



Four new species of *Cichlidogyrus* Paperna, 1960 (Monogenea, Ancyrocephalidae), all gill parasites from African mouthbreeder tilapias of the genera *Sarotherodon* and *Oreochromis* (Pisces, Cichlidae), with a redescription of *C. thurstonae* Ergens, 1981

Antoine Pariselle¹, Charles F. Bilong Bilong² & Louis Euzet³

¹IRD/GAMET, BP 5095, 34033 Montpellier Cedex 1, France

²Laboratoire de Biologie Générale, Université de Yaoundé I, BP 812, Yaoundé, Cameroon

³Station Méditerranéenne de l'Environnement Littoral, Université Montpellier II, 1 Quai de la Daurade, 34200 Sète, France

Accepted for publication 6th May, 2003

Abstract

A study of *Oreochromis niloticus* (Linnaeus), *O. aureus* (Steindachner), *Sarotherodon caudomarginatus* (Boulenger), *S. galilaeus* (Linnaeus) and *S. galilaeus sanagaensis* (Thys van den Audenaerde) (Teleostei, Cichlidae) from different locations in Africa (Burkina Faso, Cameroon, Guinea, Niger and Senegal) revealed the presence of 11 species of monogenean gill parasites. Four, belonging to *Cichlidogyrus* Paperna, 1960 and considered as new species, are described: *C. rognoni* n. sp., *C. douellouae* n. sp., *C. giostrai* n. sp. and *C. njinei* n. sp. They are distinguished by the shape and/or size of the sclerotised parts of the haptor and copulatory complexes. *C. thurstonae* Ergens, 1981 from *O. niloticus* is redescribed.

Résumé

L'étude des parasites branchiaux de *Oreochromis niloticus* (Linnaeus), *O. aureus* (Steindachner), *Sarotherodon caudomarginatus* (Boulenger), *S. galilaeus* (Linnaeus) et *S. galilaeus sanagaensis* (Thys van den Audenaerde) (Teleostei, Cichlidae) provenant de divers pays africains (Burkina Faso, Cameroun, Guinée, Niger et Sénégal) a révélé l'existence de 11 espèces de Monogenea. Quatre espèces, appartenant au genre *Cichlidogyrus* Paperna, 1960, sont considérées comme nouvelles et décrites: *C. rognoni* n. sp., *C. douellouae* n. sp., *C. giostrai* n. sp. et *C. njinei* n. sp. Elles se différencient par la forme et/ou la taille des pièces sclérifiées du haptateur et du genitalia. *C. thurstonae* Ergens, 1981 parasite de *O. niloticus* est redécrite.

Introduction

A study of gill parasites from the mouthbreeder tilapias *Oreochromis niloticus* (L.), *O. aureus* (Steindachner), *Sarotherodon caudomarginatus* (Boulenger), *S. galilaeus* (L.) and *S. galilaeus sanagaensis* (Thys van den Audenaerde) (Pisces, Cichlidae) from different locations in West Africa (Burkina Faso, Cameroon, Guinea, Niger and Senegal) revealed the presence of eleven species of *Cichlidogyrus* Paperna, 1960 (Monogenea: Ancyrocephalidae). Four are considered new species and are described here. The discovery of an auxiliary plate associated with the accessory piece of the male apparatus in *C. thurstonae* Ergens, 1981, which had not been indicated in the original description, led us to redescribe this species.

Considering the great diversity of monogenean gill parasites on African cichlids and their narrow host-specificity (Pariselle, 1996), the discovery of new species is not a surprise, particularly when new hosts (e.g. *S. caudomarginatus*) or new locations (e.g. *S. galileus sanagaensis* from Cameroon) are examined.

Materials and methods

Fish were caught in various rivers and lagoons of Burkina Faso, Cameroon, Guinea, Niger and Senegal using gill or cast nets, or after poisoning with Rotenone (Predatox®). The left branchial arches of each fish were separated into dorsal and ventral sections, and either observed directly or frozen until examination. In the laboratory, the monogeneans were detached from the gill and then transferred individually to a drop of ammonium picrate-glycerine (after Malmberg, 1957) on a slide. The preparation was then covered with a coverslip and sealed. From these preparations, drawings were made of the sclerotised pieces of the haptor and of the copulatory complex using a camera lucida. Measurements, in micrometres and as the mean followed by the range in parentheses, are those proposed by Gusev (1962) (Figure 1). The method of numbering the haptoral pieces is that adopted at ICOPA IV (Euzet & Prost, 1981). The terminology is that of Pariselle & Euzet (1995): gripus (for hamulus or anchor) and uncinulus (for hooklet or marginal hook). The part of the accessory piece, which is situated below the penis basal bulb (Figure 1), is named 'heel' by analogy.

Results

Among the 11 species recorded, seven have been described previously (see Table 1): *Cichlidogyrus acerbus* Dossou, 1982, *C. cirratus* Paperna, 1964, *C. halli* Paperna & Thurston, 1969¹, *C. thurstonae* Ergens, 1981, *C. tilapiae* Paperna, 1960, *Scutogyrus bailloni* Pariselle & Euzet, 1995 and *S. longicornis* (Paperna & Thurston, 1969). The remaining four are considered new species: *C. rognoni* n. sp. on *Oreochromis niloticus*, *C. douellouae* n. sp. on *Sarotherodon galilaeus*, *C. giostrai* n. sp. on *S. caudomarginatus* and *C. njinei* n. sp. on *S. galilaeus sanagaensis*. These new forms all belong to *Cichlidogyrus*, which is redefined below.

Cichlidogyrus Paperna, 1960

Amended diagnosis (modified after Paperna, 1960, and Pariselle & Euzet, 1997)

With characters of Ancyrocephalidae. Three pairs of cephalic glands. Two posterior ocelli with crystalline lenses. Two small inconsistent anterior ocelli.

¹According to Dossou (1982) and Douëllou (1993), this species should be re-examined because of differences noticed between measurements of specimen from a very wide range of hosts.

Median muscular pharynx. Simple intestinal caeca, joined posteriorly. Two pairs of gripi (hamuli), one dorsal and one ventral. Two transverse bars; dorsal with two auricles; ventral curved and articulated. Median posterior testis. Vas deferens on right side, not encircling intestinal caecum. Seminal vesicle present. One prostatic reservoir. Male copulatory complex with penis and accessory piece, auxiliary plate sometimes present. Median pre-testicular ovary. Submedian vaginal opening. Sclerotised vagina. Seminal receptacle present. Gill parasites of African Cichlidae and Nandidae. Type-species: *C. arthracanthus* Paperna, 1960.

Cichlidogyrus rognoni n. sp.

Type-host: *Oreochromis niloticus* (L.).

Site: Gills; between secondary gill lamellae.

Type-locality: River Senegal, Senegal.

Other records: This species was also found on the same host at the IDESSA Research Station at Bouakè, Ivory Coast.

Material studied: 30 individuals.

Type-material: Holotype deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 536 HF Tk60. Paratypes deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 536 HF Tk61; in The Natural History Museum, London: BMNH 1997.2.3.3; and in the Musée Royal d'Afrique Centrale, Tervuren: MRAC 37 407.

Description (Figure 2)

Adult: 825 (638-1,014) long, 148 (126-167) wide at level of penis. Pharynx 41 (34-47) wide. Wide dorsal gripi (hamuli) with guard 3 times longer than shaft, and arched blade: a = 48 (45-51), b = 39 (36-42), c = 4 (2-6), d = 14 (12-17), e = 12 (10-15). Dorsal transverse bar arched, with 2 very large auricles on its convex face: x = 37 (30-42), w = 10 (8-12), h = 20 (16-26), y = 14 (11-18). Ventral gripi (hamuli) similar to dorsal, slightly larger: a = 50 (45-53), b = 44 (40-47), c = 4 (2-6), d = 13 (10-16), e = 15 (13-17). Curved ventral transverse bar: x = 36 ± 1.7 (31-39), w = 8 ± 0.9 (6-10). Short uncinuli (marginal hooks) I = 14 (13-15) long; II, associated with ventral gripus, has larval size of 12 (9-13) long; III = 17 (15-22) long, IV = 21 (19-23), V = 24 (22-26), VI = 21 (18-23), VII = 17 (15-19). Penis short, slightly arched, simple; slightly curved accessory piece, with developed heel:

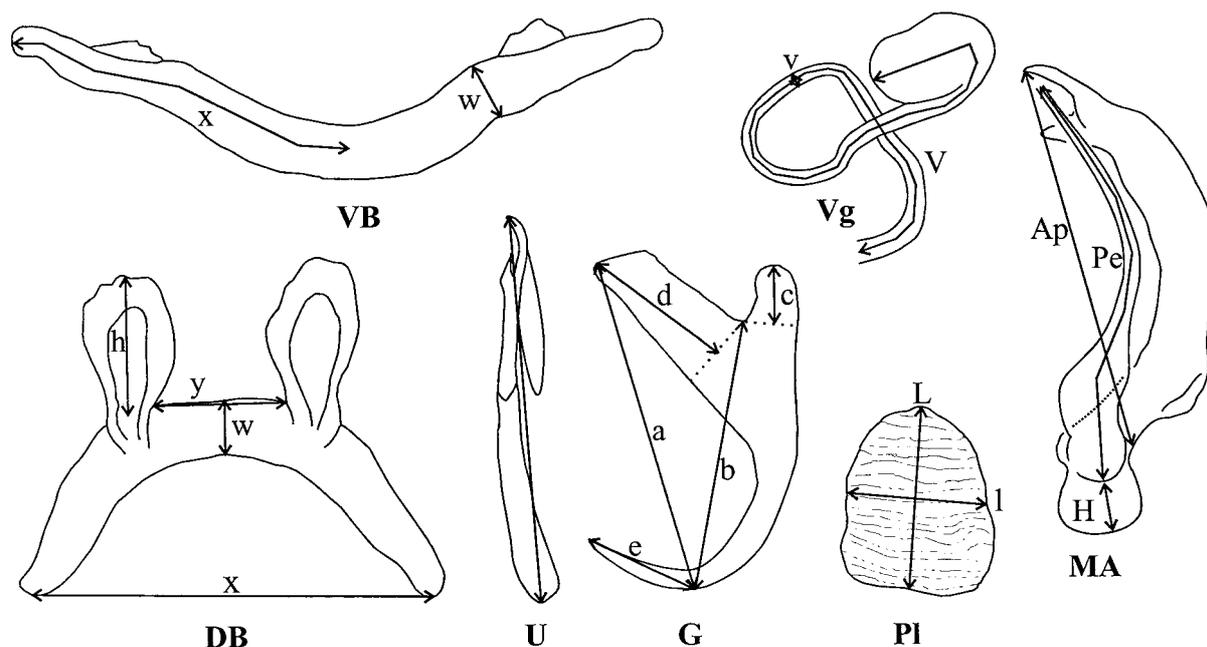


Figure 1. Measurements used in this study. Abbreviations: Ap, accessory piece; DB, dorsal transverse bar (h, auricle total length; y, distance between auricles; x, bar total width; w, bar thickness); G, gripius (a, gripius total length; b, blade length; c, shaft length; d, guard length; e, blade point length); H, heel; MA, male apparatus; Pe, penis; PI, auxiliary plate (L, total length; l, total width); U, uncinulus; VB, ventral transverse bar (x, length of one branch; w, bar thickness); Vg, vagina (V, total length; v, diameter).

Pe = 35 (29-38), Ap = 31 (27-35), He = 5 (4-7). No visible vagina.

Comments

This species belongs to the group of *Cichlidogyrus* with small uncinuli I to VII, a short penis (<60 μm) without a swollen portion and no visible vagina²: *C. bifurcatus* Paperna, 1960, *C. fontanai* Pariselle & Euzet, 1997, *C. haplochromii* Paperna & Thurston, 1969, *C. levequei* Pariselle & Euzet, 1996 and *C. tilapiae* Paperna, 1960. *C. rognoni* n. sp. is easily distinguished from all these species: *C. fontanai* has an accessory piece associated with the penis ending in at least four points (vs simple); *C. bifurcatus* has a longer penis (more than 40 vs 35 μm); and *C. haplochromii* and *C. tilapiae* have no heel at the level of the basal bulb of the penis (vs a developed one).

The name *C. rognoni* n. sp. is proposed for Dr Xavier Rognon, who provided the type-material from the River Senegal and the IDESSA Research Station.

Cichlidogyrus douellouae n. sp.

Type-host: *Sarotherodon galilaeus* (L.).

Site: Gills; between secondary gill lamellae.

Type-locality: Mékrou River at "W" National Park, Niger.

Other records: This species was also found on the same host in the Kou River (Volta Noire River tributary) at Bama near Bobodioulasso, Burkina Faso, and on *S. g. sanaganensis* in the Sanaga River at Edéa, Cameroon.

Material studied: 30 individuals.

Type-material: Holotype deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 535 HF Tk58. Paratypes deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 535 HF Tk 59; in The Natural History Museum (London): BMNH 1997.2.3.1; and in the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37 410.

Description (Figure 3)

Adult: 608 (398-735) long, 150 (107-192) wide at level of penis. Very large pharynx, 69 (53-83) wide. Small dorsal gripi (hamuli) with guard twice as long as shaft and arched blade: a = 22 (20-24), b = 17

²See discussion in Dossou (1982) and key in Pariselle (1996).

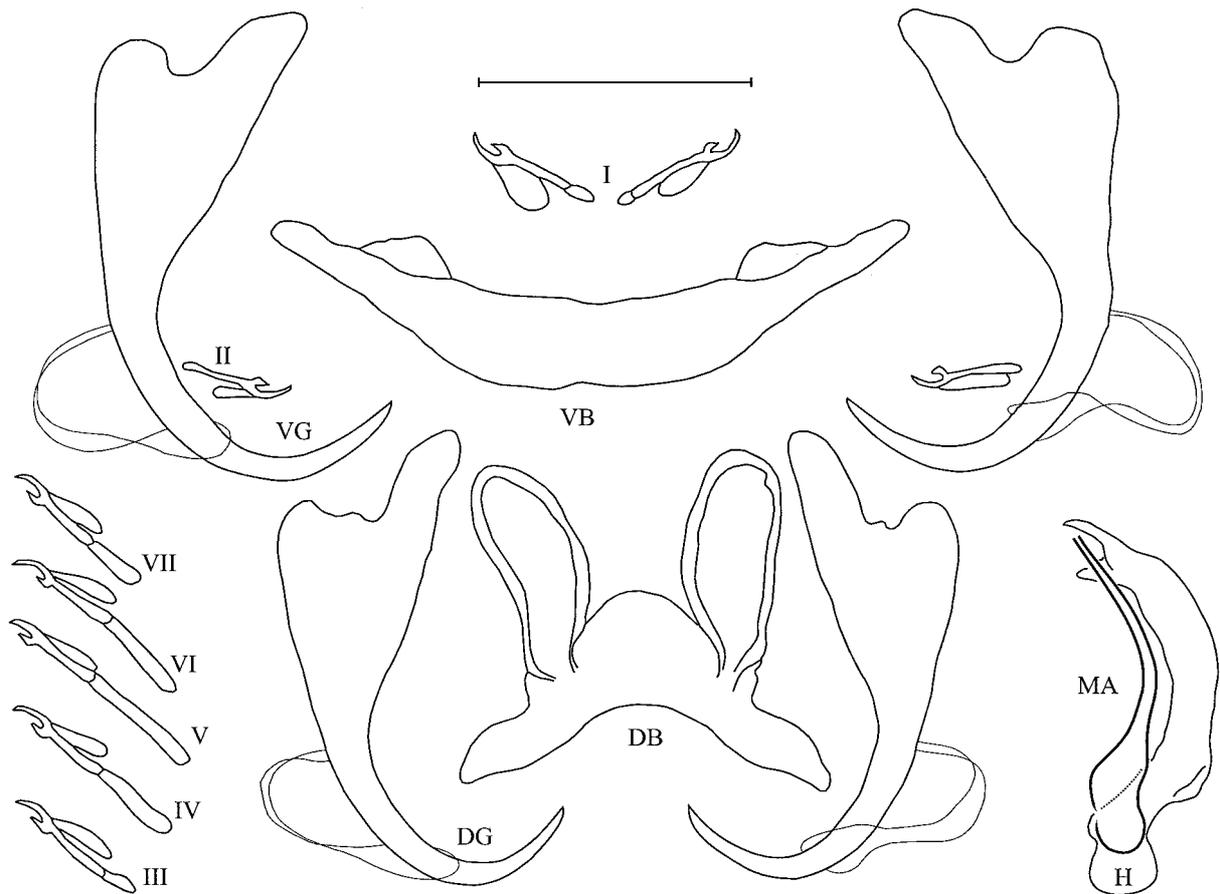


Figure 2. *Cichlidogyrus rognoni* n. sp. Abbreviations: DB, dorsal bar; DG, dorsal gripus; H, heel; MA, male apparatus; VB, ventral bar; VG, ventral gripus; I-VII, uncinuli. Scale-bar: 30 μ m.

Table 1. The African hosts studied and the species of *Cichlidogyrus* and *Scutogyrus* recorded.

<i>Oreochromis niloticus</i>	<i>Oreochromis aureus</i>	<i>Sarotherodon caudomarginatus</i>	<i>Sarotherodon galilaeus</i>	<i>Sarotherodon galilaeus sanagaensis</i>
<i>C. cirratus</i>			<i>C. acerbus</i>	
<i>C. halli</i>	<i>C. halli</i>		<i>C. halli</i>	
<i>C. thurstonae</i>	<i>C. thurstonae</i>			
<i>C. tilapiae</i>	<i>C. tilapiae</i>		<i>C. tilapiae</i>	<i>C. tilapiae</i>
<i>S. longicornis</i>	<i>S. longicornis</i>		<i>S. bailloni</i>	<i>S. bailloni</i>
<i>C. rognoni</i> n. sp.			<i>C. douellouae</i> n. sp.	<i>C. douellouae</i> n. sp.
		<i>C. giostrai</i> n. sp.		<i>C. njinei</i> n. sp.

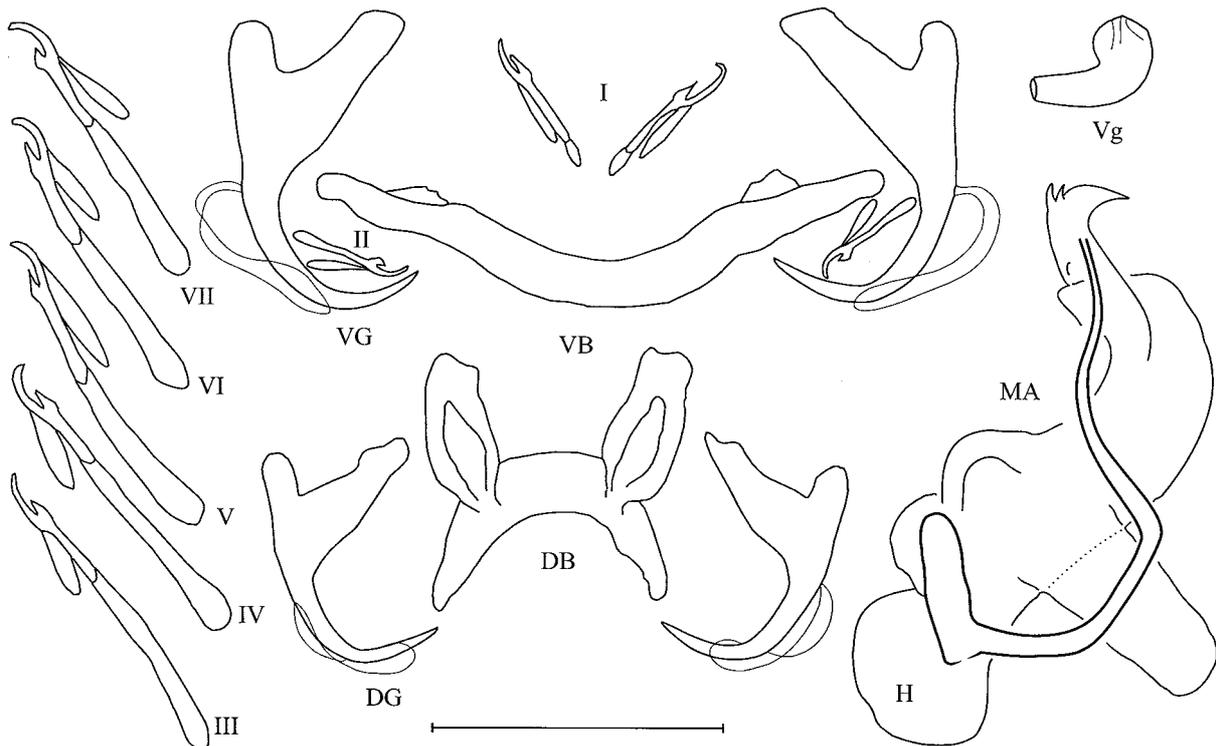


Figure 3. *Cichlidogyrus douellouae* n. sp. Abbreviations: DB, dorsal bar; DG, dorsal gripi; H, heel; MA, male apparatus; VB, ventral bar; VG, ventral gripi; Vg, vagina; I-VII, uncinuli. Scale-bar: 30 μ m.

(16-20), $c = 5$ (4-7), $d = 11$ (8-14), $e = 8$ (7-10). Small dorsal transverse bar with large auricles: $x = 23$ (20-27), $w = 5$ (4-7), $h = 15$ (11-17), $y = 10$ (7-13). Ventral gripi (hamuli), similar to dorsal but slightly more robust: $a = 29$ (26-33), $b = 23$ (20-25), $c = 6$ (4-9), $d = 12$ (10-15), $e = 10$ (8-12). Curved ventral transverse bar: $x = 29$ (26-33), $w = 5$ (4-6). Uncinuli (marginal hooks): I = 15 (14-18) long; II = 12 (10-14), III = 31 (29-34), IV = 33 (31-35), V = 34 (32-37), VI = 33 (31-35), VII = 31 (27-34). Arched tubular penis with ovoid basal bulb: $Pe = 74$ (69-83). S-shaped accessory piece with large and perpendicular diverticulum at proximal third, ending in large hook with 1, 2 or 3 small tubercles on its convex face and very large heel: $Ap = 55$ (50-62), $He = 8$ (7-10). Short and well sclerotised vagina, bent at middle: $V = 14$ (12-17), $v = 5$ (3-7).

Comments

This new species belongs to the group of *Cichlidogyrus* with short uncinuli I, long uncinuli III to VII, narrow penis (<100 μ m), S-shaped accessory piece without auxiliary plate and short conical va-

gina: *C. bouvii* Pariselle & Euzet, 1997, *C. dossoui* Douëllou, 1993 and *C. vexus* Pariselle & Euzet, 1995. It mainly differs from *C. vexus* by the shape of the accessory piece (end hook-shaped vs folded back); and from *C. bouvii* by the length of the penis (74 vs 54 μ m). *C. douellouae* n. sp. is closely related to *C. dossoui*, but can be readily distinguished by the dimensions of the penis (74 vs up to 65 μ m), the dorsal transverse bar (heavier in *C. dossoui*) and the shape of the end of the accessory piece (the presence of one, two or three small tubercles on the convex face in *C. douellouae*).

The name *C. douellouae* n. sp. is proposed for the fish parasitologist Dr Laurence Douëllou.

Cichlidogyrus giostrai n. sp.

Type-host: *Sarotherodon caudomarginatus* (Boulenger).

Site: Gills; between secondary gill lamellae.

Type-locality: Badi River at ferry crossing on Tondon Road, Guinea.

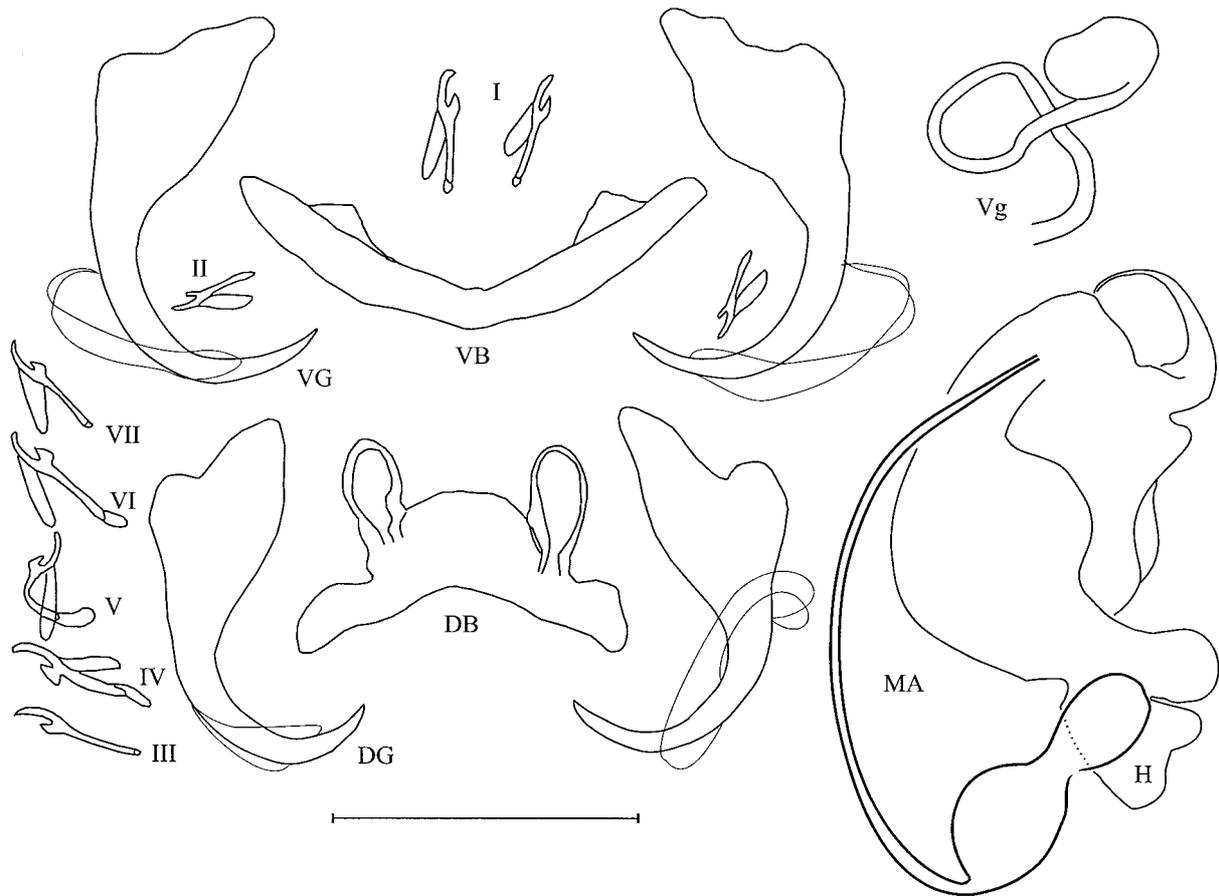


Figure 4. *Cichlidogyrus giostrai* n. sp. Abbreviations: DB, dorsal bar; DG, dorsal gripi; H, heel; MA, male apparatus; VB, ventral bar; VG, ventral gripi; Vg, vagina; I-VII, uncinuli. Scale-bar: 30 μ m.

Other records: This species was also found on the same host in the Bourouma River, 10 km south west from La Ramié, Guinea.

Material studied: 11 specimens.

Type-material: Holotype deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 529 HF Tk46. Paratypes deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 529 HF Tk47; in The Natural History Museum (London): BMNH 1997.2.3.2; and in the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37 406.

Description (Figure 4)

Adult: 601 (403-800) long, 147 (100-174) wide at level of ovary. Pharynx 32 (24-38) wide. Dorsal gripi (hamuli) with short shaft; guard 3 times longer; blade arched: a = 33 (31-35), b = 28 (26-31), c = 1 (0-3), d = 11 (10-12), e = 9 (8-11). Dorsal transverse bar arched, with 2 auricles on its convex face: x = 29

(24-35), h = 9 (8-11), w = 7 (6-10), y = 12 (11-15). Ventral gripi (hamuli) slightly larger than dorsal and with shorter shaft: a = 34 (32-36), b = 31 (29-33), c = 1 (0-2), d = 10 (8-11), e = 11 (9-12). Curved ventral transverse bar: x = 25 (23-28), w = 5 (4-6). Uncinuli (marginal hooks) I short = 11 (11-12) long; II = 11 (10-13) long; marginal uncinuli short: III = 13 (11-14) long, IV = 14 (13-15), V = 14 (14-15), VI = 13 (12-14), VII = 11 (10-12). J-shaped tubular penis with well marked swollen portion near basal ovoid bulb: Pe = 93 (83-105). Large, C-shaped accessory piece with spoon-shaped ending and developed heel: 39 (34-50) long, He = 6 (3-7). Long, thin vagina with large aperture: V = 70 (62-78), v = 2 (1-2).

Comments

This new species belongs to the group of *Cichlidogyrus* with a well-marked swollen portion near the basal bulb of the penis: *C. amphoratus* Pariselle &

Euzet, 1996, *C. ornatus* Pariselle & Euzet, 1996, *C. papernastrema* Price et al., 1969 and *C. sanjeani* Pariselle & Euzet, 1997. It differs from *C. papernastrema* mainly in the size and shape of uncinuli I, which are almost identical to those of the other pairs, whereas in *C. papernastrema* uncinuli I are much larger and more robust than the others (see illustration in Price et al., 1969). It differs from *C. amphoratus*, *C. ornatus* and *C. sanjeani* in the dimensions of the penis (93 vs 46, 53 and 39 μm , respectively) and in the shape of the accessory piece.

The name *C. giostrai* n. sp. is proposed for Mr Domenico Giostra.

Cichlidogyrus njinei n. sp.

Type-host: *Sarotherodon galilaeus sanagaensis* (Thys van den Audenaerde).

Site: Gills; between secondary gill lamellae.

Type-locality: The Sanaga River at Edéa, Cameroon.

Material studied: 10 individuals.

Type-material: Holotype deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 478 HF Tg77. Paratypes deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 478 HF Tg77; and in the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37 370.

Description (Figure 5)

Adult: 737 (720-760) long, 120 (110-120) wide at level of ovary. Pharynx 33 (30-40) wide. Dorsal gripi (hamuli) with long guard and arched blade: a = 37 (35-38), b = 32 (30-35), c = 1 (1-2), d = 12 (10-12), e = 11 (10-12). Dorsal transverse bar with short and wide auricles: x = 31 (29-32), w = 7 (6-7), h = 11 (9-12), y = 12 (10-12). Ventral gripi (hamuli), similar to dorsal but slightly heavier: a = 38 (36-39), b = 33 (31-35), c = 2 (1-2), d = 12 (11-13), e = 11 (10-12). Curved ventral transverse bar: x = 27 (26-29), w = 5 (4-6). Uncinuli (marginal hooks): I = 12 (11-12) long; II = 16 (14-17); III to VII = 20 (19-22). J-shaped, narrow, tubular penis, with marked spherical swollen portion: Pe = 91 (88-95). Accessory piece C-shaped and complicated (see Figure 5), with large heel: Ap = 45 (42-48), He = 8 (7-10). Vagina long and sinuous: V = 64 (62-68), v = 2 (2-3).

Comments

This new species belongs to the group of *Cichlidogyrus* with a well-marked swollen portion near the basal bulb of the penis: *C. amphoratus* Pariselle & Euzet, 1996, *C. ornatus* Pariselle & Euzet, 1996, *C. papernastrema* Price et al., 1969, *C. sanjeani* Pariselle & Euzet, 1997 and *C. giostrai* n. sp. It differs from *C. papernastrema* mainly by having small uncinuli I (vs large); and from *C. amphoratus*, *C. ornatus* and *C. sanjeani* by the dimensions of the penis (91 vs 46, 53 or 39 μm , respectively) and by the shape of the accessory piece. *C. njinei* n. sp. is close to *C. giostrai*, but may be distinguished by the length of uncinuli pairs II and III to VII (16 vs 11 μm and 20 vs 13 μm), the heel (8 vs 6 μm) and the shape of the accessory piece.

The name *C. njinei* n. sp. is proposed for Prof. T. Njiné, University of Yaoundé.

Cichlidogyrus thurstonae Ergens, 1981

Type-host: *Tilapia nilotica* [= *Oreochromis niloticus* (L.)].

Site: Gills; between secondary gill lamellae.

Type-locality: River Nile at Cairo, Egypt.

Present records: This species was found by us on the same host in the River Senegal, Senegal.

Material studied: 29 individuals from Senegal.

Voucher specimens: Specimen deposited in the Muséum National d'Histoire Naturelle (Paris): MNHN 537 HF Tk62.

Description (Figure 6)

When available, corresponding measurements from the original description (from Ergens, 1981) are given in brackets.

Adult: 663 (493-835) long, 140 (119-163) wide at level of penis. Pharynx 52 (45-60) wide. Dorsal gripi (hamuli) with long shaft and guard, and arched blade: a = 27 (24-29) [30], b = 21 (19-23) [20], c = 10 (8-13) [8], d = 14 (12-16) [12], e = 8 (6-9) [6]. Dorsal transverse bar arched, with 2 auricles on its convex face: x = 36 (32-47) [46], h = 14 (10-18), w = 6 (4-8) [5], y = 13 (10-16) [14.5]. Ventral gripi (hamuli) similar to dorsal but slightly larger: a = 33 (29-35) [33], b = 26 (23-28) [24], c = 10 (7-12) [8], d = 15 (13-17) [14], e = 10 (9-12) [9]. Ventral transverse bar curved, narrower at middle: x = 33 (26-37) [64/2 = 32], w = 6 (4-8) [4]. Uncinuli (marginal hooklets) I

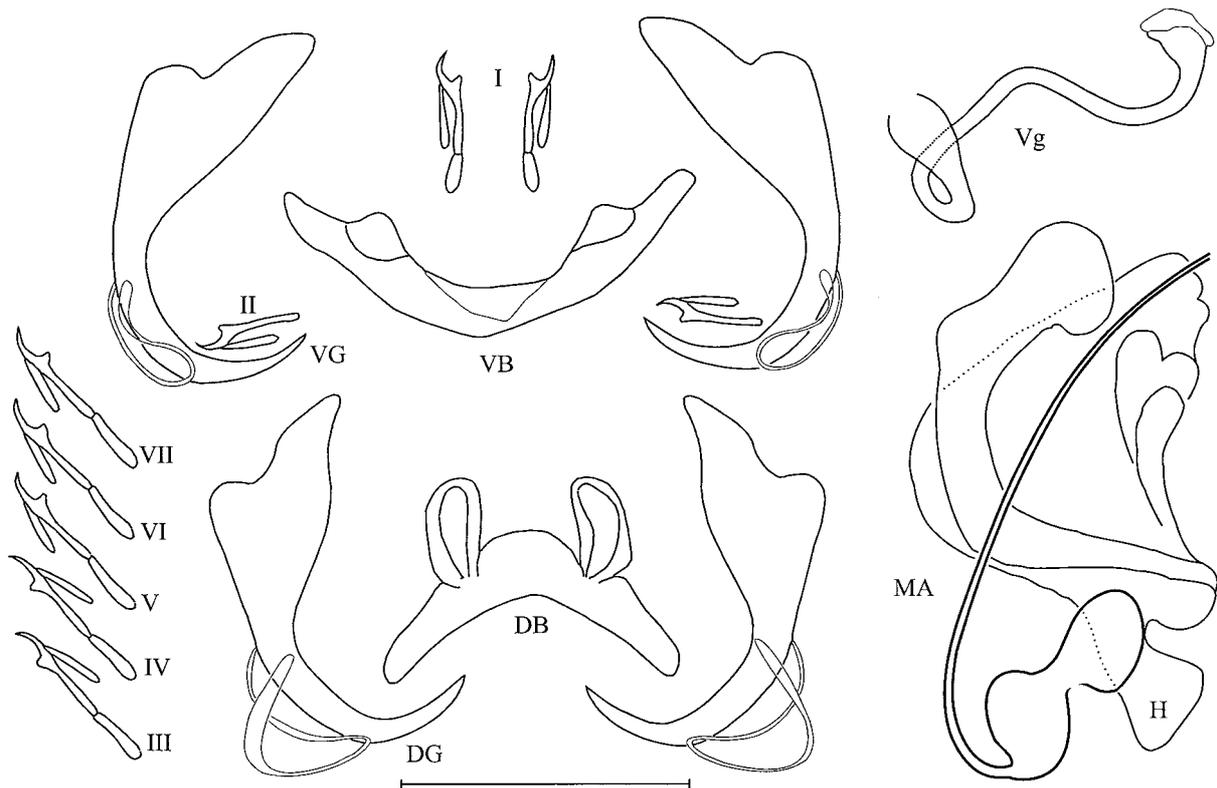


Figure 5. *Cichlidogyrus njinei* n. sp. Abbreviations: DB, dorsal bar; DG, dorsal gripus; H, heel; MA, male apparatus; VB, ventral bar; VG, ventral gripus; Vg, vagina; I-VII, uncinuli. Scale-bar: 30 μ m.

short, 17 (15-18) [13] long; II 12 (10-14); III to VII [39.5]: III = 40 (35-44), IV = 43 (39-46), V = 44 (40-47), VI = 42 (39-46), VII = 41 (37-45). Male copulatory complex composed of slightly arched tubular penis perpendicular to ovoid basal bulb: Pe = 53 (48-56). S-shaped accessory piece with long finger-like process at its proximal end; distal end pincer-like (not articulated); heel poorly developed. Accessory piece always associated with large, thin auxiliary plate with numerous aligned tubercles; as this plate is not linked to accessory piece its spatial position is variable but always close to its distal end (as shown in Figure 6): Ap = 52 (47-55), plate: 17 (15-19) by 13 (11-14), He = 4 (3-6). Vagina straight, irregularly shaped: V = 23 (20-25), v = 2 (1-2).

Comments

Only very minor differences³ between the new material and the original measurements from Egyptian

³Differences probably resulting from the way in which the measurements were taken.

specimens were found. However, the illustrations of the sclerotised parts given by Ergens (1981) perfectly match our material. Therefore, the species found in Senegal and described above is undoubtedly *C. thurstonae*, even if Ergens did not mention the presence of an auxiliary plate associated with the male apparatus.

This species belongs to the group of *Cichlidogyrus* characterised by small uncinuli I, long uncinuli III to VII and one auxiliary plate associated with the male apparatus: *C. aegypticus* Ergens, 1981, *C. agnesi* Pariselle & Euzet, 1995, *C. bilongi* Pariselle & Euzet, 1995, *C. gallus* Pariselle & Euzet, 1995, *C. microscutus* Pariselle & Euzet, 1996, and *C. paganoi* Pariselle & Euzet, 1997. *C. thurstonae* is readily distinguished from these species. *C. aegypticus*, *C. agnesi*, *C. bilongi* and *C. gallus* have a very different vaginae (in shape and length) and no finger-like process at the proximal end of the accessory piece. *C. microscutus* has a small accessory plate (*vs* wide) and a vagina with a very different shape. *C. paganoi* has similarly shaped vagina but a very different accessory piece

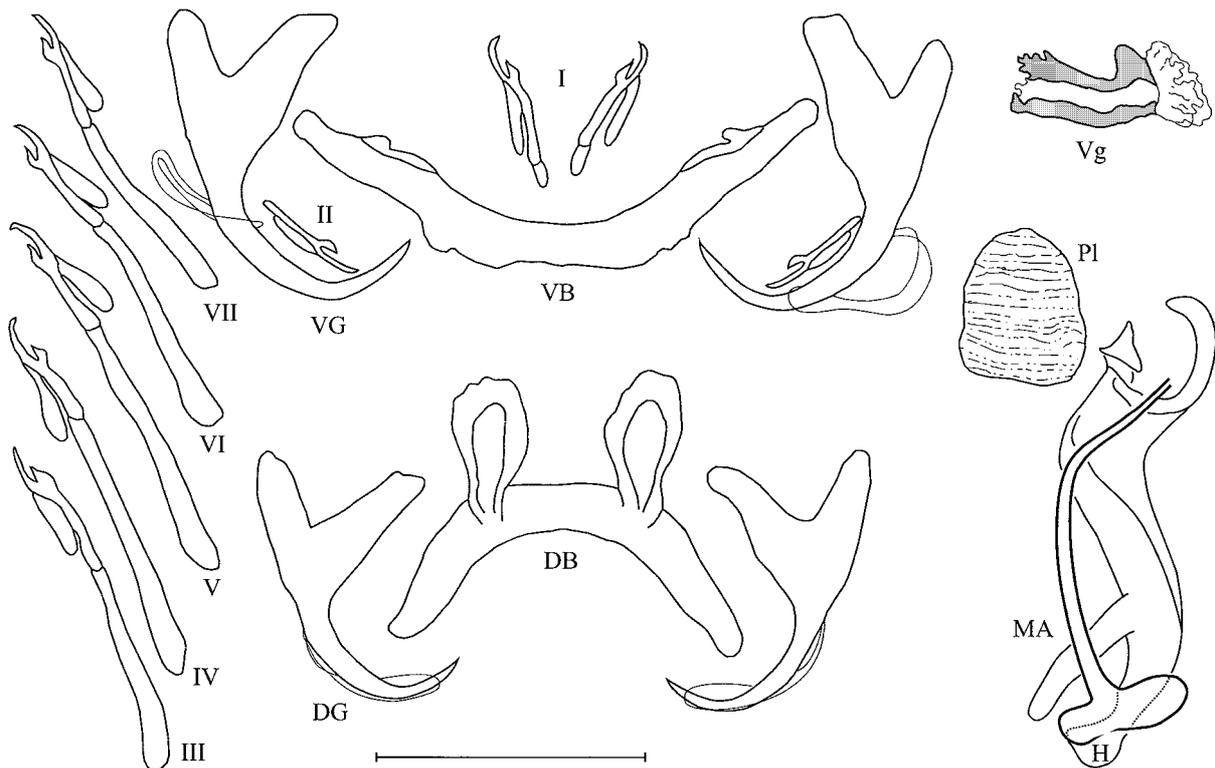


Figure 6. *Cichlidogyrus thurstonae* Ergens, 1981. Abbreviations: DB, dorsal bar; DG, dorsal gripus; H, heel; MA, male apparatus; PI, auxiliary plate; VB, ventral bar; VG, ventral gripus; Vg, vagina; I-VII, uncinuli. Scale-bar: 30 μ m.

(short finger-like process proximally vs longer) and a wider auxiliary plate.

Conclusion

As previously quoted (Pariselle, 1996), monogenean species-richness of cichlid hosts (i.e. the number of parasite species found on/in one host species) is variable, even between closely related forms. In this study on monogeneans it varies from one (in *Sarotherodon caudomarginatus*) to six (in *Oreochromis niloticus*). This variability is probably shaped by the historical events experienced by the host population (for a hypothesis, see Pariselle et al., 2003). The fact that *S. caudomarginatus* is parasitised by only one species is probably related to the homogeneity of its population (narrow range of distribution, few fluctuations in population size, little or no fragmentation of the population) compared to *O. niloticus* (wide range of distribution, probably significant fluctuations in population size, population fragmentation).

The sharing of parasite species (see Table 1) is probably the result of inheritance from ancestral host

species (see Pariselle et al., 2002) at different taxonomic levels: *O. aureus* is 'parasitologically' related to *O. niloticus*, as are *S. galilaeus* and *S. g. sanagaensis*. At a higher level, the homogeneity of mouthbreeder tilapias is highlighted by the sharing of *C. halli*, *C. tilapiae* or *Scutogyrus* spp. These phylogenetic relationships of the hosts indicated by analyses of their parasites are confirmed by genetic data (see Pouyaud & Agnès, 1995). The morphological proximity of *C. giostrai* and *C. njinei* remains enigmatic, as their two host species are not closely related.

References

- Dossou, C. (1982) Parasites de poissons d'eau douce du Bénin. III. Espèces nouvelles du genre *Cichlidogyrus* (Monogenea) parasites de Cichlidae. *Bulletin de l'Institut Fondamental d'Afrique Noire*, **44**, 295–322.
- Douëllou, L. (1993) Monogeneans of the genus *Cichlidogyrus* Paperna, 1960 (Dactylogyridae: Ancyrocephalinae) from cichlid fishes of Lake Kariba (Zimbabwe) with descriptions of five new species. *Systematic Parasitology*, **25**, 159–186.
- Ergens, R. (1981) Nine species of the genus *Cichlidogyrus* Paperna, 1960 (Monogenea: Ancyrocephalinae) from Egyptian fishes. *Folia Parasitologica*, **28**, 205–214.

- Euzet, L. & Prost, M. (1981) Report of the meeting on Monogenea: problems of systematic, biology and ecology. In: Slusarski, W. (Ed.) *Review of advances in parasitology*. Warsaw: P.W.N. Polish Scientific Publishers, pp. 1003–1004.
- Gusev, A.V. (1962) [Monogenetic trematodes.] In: Bychovskaya-Pavlovskaya, I.E. (Ed.) [*Key to the parasites of freshwater fishes of the USSR*.] Moscow-Leningrad: Academiya Nauk SSSR, pp. 200–383. (Translated from Russian by IPST, Ser. No. 1136, Jerusalem, 1964).
- Malmberg, G. (1957) [On the occurrence of *Gyrodactylus* on Swedish fishes.] *Skifterutgivna av Södra Sveriges Fiskeriförening*, (1956), pp. 19–76. (In Swedish, with description of species and a summary in English.)
- Paperna, I (1960) Studies on monogenetic trematodes in Israel. 2. Monogenetic trematodes of cichlids. *Bamidgeh*, **12**, 20–30.
- Pariselle, A. (1996) *Diversité, spéciation et évolution des Monogènes branchiaux de Cichlidae en Afrique de l'Ouest*. PhD Thesis: University of Montpellier II, France, 199 pp.
- Pariselle, A. & Euzet, L. (1995) Gill parasites of the genus *Cichlidogyrus* Paperna, 1960 (Monogenea, Ancyrocephalidae) from *Tilapia guineensis* (Bleeker, 1862), with descriptions of six new species. *Systematic Parasitology*, **30**, 187–198.
- Pariselle, A. & Euzet, L. (1997) New species of *Cichlidogyrus* Paperna, 1960 (Monogenea, Ancyrocephalidae) from the gills of *Sarotherodon occidentalis* (Daget) (Osteichthyes, Cichlidae) in Guinea and Sierra Leone (West Africa). *Systematic Parasitology*, **38**, 221–230.
- Pariselle, A., Lim, L.H.S. & Lambert, A. (2002) Monogeneans from Pangasiidae (Siluriformes) in Southeast Asia: III: Five new species of *Thaparocleidus* Jain, 1952 (Ancyrocephalidae) from *Pangasius bocourti*, *P. djambal* and *P. hypophthalmus*. *Parasite*, **9**, 207–217.
- Pariselle, A., Morand, S., Deveney, M.R. & Pouyaud, L. (2003) Parasite species richness of closely related hosts: historical scenario and 'genetic' hypothesis. In: Combes, C. & Jourdan, J. (Eds) *Taxonomy, ecology, and evolution of metazoan parasites. Livre hommage à Louis Euzet*. Perpignan: Les Presses Universitaires de Perpignan, Vol. 2, pp. 147–166.
- Pouyaud, L. & Agnèse, J.-F. (1995) Phylogenetic relationships between 21 species of three tilapiine genera *Tilapia*, *Sarotherodon* and *Oreochromis* using allozyme data. *Journal of Fish Biology*, **47**, 26–38.
- Price, C.E., Peebles, H.E. & Bamford, T. (1969) The monogenean parasites of African fishes. IV. Two new species from South African hosts. *Revue de Zoologie et de Botanique Africaine*, **79**, 117–124.