CABLEIA PUDICA N. SP. (DIGENEA: ACANTHOCOLPIDAE) FROM MONACANTHID FISHES OF THE SOUTHERN GREAT BARRIER REEF, AUSTRALIA

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Summary:

A new species, *Cableia pudica*, is described from the monacanthid fishes *Cantheschenia grandisquamis*, *Cantherhines dumerili*, *Cantherhines pardalis* and *Pervagor janthinosoma* from reef waters around Heron Island, southern Great Barrier Reef, Queensland, Australia. It differs from the only other species in the genus, *Cableia trigoni* Sogandares-Bernal, 1959 in its more elongate cirrus-sac, longer posttesticular region, smaller prepharynx, the less anterior extent of the vitelline fields and dorsally subterminal excretory pore. The status of the genus is discussed, but no firm conclusion reached. It is placed, *pro tem.* in the Acanthocolpidae. The great majority of specimens lack spermatozoa, suggesting that parthenogenesis may occur.

KEY WORDS : Acanthocolpidae, *Cableia*, Monacanthidae, *Cantheschenia*, *Cantherhines*, *Pervagor*, Great Barrier Reef, systematics, parthenogenesis.

Résumé : *CABLEIA PUDICA* N. SP. (DIGENEA: ACANTHOCOLPIDAE) DÉCRITE DES POISSONS MONACANTIDÉS DE LA PARTIE SUD DE LA GRANDE BARRIÈRE DE CORAIL, AUSTRALIE

Cableia pudica n. sp. est décrite des poissons monacantidés *Cantheschenia grandisquamis*, *Cantherhines dumerili*, *Cantherhines pardalis* et *Pervagor janthinosoma* de la zone corallienne entourant Heron Island, dans la partie sud de la Grande Barrière de Corail (Queensland, Australie). Elle diffère de *Cableia trigoni* Sogandares-Bernal, 1959, seule autre espèce connue du genre, en ce qu'elle présente une poche du cirre plus allongée, une région post-testiculaire plus longue, un pré-pharynx plus petit, une bordure antérieure des champs vitellins plus postérieure et un pore excréteur dorsal et subterminal. Le statut du genre est discuté, mais aucune conclusion définitive n'est atteinte. Il est provisoirement placé parmi les Acanthocolpidae. La grande majorité des spécimens ne présente pas de spermatozoïdes, ce qui suggère une possible reproduction parthénogénétique.

MOTS CLÉS : Acanthocolpidae, *Cableia*, Monacanthidae, *Cantheschenia*, *Cantherhines*, *Pervagor*, Grande Barrière de Corail, systématique, parthénogénèse.

INTRODUCTION

The systematics of the Digenea is not well developed, and their phylogeny is poorly understood. It is still possible to come across worms whose relationships are difficult to decipher, and which exhibit puzzling combinations of characters. *Cableia* Sogandares-Bernal, 1959 is such a genus. Although we describe a new species below, the familial affinities of the genus are still enigmatic. If our morphological interpretations are correct, its relationship to some of the families to which it has been assigned can be considered doubtful.

MATERIALS AND METHODS

The digeneans were collected from freshly killed fish and were fixed by being pipetted into nearly boiling 5 % formalin. Whole-mounts were stained with Mayer's acid haemalum, cleared in methyl salicylate and mounted in Canada balsam. Serial sections were stained in eosin and Mayer's haemalum. Measurements are quoted as ranges, with means in parentheses, and are in micrometres. The following abbreviations are used: BM(NH), the British Museum (Natural History) collection at The Natural History Museum, London; QM, Queensland Museum collection, Brisbane; USNPC, the United States National Parasite Collection, Beltsville.

MATERIAL STUDIED

Ex *Cantheschenia grandisquamis* Hutchins (type-host), Monacanthidae. Intestine. Heron Island, Queensland, Australia (23°27'S, 150°55'E (type-locality), between 9 and 24/1/1992, 15/1/1994, 6/7/1995); 17 specimens (also two sets of serial sections). QM holotype 211573, paratypes 211574-9, BM(NH) paratypes 1995.7.4.1-5.

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Ex *Cantherbines pardalis* (Rüppell), Monacanthidae. Intestine. Heron Island, Queensland, Australia (23°27'S, 150°55'E, 24/1/1992, between 14 and 21/1/1994). 37 specimens (also one set of serial sections). QM 211580-90, BM(NH) 1995.7.4.6-15.

Ex *Cantherbines dumerili* (Hollard), Monacanthidae. Intestine. Heron Island, Queensland, Australia (23°27'S, 150°55'E, 15/1/1992). Two specimens. QM 211591, BM(NH) 1995.7.4.16.

Ex *Pervagor janthinosoma* (Bleeker), Monacanthidae. Intestine. Heron Island, Queensland, Australia (23°27'S, 150°55'E, 13/1/1991). Four specimens. QM 211592-3, BM(NH) 1995.7.4.17.

RESULTS

Family Acanthocolpidae Lühe, 1909.
Genus *Cableia* Sogandares-Bernal, 1959.
Type-species *C. trigoni* Sogandares-Bernal, 1959
by original designation.

CABLEIA PUDICA N. SP. (Figs 1-3)

DESCRIPTION

Based on 65 whole-mounts and three sets of serial sections. For measurements see Table I. Body small, elongate but slightly wider at ventral sucker and testicular levels (Fig. 1). Tegument spinous; spines in closely packed rows, largest in anterior hindbody, become sparser at about testicular level and disappear about middle of post-testicular region. Eye-spot pigment scattered sparsely in forebody. Oral sucker subglobular, subterminal. Ventral sucker subglobular on short peduncle, which appears as ridge around ventral sucker in ventral view. Prepharynx distinct, but mainly within posterior concavity of oral sucker; measurement of exposed part only given in Table I. Pharynx subglobular. Oesophagus sigmoid. Intestinal bifurcation in posterior forebody. Caeca widest anteriorly, narrow for most of length, terminate blindly at about middle of post-testicular region, often not symmetrically.

Testes oval, posterior testis longer than anterior, tandem, contiguous, in mid-hindbody. External seminal vesicle absent, coiled vas deferens can be traced to cirrus-sac. Cirrus-sac long, reaching to or almost to ovary, recurved dorsally to ventral sucker (Fig. 2). Internal seminal vesicle with two oval chambers, narrows distally to form curved muscular duct; spermatozoa rarely seen (Fig. 3). Pars prostatica vesicular, small, oval; lined with anuclear cell-like bodies. Ejaculatory duct long, coiled, muscular; cirrus not seen. Prostatic gland-cells scattered rather sparsely in connective tissue in cirrus-sac. Genital atrium distinct. Genital pore slightly sinistrally submedian at level of intestinal bifurcation.

Ovary usually four-lobed (occasionally appears three to six-lobed); separated from ventral sucker by uterus, contiguous with anterior testis; median. Uterine seminal receptacle present. Mehlis' gland antero-dorsal to ovary. Laurer's canal opens dorsally to ovary. Uterus between ovary and ventral sucker, overlaps caeca laterally. Eggs small; numerous; operculate, tanned. Metraterm muscular, starts about mid-ventral sucker, runs ventrally to cirrus-sac, opens beside male duct into genital atrium. Vitellarium follicular; follicles many, relatively large, irregular; lateral fields reach from just anterior to ovary to point posterior to caecal terminations, but not close to posterior extremity; dorsal, lateral and ventral to caeca at level of gonads; confluent dorsally and ventrally in post-testicular region.

Excretory pore distinctly dorsally subterminal. Vesicle I-shaped; reaches just posterior to posterior testis.

DISCUSSION

Cableia was originally considered to belong in the Lepocreadiidae Odhner, 1905 by Sogandares-Bernal (1959). It was subsequently placed in the Opecoelidae Ozaki, 1925 by Yamaguti (1971). The most recent placement of the genus is in the Enenteridae Yamaguti, 1958 by Gibson & Bray (1982). The lack of both the external seminal vesicle and the canalicular seminal receptacle, along with the presence of small eggs are certainly uncharacteristic of lepocreadiids, and the spinous tegument, the eyespot pigment and the small eggs are not characteristic for opecoelids.

The subfamily Enenterinae was erected by Yamaguti (1958) as a subfamily of the Allocreadiidae to include three genera, *Enenterum* Linton, 1910, *Cadenatella* Dollfus, 1946 and *Jeancadenatia* Dollfus, 1946. Later, Yamaguti (1970, 1971) placed the subfamily in the Opecoelidae, including the same three genera. In the meantime Skrjabin & Koval (1966) had recognised the family Enenteridae, including two additional genera, *Koseiria* Nagaty, 1942 and *Proenenterum* Manter, 1954. Bray (1978) summarised the history of the family to that time, pointing out that its members had characters of both the Lepocreadiidae and the Opecoelidae, and retained the family *pro tem*. He also pointed out that it could readily be divided into two parts, which might represent subfamilies, applying the reasoning used to separate the opecoelid subfamilies Opecoelinae and Plagioporinae Manter, 1947. Later, Gibson & Bray (1982) formally named the second subfamily as the Cadenatellinae. They also argued for inclusion of a third subfamily, the Pseudolepidapedinae Yamaguti, 1971, with two genera *Pseudolepidapedon* Yamaguti, 1938 and *Cableia* Sogandares-Bernal, 1959, members

Figs 1-3. — *Cableia pudica* n. sp. 1. Ventral view of specimen from *Cantheschenia grandisquamis*, uterus in outline only. 2. Lateral view of anterior half of specimen from *Cantheschenia grandisquamis*, showing terminal genitalia and lack of spermatozoa in internal seminal vesicle. 3. Cirrus-sac from specimen from *Cantherbines pardalis*, showing spermatozoa in internal seminal vesicle.

Host <i>n</i>	<i>Cantheschenia grandisquamis</i> 10	<i>Cantherbines dumerili</i> 1	<i>Cantherbines pardalis</i> 10	<i>Pervagor janthinosoma</i> 2
Body length	989-1,407 (1,254)	1,081	808-1,619 (1,348)	599-654
Body width	175-255 (224)	260	172-303 (241)	127-143
Width/length (%)	16-22 (18)	24	16-23 (18)	19-24
Oral sucker	95-130 × 98-129 (110 × 113)	117 × 118	97-137 × 91-148 (120 × 127)	73-76 × 69-70
Ventral sucker	127-180 × 140-187 (160 × 165)	161 × 173	122-206 × 135-207 (172 × 184)	99-117 × 96-108
Sucker ratio	1:1.36-1.50 (1.45)	1:1.47	1:1.34-1.54 (1.45)	1:1.37-1.57
Forebody	218-316 (274)	254	191-341 (284)	180-191
Forebody/body length (%)	20-23 (21)	23	20-25 (21)	29-30
Prepharynx length	0-16 (3)	0	0	0
Pharynx	54-85 × 60-84 (75 × 73)	71 × 76	55-93 × 60-89 (82 × 77)	45-50 × 38-43
Oral sucker/pharynx width ratio	1:1.31-1.77 (1.55)	1:1.55	1:1.52-1.82 (1.64)	1:1.60-1.84
Oesophagus length	26-58 (48)	77	26-74 (48)	20-38
Intestinal bifurcation to ventral sucker	19-68 (45)	0	14-71 (49)	33-41
Caecal ends to posterior extremity	87-187 (143)	?	64-224 (133)	51-66
Anterior testis	89-148 × 99-142 (123 × 122)	78 × 95	71-149 × 81-179 (119 × 125)	52-53 × 50-51
Posterior testis	113-200 × 111-148 (161 × 131)	90 × 103	98-219 × 86-187 (170 × 126)	72-75 × 48-51
Post-testicular region	234-444 (362)	303	161-425 (352)	122-147
Post-testicular region/ body length (%)	24-32 (29)	28	20-30 (26)	20-22
Cirrus-sac	290-322 × 48-58 (308 × 51)	?	261-406 × 32-64 (349 × 60)	207 × ?
Ventral sucker to ovary	71-167 (126)	158	87-261 (188)	45-79
Ovary	64-113 × 89-151 (95 × 123)	93 × 144	55-129 × 70-174 (106 × 167)	41-47 × 47-57
Eggs	28-32 13-18 (30 × 16)	27-29 × 16-17	29-33 × 14-16 (30 × 16)	29-35 × 13-16

Table I. — Measurements of *Cableia pudica* n. sp.

of which possess an uterine seminal receptacle and a large cirrus-sac. The list of constituent genera of the Enenteridae they mentioned was considered by them to for a 'convenient phenetic, rather than a phyletic assemblage'. One of the genera they listed, namely *Neophasis* Stafford, 1904, has since been discussed in detail by Bray & Gibson (1991) and considered an aberrant acanthocolpid, taking into account life-cycle, larval and adult characters. Bray & Gibson's (1991) observations of several *Neophasis* species showed that, in contradiction to several previous descriptions, where a seminal receptacle could be traced it was of the uterine type. Gibson & Bray (1982) had placed *Neophasis* in the Enenterinae, which differs from the Pseudolepidapedinae in possessing a canalicular seminal receptacle (see Gibson & Bray, 1979, for definitions of the seminal receptacle types) so, clearly, *Neophasis* was wrongly designated at this stage. Now that *Neophasis*

is considered an aberrant acanthocolpid, it calls into question the status of the genera placed in the Pseudolepidapedinae by Bray & Gibson (1991). *Pseudolepidapedon*, which has ten described species, was considered an acanthocolpid genus by Skrjabin (1954). Indeed, eight of the described species (*P. paralichthydis* Yamaguti, 1938, *P. balistis* Manter, 1940, *P. kobayashii* Yamaguti, 1938, *P. lethrini* Yamaguti, 1952, *P. mordvinovae* Parukhin, 1978, *P. pudens* (Linton, 1900), *P. sinaloense* Bravo-Hollis, 1956 and *P. laticaeale* Reimer, 1981) have an overall morphology and particularly an alimentary system (long prepharynx, large pharynx, very short oesophagus) which is markedly similar to that of a typical acanthocolpid. The ninth described species, *P. indica* Gupta & Ahmad, 1976, has its genital pore posterior to the aperture of the ventral sucker (Gupta & Ahmad, 1976), and clearly belongs in another genus. The most recently

described species, *P. hydrolagi* Machida & Kuramochi, 1994 (described from the holocephalan *Hydrolagus mitsukurii*), is said to lack both a seminal receptacle and an external seminal vesicle, so its inclusion in the Lepocreadiidae by Machida & Kuramochi (1994) must be questionable, but its alimentary system is not markedly acanthocolpid-like. *Cableia* does not have the same superficial similarity to the typical acanthocolpid as is the case for most species of *Pseudolepidapedon* and, with its small eggs, it does not fit comfortably into the Enenteridae, Lepocreadiidae, Acanthocolpidae or Opcoelidae. A bipartite internal seminal vesicle as found in *Cableia* is rarely found in the Opcoelidae, Lepocreadiidae and Enenteridae, but is said to occur in some acanthocolpid genera, including *Stephanostomum* Looss, 1899 [see, e. g., *S. microstephanum* Manter, 1934 according to Manter (1934), Fig. 40], *Tormopsolus* Poche, 1925 [see, e. g., *T. osculatus* (Looss, 1901) according to Looss (1901), Fig. 11], and *Neophasis* [see, e. g., *N. osculatus* (Levinsen, 1881) according to Bray & Gibson (1991), Fig. 5]. The lack of an external seminal vesicle and the presence of an uterine seminal receptacle in *Cableia* precludes its inclusion in the Lepocreadiidae (*sensu* Gibson & Bray, 1982) and the spinous tegument precludes its inclusion in the Opcoelidae. If *Pseudolepidapedon* is, in fact, considered an acanthocolpid, *Cableia* is left as a *genus incertae sedis*, with claims to both enenterid and acanthocolpid affinities. Clearly a knowledge of life-cycle or larval information, or molecular phylogenetic studies, are needed to shed more light on the status of this form, but we believe that the Acanthocolpidae should act as a repository *pro tem*. The subfamily Pseudolepidapedinae is, therefore, subsumed into the family Acanthocolpidae. Whether it should retain its subfamily status is doubtful, and would need a revision of the family to ascertain. It does not appear that *Pseudolepidapedon* and *Cableia* are particularly closely related.

These specimens are considered to belong in *Cableia* because of the lobate ovary and the small eggs, but differ from the type- and only species, *C. trigoni* Sogandares-Bernal, 1959, based on a single specimen from *Lactophrys trigonus* [Ostraciidae], Bimini, West Indies, in possessing a more elongate cirrus-sac, a longer post-testicular region, a shorter prepharynx, vitelline fields less extensive anteriorly and a dorsally subterminal excretory pore. Sogandares-Bernal (1959) described a uroproct, but Yamaguti's (1971) re-examination showed that the caeca terminate blindly at different levels (see his fig. 403). In our examination of the holotype (USNPC 38864), we were not able to confirm all of Yamaguti's findings. We agree that the right caecum appears to terminate blindly at the level of the anterior part of the posterior testis, but we

cannot clearly distinguish the termination of the left caecum. It appears that the left caecum is long and may be extruded through the excretory pore (presumably during flattening) as a small globular body (see Sogandares-Bernal's figure - this feature is omitted from Yamaguti's figure). The detail is far from clear, but we can see no real evidence for a uroproct.

The definition of *Cableia* given by Yamaguti (1971) may be supplemented by the following statements: oesophagus short to long. Testes in mid- to posterior hindbody. Cirrus finely spined or not.

A striking characteristic of most of these specimens, from all four hosts, is that there is no sign of spermatozoa, in either internal or external seminal vesicles or the proximal uterus, nor is there any indication of spermatogenesis in the testes. Bray (1987) found a similar condition in the zoogonid *Steganoderma* (*S.*) *formosum* Stafford, 1904 in part of its geographical range and suggested, in line with observations discussed in Whitfield & Evans (1983), that this indicated parthenogenesis. However, in three specimens (of five) from the same host specimen of *Canthoeschenia grandisquamis* and four specimens (of 13) from the same host specimen of *Cantherhines pardalis*, spermatozoa were seen in the bipartite internal seminal vesicle and there was evidence of spermatogenesis in the testes. In several of these specimens sperm was accumulated in the proximal sling of the uterus. In these specimens there was no evidence of an external seminal vesicle. *Cableia* was described as having a "club-shaped seminal receptacle" by Sogandares-Bernal (1959), but Yamaguti (1971) re-examined and redrew the type showing "receptaculum seminis uterinum conspicuous, but no true seminal receptacle". Examination of the holotype confirms Yamaguti's findings. The name *pudica* (Latin: modest, chaste, virtuous) refers to the apparent infrequency of normal sexual activity in these worms.

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