

## MONOGENEANS FROM PANGASIIDAE (SILURIFORMES) IN SOUTHEAST ASIA: VIII. FOUR NEW SPECIES OF *THAPAROCLEIDUS* JAIN, 1952 (ANCYLODISCOIDIDAE) FROM *PANGASIVUS POLYURANODON* AND *P. ELONGATUS*

PARISELLE A.\*\*\*, LIM L.H.S.\*\*\* & LAMBERT A.\*\*\*

### Summary:

The examination of gill parasites from *Pangasius polyuranodon* Bleeker, 1852 and *P. elongatus* Pouyaud, Gustiano & Teugels, 2002 (Siluriformes, Pangasiidae) in Southeast Asia revealed the presence of four new species of Monogenea all belonging to *Thaparocleidus* Jain, 1952 (Monogenea, Ancylo-discoididae) as defined by Lim (1996) and Lim *et al.* (2001): *T. furcus* n. sp., *T. infundibulus* n. sp., *T. sudartoi* n. sp. and *T. turbinatio* n. sp.

**KEY WORDS:** Monogenea, Ancylo-discoididae, *Thaparocleidus furcus* n. sp., *Thaparocleidus infundibulus* n. sp., *Thaparocleidus sudartoi* n. sp., *Thaparocleidus turbinatio* n. sp., freshwater fish, Siluriformes, Pangasiidae, *Pangasius polyuranodon*, *Pangasius elongatus*, Southeast Asia.

**Résumé:** MONOGENÈS DE PANGASIIDAE (SILURIFORMES) EN ASIE DU SUD-EST: VIII. QUATRE ESPÈCES NOUVELLES DE *THAPAROCLEIDUS* JAIN, 1952 (ANCYLODISCOIDIDAE) CHEZ *PANGASIVUS POLYURANODON* ET *P. ELONGATUS*

L'examen des parasites branchiaux de *Pangasius polyuranodon* Bleeker, 1852 et *P. elongatus* Pouyaud, Gustiano & Teugels, 2002 (Siluriformes, Pangasiidae) en Asie du Sud-Est a révélé la présence de quatre espèces nouvelles de Monogenea appartenant toutes au genre *Thaparocleidus* Jain, 1952 (Ancylo-discoididae) tel que défini par Lim (1996) et Lim *et al.* (2001) : *T. sudartoi* n. sp., *T. infundibulus* n. sp., *T. turbinatio* n. sp. et *T. furcus* n. sp.

**MOTS CLÉS:** Monogenea, Ancylo-discoididae, *Thaparocleidus furcus* n. sp., *Thaparocleidus infundibulus* n. sp., *Thaparocleidus sudartoi* n. sp., *Thaparocleidus turbinatio* n. sp., poissons d'eau douce, Siluriformes, Pangasiidae, *Pangasius polyuranodon*, *Pangasius elongatus*, Asie du Sud-Est.

## INTRODUCTION

Within the framework of an European Commission project on the biodiversity and culture of Southeast Asian catfishes, the gills from pangasiid fishes (Siluriformes) were examined for monogeneans. This paper presents the descriptions of four new species of *Thaparocleidus* Jain, 1952 (Monogenea, Ancylo-discoididae) found on *Pangasius polyuranodon* Bleeker, 1852 and *P. elongatus* Pouyaud, Gustiano & Teugels, 2002. The first host species has been examined for specific monogenean species (see Pariselle *et al.*, 2004 a and 2004 b), while the second has not been previously examined for parasites. To date 34 species of Monogenea (33 *Thaparocleidus* and one *Pagasitrema* Pariselle, Euzet & Lambert, 2004) have been described from the sixteen studied *Panga-*

*sivus* species (*Pangasius bocourti* Sauvage, 1880; *P. djambal* Bleeker, 1846; *P. gigas* Chevey, 1930; *P. humeralis* Roberts, 1989; *P. hypophthalmus* (Sauvage, 1878); *P. kinabatanganensis* Roberts & Vidthayanon, 1991; *P. kremphi* Roberts & Vidthayanon, 1991; *P. kunyit* Pouyaud, Teugels & Legendre, 1999; *P. lithostoma* Roberts, 1989; *P. mekongensis* Gustiano, Teugels & Pouyaud, 2003; *P. nasutus* (Bleeker, 1862); *P. nieuwenhuisii* (Popta, 1904); *P. pangasius* (Hamilton, 1822); *P. polyuranodon* Bleeker, 1852; *P. rheophilus* Pouyaud & Teugels, 2000 and *P. saba-hensis* Gustiano, Teugels & Pouyaud, 2003) from India, Bangladesh, Indonesia, Malaysia, Thailand and Vietnam (see Tripathi, 1957; Lim, 1990, Pariselle *et al.* 2001 a, 2001 b, 2002 a, 2002 b, 2003, 2004 a and 2004 b).

## MATERIALS AND METHODS

Fish, caught by hook and line or collected directly from aquaculture facilities, were bought in fish markets or directly from fishermen in Indonesia (Sumatra and Borneo Islands), Vietnam (Mekong Delta) and Malaysia (Borneo Island). The fish were dissected as soon as possible, and the left branchial arches were frozen in liquid nitrogen, until examination. To verify the specific identity of host fishes, the carcasses were

\* IRD (ex-ORSTOM), Catfish Asia Project, Instalasi Penelitian Perikanan Air Tawar, Jalan Ragunan-Pasar Minggu, P.O. Box 7220/jkspn, Jakarta 12540, Indonesia.

\*\* GAMET, BP 5095, 34033 Montpellier Cedex 1, France.

\*\*\* Institute of Biological Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia.

\*\*\*\* Laboratoire Génome, Populations, Interactions, Adaptations ; UMR 5171, cc 92, Université Montpellier II, Sciences et Techniques du Languedoc, Place Eugène Bataillon, 34095 Montpellier, Cedex 5, France.

Correspondence: A. Lambert. E-mail: [lambert@univ-montp2.fr](mailto:lambert@univ-montp2.fr)

numbered, fixed and preserved in formalin. In the laboratory, the gills were thawed and the monogeneans were detached from the gill using a strong water current. The worms were then transferred individually into a drop of ammonium picrate-glycerine (mixture described by Malmberg (1957)) on a slide with a mounted needle. The preparation was then covered with a round cover slip and sealed with Glyceel (GURR - BDH Chemicals Ltd.). From these preparations, drawings were made of the sclerotised pieces of the haptor and of the copulatory complex using a camera lucida. Measurements, made with a digitiser, in micrometers, and presented as the mean  $\pm$  standard deviation followed by the range in parentheses, are those proposed by Gussev (1962) (Fig. 1). The method of numbering of the haptoral pieces is that adopted at ICOPA IV (Euzet & Prost, 1981). Terminologies is that of Pariselle and Euzet (1995) and N'Douba *et al.* (1999).

## RESULTS

Eight species of non-specific Monogenea were recorded in Southeast Asia from *Pangasius polyuranodon* and *P. elongatus* (Siluriformes, Pangasiidae). Two have been previously described

(*T. brevicochleus* Pariselle, Lim & Lambert, 2001 originally described from *P. humeralis* was found on *P. polyuranodon* and *T. vietnamensis* Pariselle, Lim & Lambert, 2002 originally described from *P. bocourti* was found on *P. elongatus*). Two species are represented by too few individuals to be conclusively described (from two to five individuals among the 988 worms collected). The four remaining species are considered new (see descriptions below), their anatomy (soft and hard parts) complies with that of the diagnosis of *Thaparocleidus* (Monogenea, Ancylo-discoididae) as defined by Lim (1996) and Lim *et al.* (2001).

## DESCRIPTIONS

### *THAPAROCLEIDUS SUDARTOI* N. SP. (Fig. 2)

Type host: *P. polyuranodon* Bleeker, 1852.

Site: gills.

Type locality: Barito River at Banjarmasin (South Kalimantan Province, Borneo Island, Indonesia).

Other records: found on the same host in the Batang Hari River at Jambi (Jambi Province, Sumatra Island, Indonesia); in the Rajang River at Sibuluan and at Kapit (Sarawak State, Borneo Island, Malaysia); and on

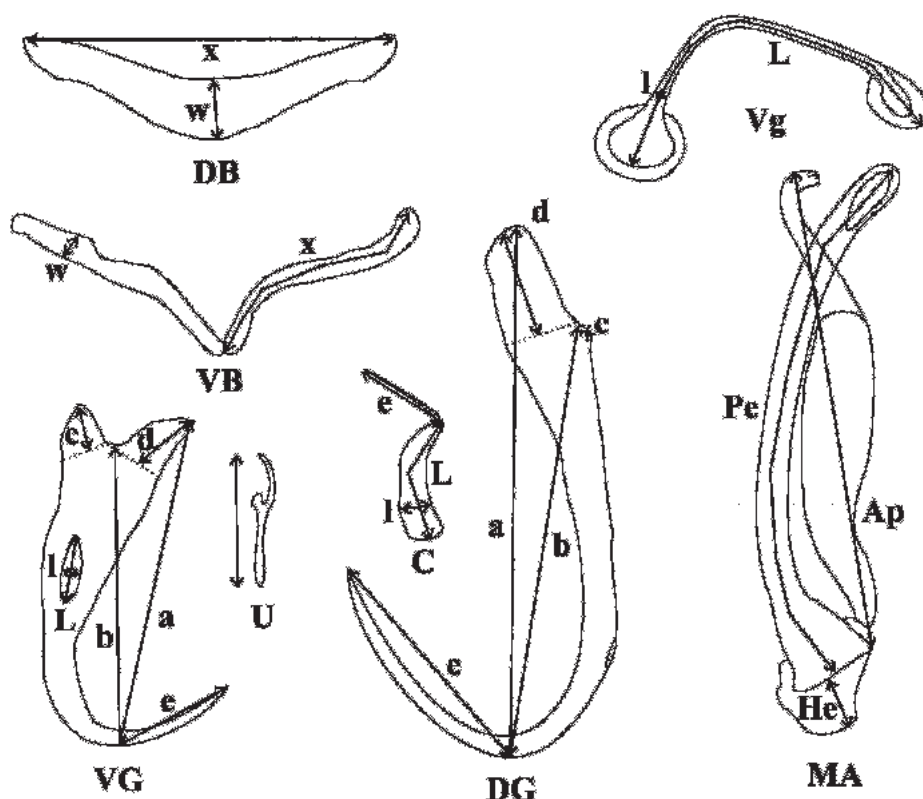


Fig. 1. – Measurements used in this study.

C = cuneus: L = length; l = largest width; e = extension length.

DB = dorsal transverse bar: x = total length; w = width in the middle.

DG = dorsal gripus: a, b, c, d and e = standard measurements.

MA = male apparatus: Pe = total length of the penis; Ap = length of the accessory piece; He = length of the heel.

U = total length of the uncinuli.

VB = ventral transverse bar: x = length of one branch; w = largest width.

VG = ventral gripus: a, b, c, d and e = standard measurements; L and l = length and width of gripus aperture.

Vg = vagina: L = total length; l = maximum width.

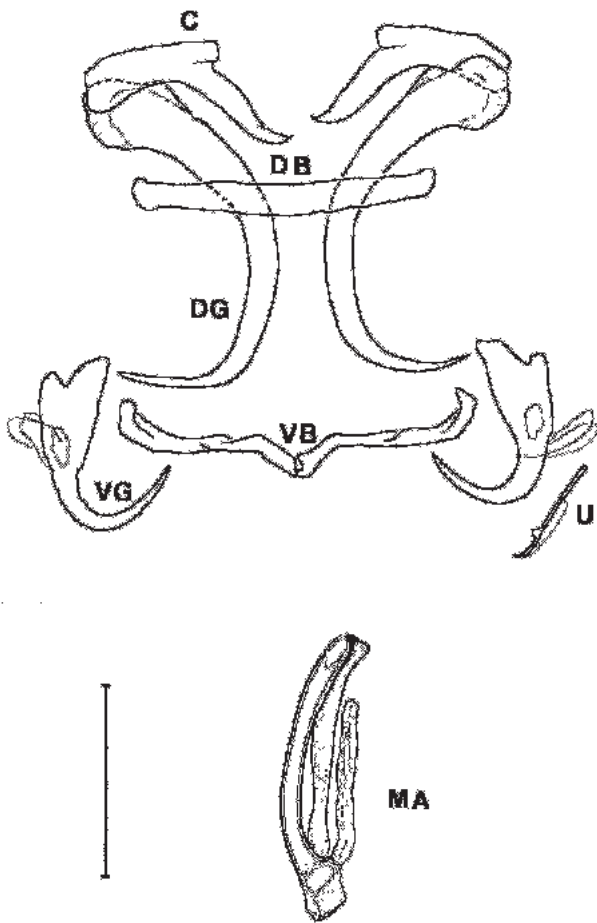


Fig. 2. – *Thaparocleidus sudartoi* n. sp. C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; U = uncinuli. Bar = 30  $\mu$ m.

*P. elongatus* from cage culture in the Mekong Delta (Vietnam).

Material studied: 30 individuals fixed and mounted in Malmberg solution.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 232 HG, TI 229. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 232 HG, TI 229 bis; and at The Natural History Museum (London): n° 2004.7.12.3.

Adults: 649  $\pm$  121 (423-959) long, 103  $\pm$  18.5 (66-145) wide at the level of the penis. Pharynx: 45  $\pm$  7.4 (27-56) wide. Dorsal gripus with blade bent at distal third and poorly marked guard: a = 50  $\pm$  1.3 (46-53), b = 46  $\pm$  1.3 (43-49), c = 1  $\pm$  0.3 (0.6-2), d = 8  $\pm$  0.7 (7-10), e = 16  $\pm$  1.4 (13-19). Large cuneus with a protuberance on the convex side and a thin and very short extension: L = 32  $\pm$  1.6 (27-35), l = 8  $\pm$  0.5 (6-9), e = 1  $\pm$  0.9 (0.1-4). Nearly straight dorsal transverse bar: x = 45  $\pm$  2.1 (40-48), w = 5  $\pm$  0.5 (4-6). Ventral gripus with well marked aperture, regularly arched blade and poorly developed guard: a = 26  $\pm$  0.9 (24-

28), b = 23  $\pm$  0.7 (21-25), c = 2  $\pm$  0.4 (1-3), d = 7  $\pm$  0.6 (6-9), e = 13  $\pm$  0.9 (11-15), L = 6  $\pm$  0.6 (4-7), l = 2  $\pm$  0.3 (1-3). V-shaped ventral transverse bar: x = 30  $\pm$  1.5 (27-34), w = 3  $\pm$  0.7 (3-5). Thin and long uncinuli II = 19  $\pm$  1.3 (15-21), long uncinuli I and III to VII = 17  $\pm$  2.9 (10-26). Short and slightly curved penis with a constant diameter and sub-terminal oval opening, developed heel: Pe = 43  $\pm$  1.8 (40-48), He = 5  $\pm$  0.9 (2-7). Accessory piece composed by two different parallel parts almost straight, different in size and starting near the basal bulb; the longest ending in a perpendicular hook: Ap = 36  $\pm$  1.4 (33-39). No visible vagina.

#### Comments

A morphologically very similar monogenean was found on the gills of *P. elongatus* from cage cultures in the Mekong Delta (Vietnam). The only difference noted is the size of the copulatory organs: 37 *vs.* 43  $\mu$ m for the penis and 29 *vs.* 36  $\mu$ m for the accessory piece. However, only four individuals were collected from this location.

This new species belongs to the group of *Thaparocleidus* with large cuneus presenting a protuberance on the convex side and a dorsal gripus with a poorly marked guard. *T. sudartoi* n. sp. is easily distinguished from *T. sabanensis* Pariselle, Lim & Lambert, 2001 and *T. phuongi* Pariselle, Lim & Lambert, 2002 in having a double accessory piece and sub-terminal penis opening; from *T. chandpuri* Pariselle, Lim & Lambert, 2001 in having a short penis (43 *vs.* 106  $\mu$ m) without a spirally coiled thickening at its extremity and no visible vagina; and from *T. redebensis* Pariselle, Lim & Lambert, 2001 in having a slightly curved short penis and no expansion of the penis wall.

*Thaparocleidus sudartoi* n. sp. is named after the researcher Sudarto at the Research Institute for Freshwater Aquaculture (RIFA) (Jakarta, Indonesia) who helped in collecting the fish samples.

#### *THAPAROCLEIDUS INFUNDIBULUS* N. SP. (Fig. 3)

Type host: *P. polyuranodon* Bleeker, 1852.

Site: gills.

Type locality: Barito River at Banjarmasin (South Kalimantan Province, Borneo Island, Indonesia).

Other records: found on the same host in the Batang Hari River at Jambi (Jambi Province, Sumatra Island, Indonesia); in the Rajang River at Kapit (Sarawak State, Borneo Island, Malaysia) and on *P. elongatus* from cage culture in the Mekong Delta at Can Tho (Vietnam).

Material studied: 31 individuals fixed and mounted in Malmberg solution.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 231 HG, TI 228.

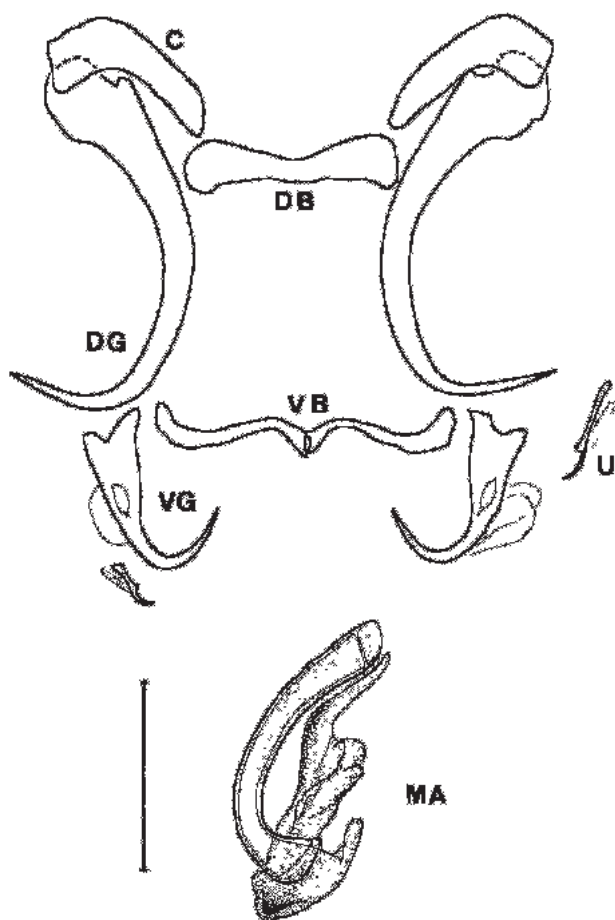


Fig. 3. – *Thaparocleidus infundibulus* n. sp. C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; U = uncinuli. Bar = 30  $\mu$ m.

Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 231 HG, TI 228 bis; and at The Natural History Museum (London): n° 2004.7.12.2.

Adults: 652  $\pm$  80.4 (506-845) long, 86  $\pm$  14.2 (62-116) wide at the level of the penis. Pharynx: 37  $\pm$  4.4 (26-47) wide. Dorsal gripus with blade bent at distal third and poorly marked guard: a = 54  $\pm$  1.6 (51-59), b = 49  $\pm$  1.4 (47-53), c = 1  $\pm$  0.3 (0.5-2), d = 9  $\pm$  0.6 (8-11), e = 16  $\pm$  1.4 (13-19). Large curved cuneus without extension: L = 28  $\pm$  1.6 (24-31), l = 8  $\pm$  0.6 (7-10). Almost straight dorsal transverse bar with rounded extremities: x = 33  $\pm$  1.6 (29-36), w = 4  $\pm$  0.4 (3-5). Ventral gripus with well marked aperture, blade bent at the middle and well marked guard: a = 24  $\pm$  0.6 (23-26), b = 22  $\pm$  0.9 (17-24), c = 3  $\pm$  0.6 (2-5), d = 5  $\pm$  0.7 (4-9), e = 10  $\pm$  0.8 (8-12), L = 5  $\pm$  0.5 (3-6), l = 2  $\pm$  0.3 (1-2). V-shaped ventral transverse bar: x = 26  $\pm$  1.5 (22-30), w = 3  $\pm$  0.5 (2-4). Uncinuli II = 15  $\pm$  1 (12-17), uncinuli I and III to VII = 15  $\pm$  2.6 (9-19). Penis consisting of a large and strong curved tube with a constant diameter, a large opening and a reduced basal

bulb: Pe = 47  $\pm$  1.1 (45-50). Heel with a short extension parallel to the copulatory tube: He = 6  $\pm$  1 (4-7). Heavy accessory piece, slightly S-shaped with a large protuberance at the middle, starting near the basal bulb: Ap = 35  $\pm$  3.3 (29-44). No visible vagina.

#### Comments

A morphologically very similar monogenean was found on the gills of the same host from the Batang Hari River (Indonesia), from the Rajang River (Malaysia) and on *P. elongatus* from cage culture in the Mekong Delta (Vietnam). The only difference noted is the size of the copulatory organ: 43 *vs.* 47  $\mu$ m. Only 6 individuals were sampled from these locations (three from Malaysia, two from Sumatra and one from Vietnam). *T. infundibulus* n. sp. belongs to the group of *Thaparocleidus* with large cuneus and a dorsal gripus with a poorly marked guard. *T. infundibulus* n. sp. is easily distinguishable from *T. sabanensis*, *T. phuongi* in having a heavy accessory piece and a large penis; from *T. chandpuri* in having a shorter penis (47 *vs.* 106  $\mu$ m) without a spirally coiled thickening at its extremity; from *T. redebensis* in having a curved shorter penis and no expansion of the penis wall; and from *T. sudartoi* n. sp. in having a large and strong penis with a large terminal opening (*vs.* thinner and with a sub-terminal opening).

*Thaparocleidus infundibulus* n. sp. is named after the funnel-shaped opening of the penis (infundibulum = funnel).

#### *THAPAROCLEIDUS TURBINATO* N. SP. (Fig. 4)

Type host: *P. polyuranodon* Bleeker, 1852.

Site: gills.

Type locality: Barito River at Banjarmasin (South Kalimantan Province, Borneo Island, Indonesia).

Other records: found on the same host in the Batang Hari River at Jambi (Jambi Province, Sumatra Island, Indonesia); in the Rajang River at Sibu (Sarawak State, Borneo Island, Malaysia); and on *P. elongatus* from cage culture in the Mekong Delta at Can Tho (Vietnam).

Material studied: 30 individuals fixed and mounted in Malmberg solution.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 233 HG, TI 230. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 233 HG, TI 230 bis; and at The Natural History Museum (London): n° 2004.7.12.4.

Adults: 481  $\pm$  100.2 (315-714) long, 72  $\pm$  16.6 (47-105) wide at the level of the penis. Pharynx: 30  $\pm$  5.4 (21-46) wide. Dorsal gripus with blade bent at distal third and poorly marked guard: a = 54  $\pm$  3.4 (46-60), b = 42  $\pm$  2.8 (35-47), c = 1  $\pm$  0.2 (0.5-1), d = 15  $\pm$  1.2 (12-17),

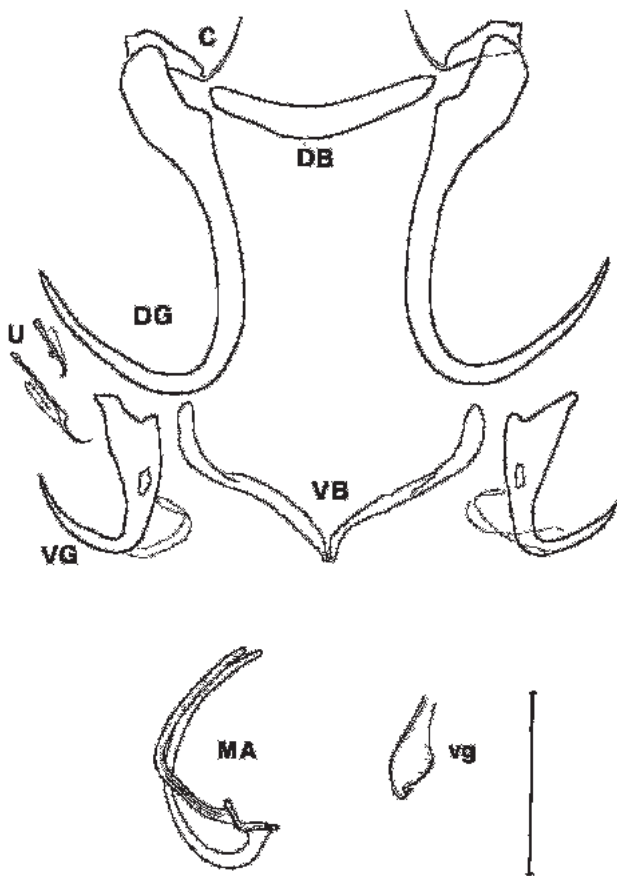


Fig. 4. – *Thaparocleidus turbinatio* n. sp. C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; vg = vagina; U = uncinuli. Bar = 30  $\mu$ m.

$e = 28 \pm 1.7$  (24-31). Small cuneus with long and thin extension:  $L = 12 \pm 1.1$  (9-14),  $l = 5 \pm 0.6$  (4-7),  $e = 11 \pm 1.8$  (7-14). Slightly V-shaped dorsal transverse bar:  $x = 35 \pm 2.5$  (28-39),  $w = 5 \pm 0.5$  (4-6). Ventral gripus with marked aperture and guard:  $a = 24 \pm 1.2$  (21-26),  $b = 20 \pm 1.1$  (18-22),  $c = 1 \pm 0.3$  (0.3-2),  $d = 8 \pm 0.5$  (6-9),  $e = 15 \pm 0.9$  (14-17),  $L = 4 \pm 0.5$  (3-5),  $l = 2 \pm 0.4$  (1-3). V-shaped ventral transverse bar:  $x = 34 \pm 2.5$  (29-39),  $w = 3 \pm 0.4$  (3-4). Thin uncinuli II =  $16 \pm 1$  (13-19), uncinuli I and III to VII =  $15 \pm 2.8$  (9-19). C-shaped thin penis with constant diameter, beginning with a poorly marked basal bulb:  $Pe = 52 \pm 2.6$  (45-57), short heel:  $He = 6 \pm 0.8$  (4-8). Very simple and bent at the middle accessory piece, with a gutter depression along the first third, linked to the basal bulb of the penis:  $Ap = 40 \pm 2.2$  (35-44). Conical vagina:  $L = 13 \pm 1.6$  (10-16),  $l = 7 \pm 1$  (5-9).

Comments

Specimens from Malaysia seem to have slightly smaller sclerotised pieces (accessory piece, dorsal transverse bar, and ventral and dorsal gripi). However, only four individuals were sampled from this location.

*T. turbinatio* n. sp. belongs to the group with cuneus long extension (more than half the length of the cuneus). *T. turbinatio* n. sp. is easily distinguishable mainly by the shape and/or size of the penis (C-shaped, thin with a constant diameter and 52  $\mu$ m long) from all the *Thaparocleidus* already described in this group: *T. humerus* Pariselle, Lim & Lambert, 2002 and *T. meburus* Pariselle, Lim & Lambert, 2002 (straight with a large diameter); *T. babari* Pariselle, Lim & Lambert, 2001 (3-shaped and 89  $\mu$ m long); *T. pangasi* (Tripathi, 1957), *T. mahakamensis* Pariselle, Lim & Lambert, 2001, *T. sinespinae* Pariselle, Lim & Lambert, 2001, *T. sadilii* Pariselle, Lim & Lambert, 2002, *T. vietnamensis* and *T. caecus* (Mizelle & Kristsky, 1969) (181, 169, 152, 129, 91 and 69  $\mu$ m long respectively); *T. culter* Pariselle, Lim & Lambert, 2002 and *T. culteroides* Pariselle, Lim & Lambert, 2002 (curved with a thick wall and large heel).

The name *Thaparocleidus turbinatio* n. sp. is based on the shape of the vagina (turbinatio = cone-shaped).

*THAPAROCLEIDUS FURCUS* N. SP. (Fig. 5)

Type host: *P. polyuranodon* Bleeker, 1852.

Site: gills.

Type locality: Barito River at Banjarmasin (South Kalimantan Province, Borneo Island, Indonesia).

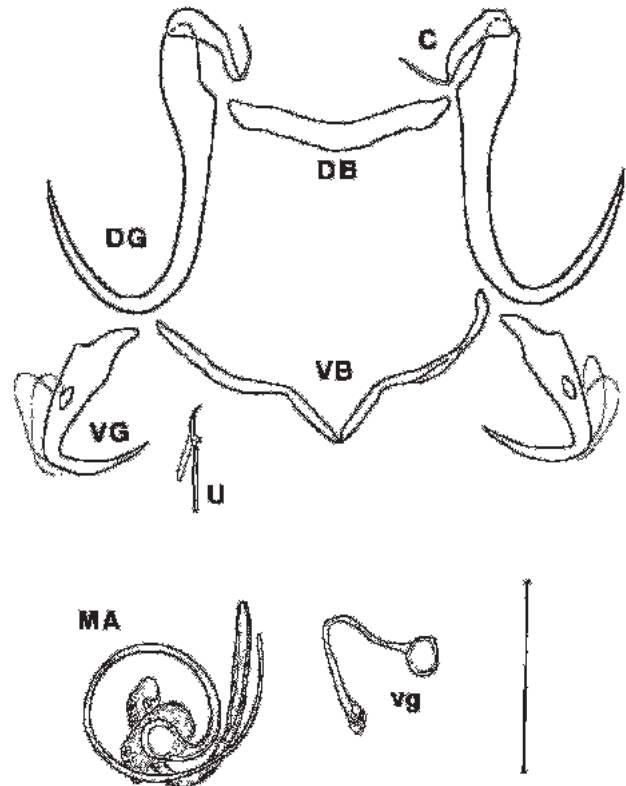


Fig. 5. – *Thaparocleidus furcus* n. sp. C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; vg = vagina; U = uncinuli. Bar = 30  $\mu$ m.

Other records: found on the same host in the Batang Hari River at Jambi (Jambi Province, Sumatra Island, Indonesia); in the Rajang River at Sibu and Kapit (Sarawak State, Borneo Island, Malaysia); and on *P. elongatus* from cage culture in the Mekong Delta at Can Tho (Vietnam).

Material studied: 30 individuals fixed and mounted in Malmberg solution.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 230 HG, TI 227. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 230 HG, TI 227 bis; and at The Natural History Museum (London): n° 2004.7.12.1.

Adults:  $487 \pm 74.4$  (336-614) long,  $74 \pm 14.6$  (50-104) wide at the level of the penis. Pharynx:  $36 \pm 4.4$  (29-46) wide. Dorsal gripus with blade bent at distal third and poorly marked guard:  $a = 43 \pm 2.7$  (38-49),  $b = 34 \pm 2.1$  (31-40),  $c = 1 \pm 0.3$  (0.3-1),  $d = 10 \pm 1$  (8-13),  $e = 22 \pm 1.7$  (19-26). Small cuneus with long and thin extension:  $L = 12 \pm 1.1$  (10-14),  $l = 4 \pm 0.6$  (3-5),  $e = 10 \pm 1.6$  (6-15). Slightly V-shaped dorsal transverse bar:  $x = 31 \pm 2.7$  (26-35),  $w = 4 \pm 0.5$  (3-4). Ventral gripus with marked aperture and poorly marked guard:  $a = 23 \pm 1.4$  (20-27),  $b = 18 \pm 1.1$  (16-20),  $c = 1 \pm 0.2$  (0.4-2),  $d = 7 \pm 0.6$  (6-8),  $e = 14 \pm 0.8$  (12-16),  $L = 3 \pm 0.4$  (2-4),  $l = 1 \pm 0.3$  (0.4-2). V-shaped ventral transverse bar:  $x = 31 \pm 2$  (28-35),  $w = 2 \pm 0.3$  (2-3). Thin uncinuli II =  $14 \pm 1$  (12-17), uncinuli I and III to VII =  $15 \pm 2.5$  (9-21). Spirally coiled (1.5 turns) very thin penis, beginning with a marked basal bulb:  $Pe = 87 \pm 9.9$  (65-103), rounded heel:  $He = 4 \pm 1$  (2-6). Simple, bent at the first third accessory piece, with a gutter depression along the distal half:  $Ap = 49 \pm 2.8$  (44-54). Thin and tubular vagina, bend at the middle, with rounded extremities:  $L = 28 \pm 2.2$  (25-35),  $l = 1 \pm 0.2$  (1-2).

#### Comments

*T. furcus* n. sp. is the only species within *Thaparocleidus* from Pangasiid hosts possessing a cuneus long extension (more than half the length of the cuneus) and a spirally coiled penis.

The name *Thaparocleidus furcus* n. sp. is based on the appearance of the accessory piece extremity which looks like a fork because of the gutter depression (furca = fork).

## CONCLUSIONS

It should be noted that *T. vietnamensis* from *P. elongatus* was found only on hosts sampled in cage culture in the Mekong River in Vietnam (as in the original description) and represent 50 % of all

the monogenean recorded on this host species (see conclusions in Pariselle *et al.*, 2002 a).

*T. brevicochleus*, initially described from *P. humeralis* in the Kapuas River, was found only on *P. polyuranodon* from the Barito River. As these two host species are not closely related (see Pouyaud *et al.*, 2000) and as the two rivers basins are well separated on Borneo Island, no conclusions are possible on whether these has been recent lateral transfer or coevolution of parasites and hosts. Some of the new species described above have morphometrical differences according to the location [Vietnamese population of *T. sudartoi*; population of *T. infundibulus* from Kalimantan (Indonesian part of Borneo); Malaysian population of *T. turbinatio*]. These differences, as well as the number of worm collected seem to be too small to allow establishment of different species. The differences may have arisen, because the host populations are isolated and the parasites were subject to genetic drift. A similar phenomenon has been noticed among *Thaparocleidus phuongi* from *Pangasius kunyit*, *P. sababensis* and *P. mekongensis* where the differences have been considered sufficient to describe location specific sub-species (see Pariselle *et al.* 2002 b). In this case, the isolation of host populations may be more ancient.

The four new species described in this paper bring the number of monogenean species described on 17 species of pangasiids (*P. bocourti*, *P. djambal*, *P. elongatus*, *P. gigas*, *P. humeralis*, *P. hypophthalmus*, *P. kinabatanganensis*, *P. krempfi*, *P. kunyit*, *P. lithostoma*, *P. mekongensis*, *P. nasutus*, *P. nieuwenhuisii*, *P. pangasius*, *P. polyuranodon*, *P. rheophilus* and *P. sababensis*) to 38.

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[d-camus@chru-lille.fr](mailto:d-camus@chru-lille.fr)

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