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**Summary:**

The examination of gill parasites from Pangasius bocourti Sauvage, 1880; P. djambal Bleekeke, 1846; P. hypophthalmus (Sauvage, 1878) and P. gigas Chevey, 1930 (Siluriformes, Pangasiidae) revealed the presence of seven species of Monogenea among which five are considered new species. They all belong to Thaparocleidus Jain, 1952 (Ancylodiscoididae) as defined by Lim (1996) and Lim et al. (2001).__P. bocourti:_ T. combesi n. sp., T. komarudini n. sp. and T. vietnamensis n. sp._

_T. djambal:_ T. caecus [Mizelle & Kritsky, 1969], T. combesi n. sp., T. euzeti n. sp., T. komarudini n. sp. and T. sadillii n. sp._

_T. hypophthalmus:_ T. caecus, T. siamensis (Lim, 1999) and T. vietnamensis n. sp._

_P. gigas:_ no Monogenea were found on this host species.

**KEY WORDS** : Monogenea, Ancylodiscoididae, Thaparocleidus combesi n. sp., Thaparocleidus euzeti n. sp., Thaparocleidus komarudini n. sp., Thaparocleidus sadillii n. sp., Thaparocleidus vietnamensis n. sp., Thaparocleidus caecus, Thaparocleidus siamensis, freshwater fish, Siluriformes, Pangasiidae, Pangasius bocourti, Pangasius djambal, Pangasius hypophthalmus, Pangasius gigas, South East Asia.

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**INTRODUCTION**

Within the framework of an EC project on the bio-diversity and culture of Southeast Asian catfishes, the gills from pangasid fishes (Siluriformes, Pangasiidae) were examined for mono­geneans. This third paper (see Pariselle et al., 2001a, b) presents the descriptions of the five new species of Thaparocleidus Jain, 1952 (Monogenea, Ancylodiscoididae) found on Pangasius bocourti Sauvage, 1880, Pangasius djambal Bleekeke, 1846, P. hypophthalmus (Sauvage, 1878) and P. gigas Chevey, 1930. Only _P. hypophthalmus_ have been previously examined for parasites (see Lim, 1990). To date a total of 12 species of _Thaparocleidus_ have been described from Pangasius bocourti (Sauvage, 1878); _P. pangasius_ (Bleeker, 1846); _P. hypophthalmus_ (Sauvage, 1878) and _P. gigas_ Chevey, 1930 (Siluriformes, Pangasiidae) as defined by Lim (1996) and Lim et al. (2001). Among these species, five are considered new.

**Résumé :** Monogènes de Pangasiusidae (Siluriformes) en Asie du Sud-Est : III. Cinq espèces nouvelles de Thaparocleidus Jain, 1952 (Ancylodiscoididae) chez Pangasius bocourti, P. djambal et P. hypophthalmus

L'examen des parasites branchiaux de Pangasius bocourti Sauvage, 1880; P. djambal Bleekeke, 1846; P. hypophthalmus (Sauvage, 1878) et P. gigas Chevey, 1930 (Siluriformes, Pangasiidae) a révélé la présence de sept espèces de Monogenea appartenant au genre Thaparocleidus Jain, 1952 (Ancylodiscoididae) tel que défini par Lim (1996) et Lim et al. (2001). Parmi ces espèces, cinq sont considérées comme nouvelles.

**MOTS CLÉS :** Monogenea, Ancylodiscoididae, Thaparocleidus combesi n. sp., Thaparocleidus euzeti n. sp., Thaparocleidus komarudini n. sp., Thaparocleidus sadillii n. sp., Thaparocleidus vietnamensis n. sp., Thaparocleidus caecus, Thaparocleidus siamensis, poissons d'eau douce, Siluriformes, Pangasiidae, Pangasius bocourti, Pangasius djambal, Pangasius hypophthalmus, Pangasius gigas, Asie du Sud Est.

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**MATERIALS AND METHODS**

Fish were bought in fish markets or directly from fishermen: _P. bocourti_ from Vietnam, _P. djambal_ from Indonesia (Java, Sumatra and Kalimantan Islands), _P. hypophthalmus_ from Vietnam and Indo-
nesia, and *P. gigas* from Thailand. Fish were caught in rivers using lines, nets or in aquaculture facilities (cages or ponds). The left branchial arches of each fish were separated into dorsal and ventral sections, and frozen in liquid nitrogen, until examination. The host carcasses were numbered, fixed and preserved in formalin to verify the specific identity of host fishes. In the laboratory, the gills were thawed and the monogeneans were detached from the gill using a strong water current. The monogeneans were then transferred individually on a slide with a mounted needle, into a drop of ammonium picrate-glycerine (mixture described by Malmberg (1957)). 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 as the mean ± the 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). Terminology is that of Pariselle & Euzet (1995) and N'Douba *et al.* (1999).

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.
Box: measurements of spiral diameter for the penis (MA) and the vagina (Vg) in *T. euzeti* n. sp.
RESULTS

Seven monogenean species\(^1\) were recorded from *P. bocourtii*, *P. djambal* and *P. hypophthalmus*, all belonging to *Thaparocleidus* (Ancylostomidae, Monogenea) as defined by Lim (1996). Two have been previously described: *Thaparocleidus caecus* (Mizelle & Kritsky, 1969), recovered from *P. djambal* both in ponds (Sukamandi Research Station, West Java, Java Island, Indonesia) and in the wild (Solo River at Cepu, East Java, Java Island, Indonesia); and on *P. hypophthalmus* at the Sukamandi Research Station (West Java, Java Island, Indonesia). *Thaparocleidus siamensis* (Lim, 1990) recovered on *P. hypophthalmus* in aquaculture facilities from Vietnam (cage on the Mekong River at Can Tho) and Indonesia (Sukamandi Research Station, West Java, Java Island). *Thaparocleidus komarudini*

\(^1\) An eighth species was found on *P. djambal* from the Indragiri River at Rengat (Riau province, Sumatra Island, Indonesia), but only four worms could be examined, it is too few to describe this new species.

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**Fig. 2.** - *Thaparocleidus sadilii* n. sp. C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; U = uncini. Bar = 30 μm.
n. sp. and T. combesi n. sp. were recorded from P. bocourti and P. djambal. Thaparocleidus vietnamese n. sp. was found in Vietnam on P. bocourti and P. hypophthalmus. Thaparocleidus sadilii n. sp. and T. euzeti n. sp. were recorded from P. djambal only (see descriptions below). No monogenean parasites were recorded on P. gigas in The Mekong River at Nong Khai (Thailand) (only two specimens examined).

DESCRIPTORS

Thaparocleidus sadilii n. sp. (Fig. 2)

Type-host: P. djambal Bleeker, 1846.
Site: gills.
Type-locality: Solo River at Cepu (East Java, Java Island, Indonesia).
Material studied: 18 individuals.

Adults: 595 ± 96.7 (415-755) long, 115 ± 20.4 (79-159) wide at level of penis. Pharynx: 51 ± 7.1 (40-64) wide. Dorsal gripus with blade bent at distal third, poorly marked guard: a = 44 ± 2 (38-48), b = 36 ± 1.8 (32-40), c = 1 ± 0.4 (0.5-2), d = 10 ± 1.1 (9-13), e = 25 ± 1.1 (23-27). Small cuneus with long extension: L = 9 ± 1.2 (6-12), l = 4 ± 0.4 (3-5), e = 7 ± 1.2 (4-10). Slightly curved, short dorsal transverse bar: x = 28 ± 1.8 (24-32), w = 5 ± 0.4 (4-6). Ventral gripus with well-marked aperture, poorly developed guard: a = 23 ± 0.8 (21-25), b = 21 ± 0.9 (19-23), c = 1 ± 0.2 (0.7-1.5), d = 6 ± 0.6 (5-7), e = 14 ± 0.6 (12-15), L = 5 ± 0.5 (4-6), l = 2 ± 0.4 (1-3). Thin V-shaped ventral transverse bar with rounded extremities: x = 30 ± 1.5 (28-34), w = 4 ± 0.6 (3-4). Very thin uncinuli II = 12 ± 0.9 (9-13) long, uncinuli I and III to VII = 12 ± 0.8 (9-16) long. Long penis folded after bell-shaped basal bulb, constricted after proximal third and well developed heel: Pe = 123 ± 4.8 (113-130), He = 11 ± 1.5 (8-14). Long, large, S-shaped accessory piece linked to basal bulb of the penis: Ap = 63 ± 3.9 (55-73). No visible vagina.

Comments

Among the 12 described species belonging to Thaparocleidus on Pangasius hosts only four have a non spirally coiled penis longer than 100 μm. T. sadilii n. sp. is easily distinguishable (no overlapping between the range of measurements) from:

- T. chandpuri Pariselle et al., 2001 by the shape and size of all the haptorial sclerotised parts, by the shape (non spirally coiled, thickening at the extremity) and the size (123 vs. 106 μm) of the penis.
- T. panguisi (Tripathi, 1957) by the size of the penis (123 vs. 181 μm) and the size of the cuneus (9 vs. 20 μm) (measurements from Pariselle et al., 2001).
- T. mabakamensis Pariselle et al., 2001 by the size of the penis (123 vs. 169 μm) and the size of the dorsal and ventral gripus (44 vs. 59 μm and 23 vs. 27 μm).

T. sadilii n. sp. is close to T. sinispinae Pariselle et al., 2001 but may be distinguished in having a shorter penis (123 vs. 152 μm).

Thaparocleidus sadilii n. sp. is named for M. Didi Sadili from the Department of Sea Exploration and Fisheries in Jakarta who provide the specimens of P. djambal from Java Island.

Thaparocleidus komarudivi n. sp. (Fig. 3)

Type-host: P. djambal Bleeker, 1846.
Site: gills.
Type-locality: Batang Hari River at Jambi (Jambi province, Sumatra Island, Indonesia).
Also found on P. bocourti Sauvage, 1880 in aquaculture cages on the Mekong River at Chau Doc (Vietnam).
Material studied: 30 individuals (15 from P. djambal and 15 from P. bocourti).

Very large worms, adults: 1436 ± 384.6 (751-2107) long, 210 ± 37.8 (129-285) wide at level of penis. Pharynx: 105 ± 15.6 (52-133) wide. Dorsal gripus with blade bent at distal third, poorly marked guard: a = 47 ± 2.5 (39-52), b = 37 ± 1.5 (34-40), c = 1 ± 0.4 (0.5-3), d = 14 ± 1.5 (10-18), e = 25 ± 1.3 (22-28). Short cuneus with short extension: L = 9 ± 1.3 (7-13), l = 4 ± 0.7 (3-6), e = 2 ± 0.9 (1-5). Slightly straight dorsal transverse bar: x = 36 ± 1.8 (33-40), w = 6 ± 0.6 (5-7). Ventral gripus with very small aperture (sometimes not visible), large, rounded blade, poorly developed guard: a = 25 ± 1 (22-27), b = 21 ± 0.8 (19-23), c = 1 ± 0.4 (0.4-2), d = 8 ± 1 (6-10), e = 14 ± 1 (12-16), L = 2 ± 0.9 (0-5), l = 1 ± 0.4 (0-2). Thin V-shaped ventral transverse bar: x = 34 ± 2 (29-38), w = 4 ± 0.7 (3-6). Thin uncinuli II = 14 ± 1.5 (11-17) long, uncinuli I and III to VII = 12 ± 0.8 (9-15) long. Long penis folded after bell-shaped basal bulb, distal quarter covered with very thin scab­bard, which extremity is thickened, developed heel: Pe = 101 ± 7.4 (91-115), He = 7 ± 1.8 (5-11). Double accessory piece linked to basal bulb of the penis: one long and S-shaped: Ap = 75 ± 4.7 (65-82), the second

2 Only 18 individuals should be measured because P. djambal has become rare in the rivers of Java Island.
one straight and round ended: 50 ± 4.4 (40-58) long. No visible vagina.

Comments

_T. komarudini_ n. sp. is morphologically close to the previously cited _Thaparocleidus_ species found on _Pangasius_ host (see above), but may be easily distinguished in having a double accessory piece. _Thaparocleidus komarudini_ n. sp. is named for M. Oman Komardin from the Central Research Institute for Freshwater Fisheries in Sukamandi (Indonesia) who help in collecting material.

_THAPAROCLEIDUS COMBESI_ N. SP. (Fig. 4A and B)

Type-host: _P. djambal_ Bleeker, 1846.
Site: gills.
Type-locality: Barito River at Buntok (Central Kalimantan province, Borneo Island, Indonesia).

Other locality: also found on the same host in the Batang Hari River at Jambi (Jambi province, Sumatra Island, Indonesia); in the ponds of Sukamandi Research Station (West Java, Java Island, Indonesia) and in the Solo River at Cepu (East Java, Java Island, Indonesia).

Also found on _P. bocourti_ Sauvage, 1880 in aquaculture cages on the Mekong River at Chau Doc (Vietnam).

Material studied: 30 individuals.

Very large worms, adults: 1372 ± 152.3 (1066-1622) long, 197 ± 37 (128-328) wide at level of penis. Pharynx: 77 ± 6.6 (63-90) wide. Very large dorsal gripus
Fig. 4A. – *Thaparocleidus combesi* n. sp. haptorial sclerotised parts: C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; VB = ventral transverse bar; VG = ventral gripus; U = uncinuli. Bar = 30 μm.

Fig. 4B. – *Thaparocleidus combesi* n. sp. genitalia: MA = male apparatus; Vg = vagina. Bar = 30 μm.
with blade bent at distal third, short guard: a = 141 ± 3.5 (134-147), b = 116 ± 3.3 (110-125), c = 3 ± 1 (1.4-6), d = 31 ± 2.7 (22-38), e = 65 ± 2.8 (57-70). Very large cuneus with short extension: L = 65 ± 3 (57-69), l = 19 ± 1.1 (16-22), e = 4 ± 1.5 (2-9). Very large, slightly curved dorsal transverse bar: x = 87 ± 2.5 (82-91), w = 11 ± 1 (8-13). Very large ventral gripus without aperture: a = 68 ± 2.7 (62-74), b = 55 ± 3.1 (46-61), c = 3 ± 1.3 (1-8), d = 22 ± 2 (19-27), e = 40 ± 1.3 (36-42). V-shaped ventral transverse bar: x = 54 ± 2.1 (49-59), w = 6 ± 0.8 (5-8). Thin uncinuli II = 13 ± 1.3 (10-15) long, strong uncinuli I and III to VII = 17 ± 1.4 (11-21) long. Very long, thin, spirally coiled (14-15 turns) penis with short heel, ovoid basal bulb; as this tube is very long, coiled in a double helix and with a very thin ending it is virtually impossible to take a reliable measurement, the length have been estimated on one specimen: Pe = 2245, heel (measured on 30 specimens): He = 7 ± 1.1 (5-11). No accessory piece. The vagina is very long, sinuous and become less and less sclerotised so no measurement could be taken.

Comments

Only three *Thaparocleidus* species have been described with a spirally coiled penis: *T. brevicochleus* Pariselle et al., 2001, *T. kapuasensis* Pariselle et al., 2001 and *T. gustianoi* Pariselle et al., 2001. *T. combesi* n. sp. is easily distinguishable from all these species (and all the species of *Thaparocleidus* described until now) by the larger size of all the sclerotised parts of genitalia and haptor apparatus.

*Thaparocleidus combesi* n. sp. is named in honour of Pr. Claude Combes, parasitologist from the University of Perpignan (France).

**Thaparocleidus euzeti** n. sp. (Fig. 5A and B)

Type-host: *P. djambal* Bleeker, 1846.
Site: gills.
Type-locality: Batang Hari River at Jambi (Jambi province, Sumatra Island, Indonesia).
Other locality: also found on the same host in the Indragiri River at Rengat (Riau province, Sumatra Island, Indonesia).

Material studied: 30 individuals.

Type-material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 41 HG, slide Tg 183. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 41 HG, slide Tg 184; at The Natural History Museum (London): n° 2001.11.27.4.

Adults: 599 ± 106.8 (384-765) long, 131 ± 13-3 (107-164) wide at level of penis. Pharynx: 43 ± 4.2 (34-49) wide. Dorsal gripus with blade bent at distal third, poorly marked guard: a = 64 ± 2.1 (60-68), b = 52 ± 2.1 (44-55), c = 1 ± 0.4 (0.5-3), d = 17 ± 1.7 (13-21), e = 30 ± 1.2 (28-34). Large cuneus with extension: L = 25 ± 1.4 (22-28), l = 7 ± 0.6 (6-8), e = 6 ± 1 (3-9). Strong, slightly curved dorsal transverse bar: x = 43 ± 1.9 (39-47), w =

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Fig. 5A. — *Thaparocleidus euzeti* n. sp. haptorial sclerotised parts: C = cuneus; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; VB = ventral transverse bar; VG = ventral gripus; U = uncinuli. Bar = 30 μm.
Fig. 5B. – *Thaparocleidus euzeti* n. sp. genitalia: MA = male apparatus; Vg = vagina. Bar = 30 μm.

8 ± 0.9 (7-10). Ventral gripus with large aperture, poorly developed guard: a = 33 ± 0.7 (31-34), b = 26 ± 0.7 (25-28), c = 1.5 ± 0.4 (0.8-3), d = 12 ± 0.9 (10-15), e = 19 ± 0.7 (16-20), L = 4 ± 0.6 (3-6), l = 2 ± 0.4 (1-3). V-shaped ventral transverse bar: x = 33 ± 1.4 (31-37), w = 4 ± 0.5 (3-5). Long, thin uncini I = 17 ± 1.8 (12-20) long, strong uncini I and III to VII = 17 ± 2.4 (10-20) long. Extremely long and thin spirally coiled penis with an ovoid basal bulb attached on a large cupule like structure (diameter = 35 ± 4.3 (19-41)), no visible heel. The length of such very thin tube is impossible to measure because the specimens are squashed between slide and cover slip. We could only give the diameter of the spiral (61 ± 7.5 (47-78) from the 30 specimens) and a rough estimation of the total length and number of turns, taken from one very well preserved individual: 7450 μm and = 35 turns. Very simple accessory piece apparently not linked to basal bulb of penis: Ap = 48 ± 2.7 (42-53). Extremely long, thin, well sclerotised, spirally coiled (double pitch) vagina, largest diameter of spiral = 53 ± 4.8 (44-61), diameter of tube at distal extremity = 2 ± 0.3 (1-5), the total length is impossible to estimate as we could not count the number of turns (squashed individuals and double pitch spiral).

Comments

Now four *Thaparocleidus* species have been described with a spirally coiled penis: *T. brevicocbleus* Pariselle *et al.*, 2001, *T. kapuasensis* Pariselle *et al.*, 2001, *T. gustianoii* Pariselle *et al.*, 2001 and *T. combesi* n. sp. (see
above); *T. euzeti* n. sp. is easily distinguishable from all these species by the great number of turns and the huge length of the penis, and by the shape of the vagina (spirally coiled).

The name *Thaparoleidus euzeti* n. sp. is proposed in honour of Pr. Louis Euzet, parasitologist from the University of Montpellier (France).

**Thaparoleidus vietnamensis** n. sp. (Fig. 6)

Type-host: *P. bocourti* Sauvage, 1880.

Site: gills.

Type-locality: Aquaculture cages on the Mekong River at Chau Doc (Vietnam).


Material studied: 33 individuals (10 from *P. bocourti*, *P. hypophthalmus*, *P. conchophilus* and three from *P. kunyit*).

Type-material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 40 HG, slide Tg 181. Paratypes deposited at the Muséum National

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Fig. 6. — *Thaparoleidus vietnamensis* 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 μm.
Species

<table>
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<tr>
<th>Measurements</th>
<th>T. vietnamensis</th>
<th>T. caecus</th>
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<td>Min</td>
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<td>Total length</td>
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Table I. - Measurements from T. vietnamensis n. sp. and T. caecus.

T. vietnamensis is very close to T. caecus, but could be easily distinguished (no overlap of range) by: the length of the copulatory tube (91 μm vs. 69 μm), of the accessory piece (54 μm vs. 42 μm and the distance between the spine like structure and the extremity of the copulatory tube (31 μm vs. 21 μm).

The name *Thaparocleidus vietnamensis* n. sp. is proposed for the location (Vietnam vs. Peninsular Malaysia (Lim, 1990) or Indonesia and Malaysia (Pariselle et al., 2001b) for closely related species).

CONCLUSIONS

*Thaparocleidus caecus*, described in the United States on an unidentified aquarium fish coming from Thailand (Mizelle & Kritsky, 1969), was recovered by Lim (1990) from cage culture in Malaysia on *P. sutchi* (syn. *P. hypophthalmus*) also imported from Thailand. This parasitic species was found again in Indonesia (nobis) on *P. hypophthalmus* introduced from Thailand for culture purpose, and on *P. djambal* in the wild and in aquaculture facilities. So we may wonder what is the natural host for *T. caecus*, as Mono-
genea are considered species specific toward their hosts. We may say that it is *P. djambal* (only occurrence in the wild), but:

- *T. caecus* was found on *P. djambal* in two locations only (Solo River and Sukamandi Research Station), the ones where *P. hypophthalimus* was also introduced (for culture purpose).

- These two host species are naturally allopatric (*P. hypophthalimus* from the Mekong basin, *P. djambal* from Indonesia) and phylogenetically well separated (Pouyaud et al., 2000).

- No *P. djambal* was introduced to Thailand or Malaysia. So we may suppose that there was in Indonesia a lateral transfer of *T. caecus* between *P. hypophthalimus* and *P. djambal* both in the wild and in the ponds of the Sukamandi Research Station.

Is the presence of *Thaparocleidus combesi* n. sp. and *T. komarudini* n. sp. both on *P. bocourti* and *P. djambal*, due to lateral transfers? In this case:

- There was no introduction neither of *P. djambal* in Vietnam nor of *P. bocourti* in Indonesia.

- These two fish species are closely related (Pouyaud et al., 2000).

So we may suppose that *T. combesi* and *T. komarudini* occur naturally on both host species and were inherited from their ancestor.

The presence of *T. vietnamensis* n. sp. on four different host species (*P. bocourti, P. hypophthalimus*), *P. kunyit* Pouyaud et al., 2000 and *P. concophilus* Roberts & Vidthayanon, 1991) sampled in aquaculture facilities on the Mekong Delta, may be the result of lateral transfer or of natural occurrence, as all these host species originate from this river.

The present five new species bring the number of *Thaparocleidus* species described on 10 species of pangasiids (*P. bocourti, P. djambal, P. gigas, P. humeralis, P. hypophthalimus, P. kinabatanganensis, P. lithostoma, P. nieuwenhuisii, P. pangasius* and *P. rheophilus*) to 17. The diversity of monogenean species on the 10 studied host species is now variable from zero to six

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