge and Fox 1950)	(112-171)	(89-1 70)	(1.2-5.0)	375(299-431)	117 (1W130)	32 (2243)	46 (38-60)	<i>Sceloporus occidentalis occidentalis</i>
<i>O. crotaphyti</i> (McAllister et al. 1985)	47(38-52)	17.4 (10.6-27.0)	none	378(337-409)	107 (92-117) X121 (114-138)	30 (23-37)	25 (12-35)	<i>Crotaphytus collaris</i>
<i>O. mutabili</i> (Morsy et al., 2013)	27(25-39)	14.6(11.5-22.3)	1.1(0.8-1.6)	324(300-360)	100 (97-124)	33 (24-36)	36(31-40)	<i>Agama mutabilis</i>
<i>O. mutabili</i> (Present study)	33(28-39)	14.6(11.5-22.3)	-	324(300-360)	100(97-124)	30 (22-39)	33(29-42)	<i>Agama stellio</i>
<i>Oochoristica</i> sp. nov. (Present study)	36(29-41)	16.3(13.5-26.8)	-	-	276(260-344)	(n = 4), 22 (18-28)	25(20-35)	<i>Agama stellio</i>

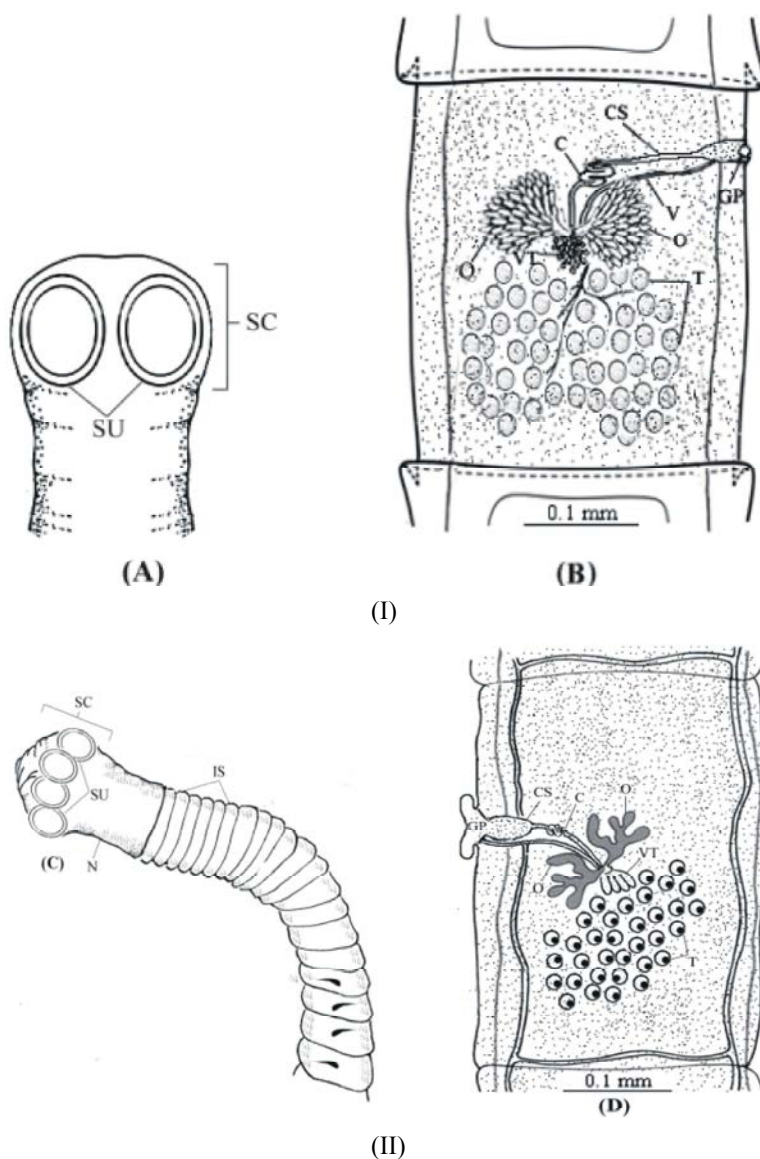


Fig. 17: Line diagrams of: I. *O. mutapili*: (A) Scolex, (B) Mature segment. II. *Oochoristica* sp. nov. (C) Scolex, (D) Mature segment

Taxonomic Summary:

Type-host: *Agama stellio* (Reptilia: Agamidae).

Type-locality: South Sinai, Egypt.

Site of infection: Intestine of the host lizard.

Prevalence: Twenty seven lizard samples were examined for cestode parasites, 8 (29.6%) and 6 (22.22%) were infected with two species of cestodes respectively.

Etymology: For *Oochoristica mutabilis*, the specific name of the parasite is derived from the species name of the Egyptian changeable lizard *Agama mutabilis*.

DISCUSSION

The morphological studies of the collected cestode parasites revealed that it is belonged to the genus *Oochoristica* Luhe [2] of the order Anoplocephalidae Cholodkovsky [22] of class Eucestoda Wardle [23]. The *Oochoristica* species occurring in lizards can be divided into 2 groups according to the length of the unsegmented region behind the scolex traditionally termed the "neck." The first group contains 3 species with no neck or a very short neck region: *O. anniellae* [13], *O. crotaphyti* and *O. bivitellobata* [12]. The second group has a long neck region and consists of approximately 43 species. A comparison between different parts of the body of the most similar species of genus *Oochoristica* is presented in Table 1. The present two species is distinctly different from *O. bivitellobata* (in the first group) in having no neck, an entire vitelline gland, more proglottids and fewer and smaller testes and from *O. anniellae* in strobila length, scolex width, testes diameter, uterine capsule width and oncosphere hook length; however, *O. crotaphyti* can be differentiated from *O. anniellae* by possessing more proglottids, fewer testes and a genital aperture in the anterior one fourth of mature proglottids (rather than in the anterior one-half) and by lacking primordium development in the early proglottids. The two species described herein belongs to the second group of *Oochoristica* (with a neck), but by comparison it is reported that the first species is morphologically similar to two species, *O. parvovaria* [11] found in North America in the presence of the cirrus sac, which lies anterior to the portal part of the ovary, the bilobed ovary situated in the center of proglottids. However, it can be differentiated by possessing more proglottids, fewer testes and the lack of primordium development in the early

proglottids of the comparable species. Also, it was more or less similar to *O. mutabilis* [24] morphologically with some morphometric differences, so it should be named *O. mutabilis* as a redescription with a new host *A. stellio*. The second species possesses all of the characteristic features of genus *Oochoristica* described for the first time and no records regarding the description of this species were previously recorded, this species shared all of the morphological characteristics of the first species except for the followings: a narrow scolex with 4 small suckers, non hooked cap like crown in the top, the testicular mass was less in number, the genital atrium was largely muscular with a wide, lipped and projected genital pore. The life cycle of the present parasites were not studied. However, the basic host sequence in all known life-cycles includes tenebrionid beetles or other insect intermediate hosts alternating with various amniote definitive hosts [25]. Life cycle studies have been reported for four species of *Oochoristica*. Millemann and Read [26] in a program abstract reported that cysticercoids of *O. scelopori* formed in larvae or adults of the tenebrionid beetle *Tribolium confusum*, but published no experimental results. Hickman [27] reported the life-cycle of *O. vacuolata* [28] from Australian scincid lizards, but was unable to follow development in experimental infections of the definitive host. Widmer and Olsen [29], working on *O. osheroffi* reported metacestode development in insects and followed cestode development in rattle snakes, but only to worms with immature proglottids. So according to the above descriptions, the present study includes a new host record of two cestodes, one of them is redescribed with a new host record and the other should be recorded as a new species within the genus *Oochoristica*.

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