

Gill parasites of the genus *Cichlidogyrus* Paperna, 1960 (Monogenea, Ancyrocephalidae) from *Tilapia guineensis* (Bleeker, 1862), with descriptions of six new species

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Abstract

A study of gill parasites of *Tilapia guineensis* (Bleeker, 1862) (Cichlidae) from different locations in West Africa (Senegal, Guinea, the Ivory Coast and the Congo) revealed the presence of twelve species of *Cichlidogyrus* Paperna, 1960 (Monogenea). Six have been recorded previously from *T. zillii* (Gervais, 1848) or *Tristamella simonis* (Günther, 1864) and six are considered new species: *C. agnesi* n. sp., *C. bilongi* n. sp., *C. gallus* n. sp., *C. flexicolpos* n. sp., *C. louipaysani* n. sp. and *C. vexus* n. sp. In the first three species cited, we report the presence of an auxiliary plate in the male copulatory complex which is characteristic of the species *C. aegypticus* Ergens, 1981, a parasite of *Tilapia zillii*.

Resumé

L'étude des Monogenea parasites branchiaux de *Tilapia guineensis* (Bleeker, 1862) (Cichlidae), provenant de diverses localités en Afrique de l'Ouest (Sénégal, Guinée, Côte d'Ivoire et Congo) a révélé, à côté de six espèces de *Cichlidogyrus* Paperna, 1960 déjà connues chez *Tilapia zillii* (Gervais, 1848) ou chez *Tristamella simonis* (Günther, 1864), l'existence de six espèces nouvelles, *C. agnesi* n. sp., *C. bilongi* n. sp., *C. gallus* n. sp., *C. flexicolpos* n. sp., *C. louipaysani* n. sp. et *C. vexus* n. sp. On signale, chez les trois premières citées, la présence d'une plaque auxiliaire au niveau de l'appareil copulateur mâle; plaque caractéristique de l'espèce *Cichlidogyrus aegypticus* Ergens, 1981, parasite de *Tilapia zillii*.

Introduction

Within the framework of current studies relating to the development of cichlid aquaculture (*Tilapia* [sensu lato]) the present study on the parasitic fauna of the different species found in West Africa was undertaken in order to determine the para-

sites available for use as potential biological indicators of host species or populations, and to identify potential pathogens in terms of fish culture which might result either by accumulation or transfer.

The present study is concerned with the gill Monogenea of *Tilapia guineensis* (Bleeker, 1862),



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a cichlid for which there is currently only one known monogenean, *Enterogyrus coronatus* Pariselle, Lambert & Euzet, 1991, a stomach parasite.

Materials and methods

Fish were caught in various rivers and lagoons of Senegal, Guinea, the Ivory Coast and the Congo using gill or cast nets. The fish were either dissected on site immediately after capture or kept fresh and dissected later in the laboratory. In both cases, the left branchial arches, separated into dorsal and ventral sections, were frozen at -20°C or in liquid nitrogen, until examination. In order to verify the specific identity of the host fishes, the carcasses were numbered, fixed and preserved in formalin. After thawing, the parasites were detached from the gill, using a strong water current, and transferred individually with a mounted needle directly into a drop of ammonium picrate-glycerine mixture on a slide, following Malmberg (1957). The preparation was then covered with a round cover slip and after several hours, which is necessary for the proper impregnation of the mounting medium, the cover-slip was sealed with Glyceel (Gurr-BDH Chemicals Ltd). From these preparations, drawings were made of the sclerotised pieces of the haptor and copulatory complex (stained with the ammonium picrate) using a camera lucida. All measurements were made using a digitiser. The measurements were those proposed by Gusev (1962) (Fig. 1) and are presented in micrometres as the mean \pm the standard deviation, with the range in parentheses.

The terminology and numbering of the haptoral pieces are those adopted at ICOPA IV (Euzet & Prost, 1981) (uncinulus I medio-ventral, uncinulus II ventral associated with ventral "anchor" (see below), marginal uncinuli III-IV latero-dorsal, marginal uncinuli V-VI-VII latero-ventral).

We suggest the term "uncinulus" for the small marginal hooks of the oncomiracidium of monogeneans. Generally uncinuli are persistent, with some morphological changes, in the adult haptor of the Monopisthocotylea but disappear in adult haptor of most polyopisthocotyleans.

We suggest "gripus" for the large median hooks of the Dactylogyridea. We reserve the name "hamulus" for the large haptoral hooks of the oncomiracidium (and which persist at the posterior extremity of the haptor in some adults) of the Polyopisthocotylea. So, on each side of the oncomiracidial haptor of the polyopisthocotyleans, we have two hamuli, one posterior (hamulus I) ("en fleau" in the Microcotylidae) and one more lateral (hamulus II), the postero-lateral uncinulus being placed between these hamuli. The use of *hamulus* (*hamuli*) for the large median hooks in both subclasses has brought about associations and even homologies which are very likely erroneous. The large hooks of the Dactylogyridea are very different in their ontogeny and structure from the large hooks (hamulus) of the polyopisthocotyleans. The former appear in the hindbody and migrate into the haptor (Kearn, 1968; Lambert, 1975, 1980a,b), whereas the latter appear and remain in the haptor (Llewellyn, 1963; Euzet, 1958). The structure of the *gripus* is characterised by a "filament" attached to the blade, which is never the case in hamuli. The use of *gripus* is currently limited to the Dactylogyridea, but the term may possibly be applied to other monopisthocotyleans, when their post-larval development has been elucidated.

Results

In addition to five species of *Cichlidogyrus*, Paperna, 1960 already found on *Tilapia zillii* (Gervais, 1848), namely *C. aegypticus* Ergens, 1981, *C. cubitus* Dossou, 1982, *C. digitatus* Dossou, 1982, *C. ergensi* Dossou, 1982 and *C. tiberianus* Paperna, 1960, and one species, *C. arthracanthus* Paperna, 1960, described from *Tristamella simonis* (Günther, 1864) but mentioned by Paperna (1979) on *T. zillii*, six species were found that are considered new. All six new species belong to *Cichlidogyrus* as redefined by Dossou & Birgi (1984). The anatomy of the soft parts is identical, with specific differences coming from the morphology and size of the sclerotised pieces of the haptor, the male copulatory complex and vagina.

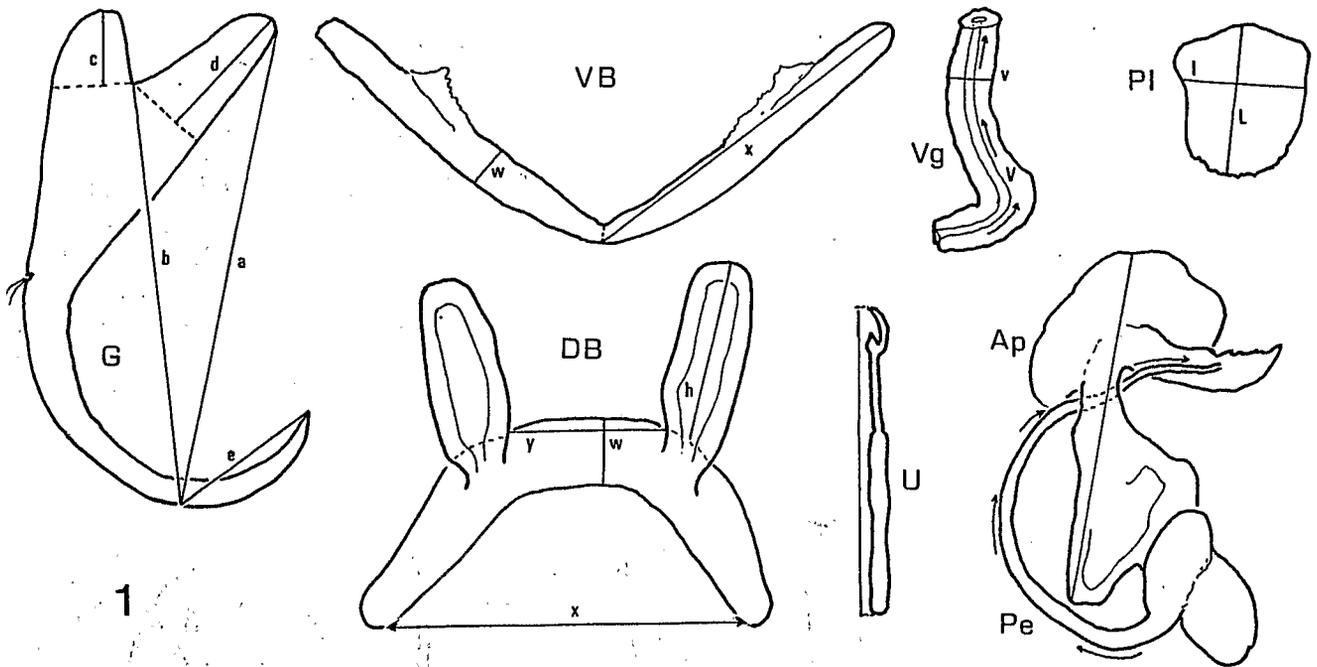


Fig. 1. Measurements used in this study. Abbreviations: Ap, accessory piece; DB, dorsal transverse bar; G, gripus; Pe, penis; Pl, auxilliary plate; U, uncinulus; VB, ventral transverse bar; Vg, vagina.

Cichlidogyrus agnesi n. sp.

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Tiassalé, Bandama River, Ivory Coast.

Material studied: 11 individuals stained and mounted in Malmberg's solution.

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 220 HF-Tk 22. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): 220 HF-Tk 23; at The Natural History Museum (London): Reg. No. 1993.5.14.7; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.338.

Description (Fig. 2)

Adult individuals: 825 ± 101 (613–954) long, 153 ± 13 (126–176) wide at level of vagina; pharynx 44 ± 3 (38–48) at widest point.

Dorsal gripus with guard slightly longer than shaft; blade arched, bent in distal half (Fig. 2,

DG); dimensions: a = 30.3 ± 1.2 (27–31), b = 22.8 ± 0.8 (21–24), c = 8.3 ± 1 (6–10), d = 13.5 ± 1.2 (10–15), e = 10.5 ± 0.6 (9–11). Dorsal transverse bar arched, with 2 long auricles on its convex face (Fig. 2, DB); dimensions: x = 43.3 ± 3.7 (35–48), h = 17.4 ± 1.4 (13–19), w = 6.3 ± 0.9 (5–7), y = 17.2 ± 1.3 (16–19). Ventral gripus slightly larger than dorsal (Fig. 2, VG); dimensions: a = 33.6 ± 1.1 (30–35), b = 27.6 ± 0.9 (25–29), c = 8.3 ± 0.8 (6–9), d = 13.6 ± 1.3 (10–16), e = 11.5 ± 0.5 (10–12). Ventral transverse bar thinner in middle, 'V'-shaped (Fig. 2 VB); dimensions: y = 43.9 ± 1.9 (38–44), w = 6.3 ± 0.6 (5–8). Uncinulus I = 18.9 ± 0.8 (16–20) long; uncinulus II associated with ventral gripus = 13.7 ± 0.5 (12–14); marginal uncinulus III = 40.6 ± 1.4 (37–43), IV = 45.8 ± 1.2 (43–47), V = 45.7 ± 1.5 (42–48), VI = 43 ± 1.1 (40–45), VII = 39.9 ± 1.2 (37–42) (Fig. 2). Male copulatory complex composed of long, arched, tubular penis, gradually tapering from basal bulb to distal end (Fig. 2, Pe); dimensions 132.5 ± 3.3 (128–140) long. Sclerotised mass on basal bulb

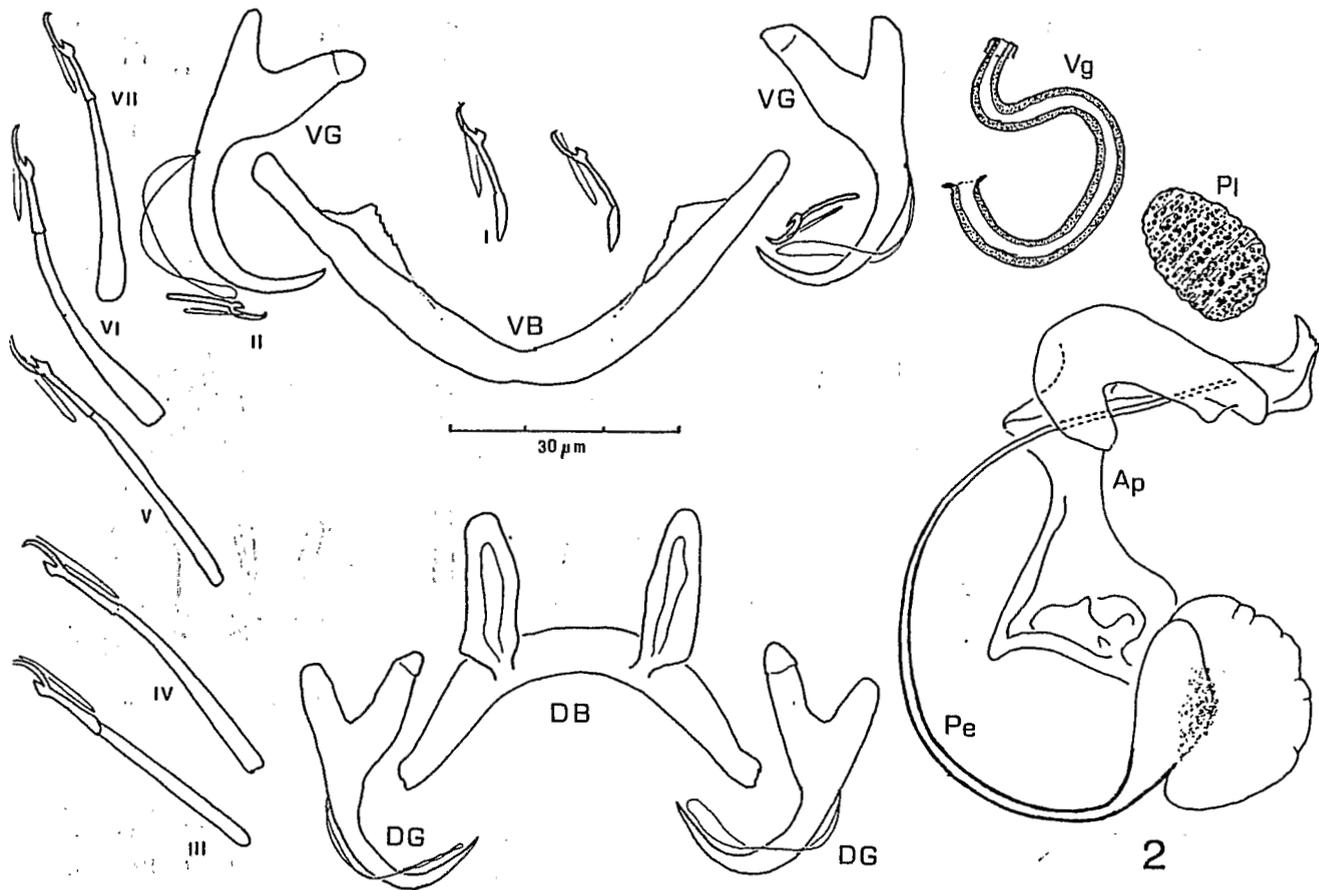


Fig. 2. *Cichlidogyrus agnesi* n. sp. Abbreviations: Ap, accessory piece; DG, dorsal gripus; DB, dorsal bar; Pe, penis; Pl, auxiliary plate; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

fused with highly curved accessory piece, forming terminal hook (Fig. 2, Ap); dimensions: 56.3 ± 4.9 (48–64) long. Ovoid thickened auxiliary plate with numerous roughly aligned tubercles, always present near distal region of copulatory complex (Fig. 2, Pl); dimensions: $L = 19.9 \pm 1.5$ (17–23), $l = 14.6 \pm 1.1$ (12–16). Vagina with thickened sclerotised lining, characteristic sickle shape (Fig. 2, Vg); dimensions: $V = 67.8 \pm 3.2$ (62–72), $v = 4.3 \pm 0.4$ (3–4).

Discussion

This species belongs to the group of *Cichlidogyrus* with a small uncinulus I and long marginal uncin-

uli III–VII, but it differs from this group, like *C. aegypticus*, by the presence of an auxiliary plate associated with the male copulatory complex. It is distinguished from *C. aegypticus* and its relatives principally by the morphology and size of the copulatory complex and the sclerotised portion of the vagina. The name *Cichlidogyrus agnesi* n. sp. is dedicated to the geneticist Dr. J.-F. Agnès.

Cichlidogyrus bilongi n. sp.

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Tiassalé, Bandama River. This spe-

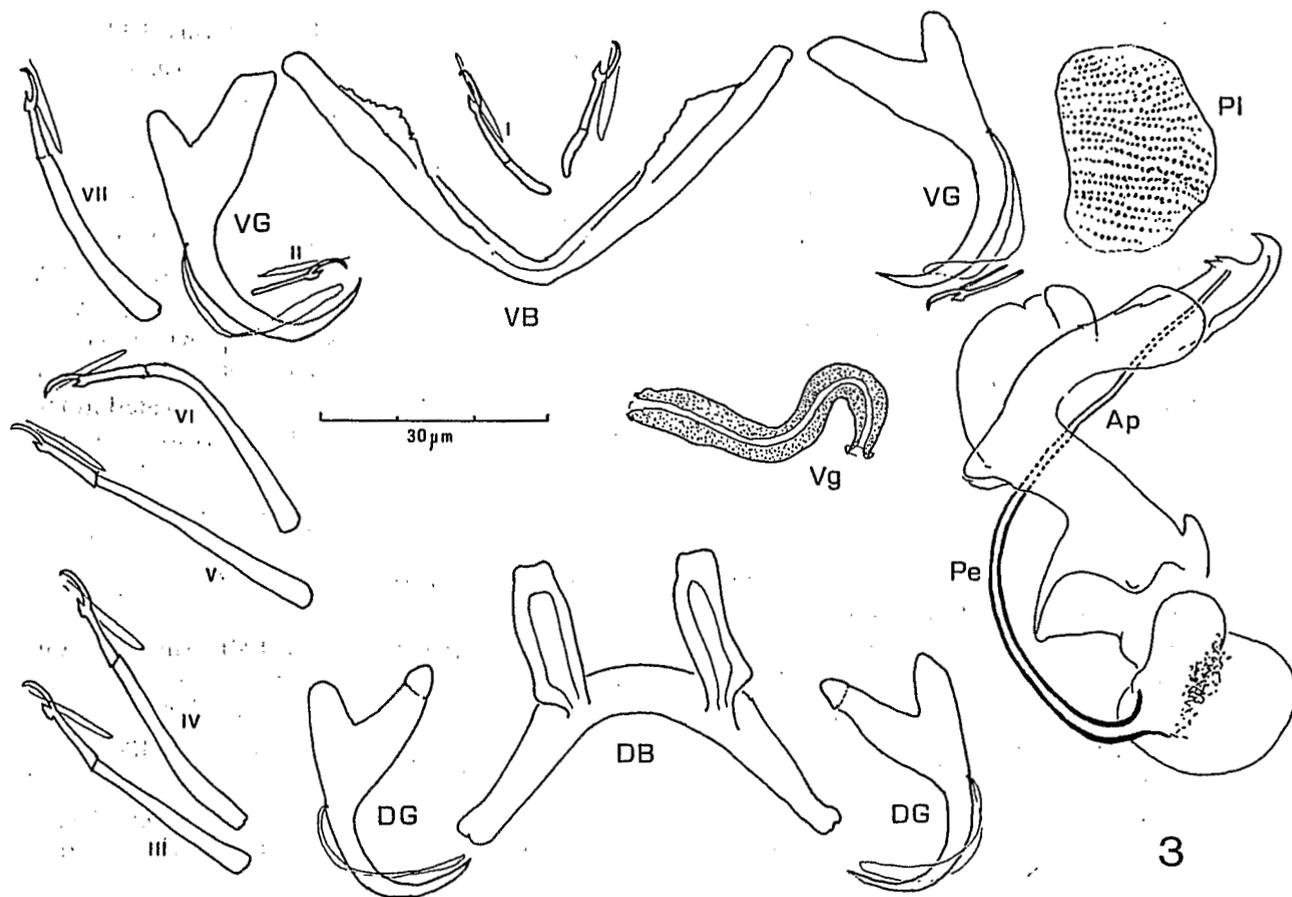


Fig. 3. *Cichlidogyrus bilongi* n. sp. Abbreviations: Ap, accessory piece; DG, dorsal gripus; DB, dorsal bar; Pe, penis; Pl auxiliary plate; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

transverse bar with long, straight auricles (Fig. 4, DB); dimensions: $x = 36.1 \pm 4.2$ (31-49), $w = 4.2 \pm 0.4$ (3-5), $h = 15.2 \pm 1.1$ (13-18), $y = 14.5 \pm 1.3$ (12-18). Ventral gripus of same shape as dorsal (Fig. 4, VG); dimensions: $a = 29.7 \pm 0.9$ (27-33), $b = 25.6 \pm 1.5$ (24-36), $c = 5.2 \pm 0.5$ (3-6), $d = 11.2 \pm 1$ (8-13), $e = 10.9 \pm 0.6$ (9-12). Ventral transverse bar 'V'-shaped (Fig. 4, VB); dimensions: $x = 34.9 \pm 2.6$ (23-39), $w = 4.3 \pm 0.4$ (3-5). Uncinulus I = $15 - 0.5$ (14-16) long; uncinuli II, associated with ventral gripus = 12.5 ± 0.5 (10-13); marginal uncinulus III = 32.8 ± 1.4 (29-35), IV = 35.6 ± 1.8 (32-39), V = 36.9 ± 1.4 (33-39), VI = 35.7 ± 1.4 (32-38), VII = 33.1 ± 1.3 (30-35) (Fig. 4). Male copulatory complex re-

sembles that of the previous species, from which it differs by being shorter, by wider penis with thicker lining at base (Fig. 4, Pe), by presence of large semicircular expansion at bend of accessory piece, by having its distal end lightly arched and serrated on its concave edge and slightly shell-shaped auxiliary plate with more sclerotised edge and approximately one dozen distinct serrations (Fig. 4, Ap). Dimensions: Pe = 73.1 ± 2 (70-78), He = 7.6 ± 0.8 (6-10); Ap = 40.7 ± 2.5 (35-46); auxiliary plate (Fig. 4, Pl) dimensions: L = 16 ± 2 (10-18), l = 15.9 ± 1.9 (10-18). Vagina slightly sinuous, with thick lining (Fig. 4, Vg); dimensions: V = 32.7 ± 2.2 (25-36), v = 5 ± 0.6 (3-6).

cies was also found on the same host at the research station at Layo, Ebrié Lagoon, Ivory Coast.

Material studied: 28 individuals stained and mounted in Malmberg's solution.

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 218 HF-Tk 18. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): 218 HF-Tk 19; at The Natural History Museum (London): Reg. No. 1993.5.14.8; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.337.

Description (Fig. 3)

Adult individuals 730.5 ± 128.6 (466–1052) long, 135.9 ± 19 (88–174) wide at level of vagina; pharynx 40.5 ± 3.7 (28–48) at widest point. Dorsal gripus similar to those of *C. agnesi* n. sp. (Fig. 3, DG); dimensions: $a = 28.1 \pm 1.4$ (24–30), $b = 22.4 \pm 0.8$ (20–23), $c = 7.2 \pm 0.8$ (4–8), $d = 11.7 \pm 1.2$ (8–14), $e = 10.3 \pm 0.6$ (9–11). Dorsal transverse bar arched, with 2 long auricles on its convex face (Fig. 3, DB); dimensions: $x = 41.2 \pm 3$ (35–46), $w = 5.6 \pm 0.4$ (4–6), $h = 16.8 \pm 1.1$ (14–19), $y = 14 \pm 1.8$ (11–19). Ventral gripus (Fig. 3, VG) dimensions: $a = 32.1 \pm 1.2$ (29–34), $b = 27.2 \pm 0.9$ (25–29), $c = 6.9 \pm 0.8$ (5–8), $d = 12.5 \pm 1.1$ (9–14), $e = 11.4 \pm 0.8$ (9–13). Ventral transverse bar 'V'-shaped (Fig. 3, VB); dimensions: $x = 38.6 \pm 2.2$ (34–43), $w = 4.8 \pm 0.4$ (4–6). Uncinulus I = 18.4 ± 1 (16–20) long; uncinulus II associated with ventral gripus, has larval size = 13.2 ± 0.4 (12–13); marginal uncinuli, with developed shaft; lengths: III = 36.8 ± 1.6 (33–40), IV = 42.1 ± 1.8 (36–44), V = 42.1 ± 1.7 (38–45), VI = 39.1 ± 1.3 (35–41), VII = 36.9 ± 1.4 (33–39) (Fig. 3). Male copulatory complex, which resembles that of *C. agnesi* n. sp., distinguished by length of penis (101 vs 132) (Fig. 3, Pe); accessory piece with thicker distal hook, serrated on convex edge (Fig. 3, Ap) and by auxiliary plate covered by irregular rows of small tubercles (Fig. 3, Pl); dimensions: Pe = 101.2 ± 2.6 (95–105) long, He = 9.8 ± 1.2 (6–11); Ap = 57.7 ± 5.3 (44–69); auxiliary plate (Fig. 3, Pl) dimensions: L = 25.4 ± 2.7 (19–29), l = 19.9 ± 2.1 (14–22).

Vagina, with sclerotised lining, forms sickle with long shaft (Fig. 3, Vg); dimensions: V = 43.7 ± 1.9 (39–47), v = 5.6 ± 0.6 (4–6).

Discussion

Like the previous species, this species belongs to the group of *Cichlidogyrus* with a small uncinulus I, large uncinuli III–VII and an auxiliary plate. It is easily distinguished from the previous species by the shape and the size of the sclerotised portion of the vagina. *C. bilongi* n. sp. is dedicated to Dr C.F. Bilong-Bilong of the University of Yaoundé, the Cameroon.

Cichlidogyrus gallus n. sp.

Syn. *C. aegypticus* Ergens, 1981 *sensu* Dossou (1982).

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Tiassalé, Bandama River, Ivory Coast. This species has also been found on the same host at the research station at Layo, Ebrié Lagoon, Ivory Coast, and on *T. zillii* in the Ouémé River, Benin, by Dossou (1982).

Material studied: 30 individuals stained and mounted in Malmberg's solution.

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 221 HF-Tk 24. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): 221 HF-Tk 25; at The Natural History Museum (London): Reg. No. 1993.5.14.10.; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.336.

Description (Fig. 4)

Adult individuals 550.9 ± 51.1 (465–696) long, 125.8 ± 17.8 (73–163) wide at level of vagina; pharynx 37.4 ± 3.1 (29–44) at widest point. Dorsal gripus resembles those of 2 previous species (Fig. 4, DG); dimensions: $a = 24.7 \pm 4.2$ (22–26), $b = 20.2 \pm 0.6$ (18–21), $c = 5 \pm 0.5$ (4–6), $d = 9.9 \pm 0.8$ (8–11), $e = 9.1 \pm 0.6$ (7–10). Dorsal

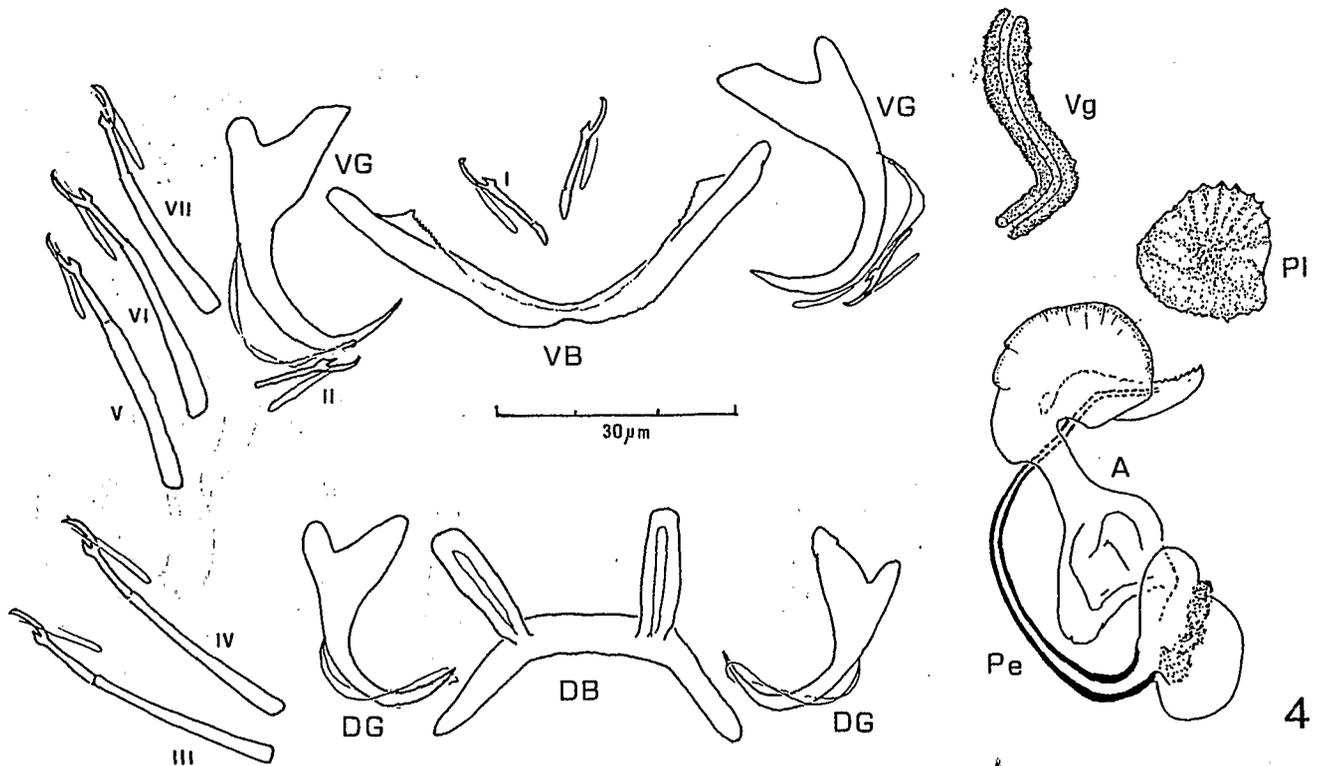


Fig. 4. *Cichlidogyrus gallus* n. sp. Abbreviations: Ap, accessory piece; DG, dorsal gripus; DB, dorsal bar; Pe, penis; PI, auxiliary plate; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

Discussion

Within the group of *Cichlidogyrus* that possess an auxiliary plate in the genital complex, this species is distinguished by the size of the copulatory complex and the presence of a large semicircular expansion on the accessory piece. It is considered a new species and the name *Cichlidogyrus gallus* n. sp. is proposed because the expansion of the accessory piece resembles a cockerel's crest.

Other monogeneans were also found on *T. guineensis* which correspond exactly to the original description of *Cichlidogyrus aegypticus* Ergens, 1981. This determination is based particularly on the characteristic morphology of the vagina, which is thin-walled, vase-shaped, slightly sclerified and curved in its distal third (see fig. 7, p. 211 of Ergens, 1981).

It appears that the designation to *C. aegypticus* of a parasite from *Tilapia zillii* by Dossou (1982),

because of the presence of an auxiliary plaque which he believed was characteristic of this species, is partly erroneous, because of our discovery of at least four different species of *Cichlidogyrus* having this same sclerotisation. The morphology and the size of the vagina, plus the sclerotised pieces, leads us to the conclusion that the species described by Dossou (1982) as *C. aegypticus* Ergens, 1981 is *C. gallus* n. sp.

Cichlidogyrus flexicolpos n. sp.

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Tiassalé, Bandama River, Ivory Coast. This species was also found on the same host at the research station at Layo, Ebrié Lagoon, Ivory Coast and in the River Congo.

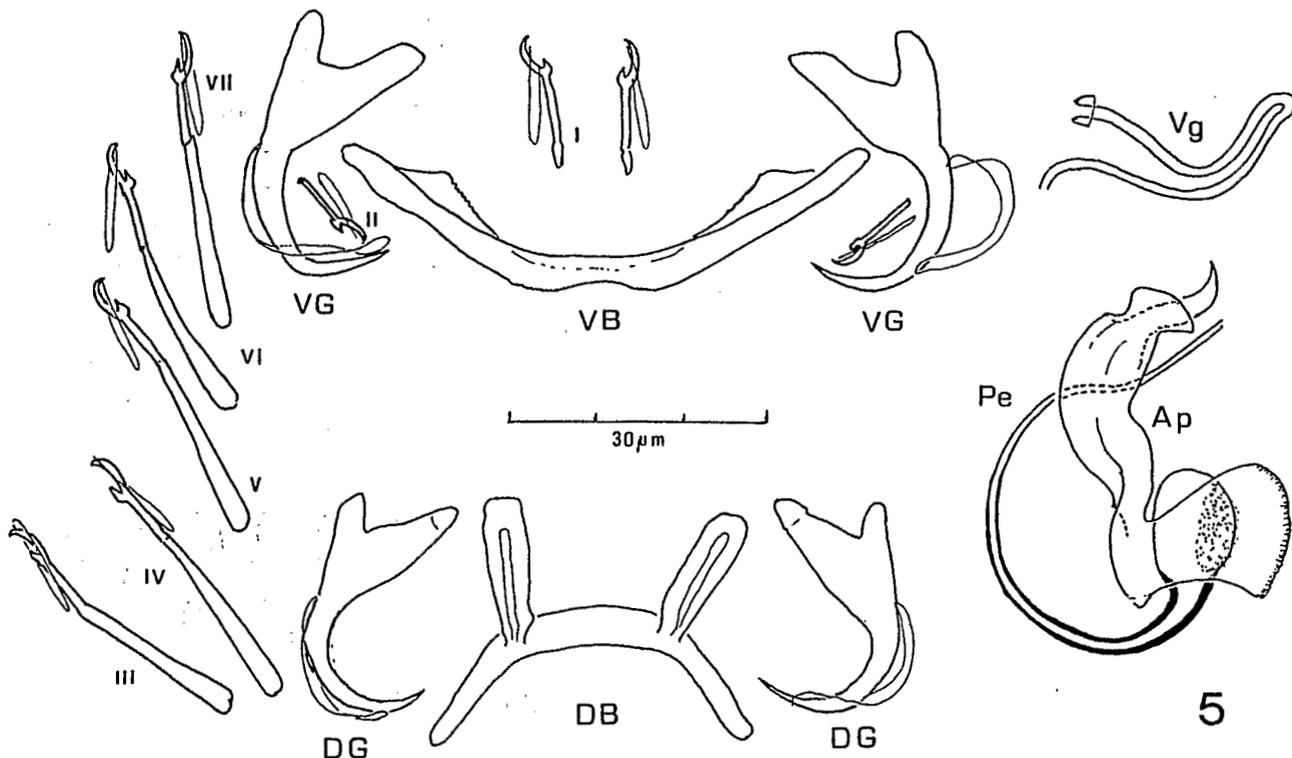


Fig. 5. *Cichlidogyrus flexicolpos* n. sp. Abbreviations: Ap, accessory piece; DA, dorsal gripus; DB, dorsal bar; Pe, penis; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

Material studied: 24 individuals stained and mounted in Malmberg's solution.

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 217 HF-Tk 16. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): 217 HF-Tk 17; at The Natural History Museum (London): Reg. No. 1993.5.14.9; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.340.

Description (Fig. 5)

Adult individuals: 485 ± 71.9 (411–760) long, 122.5 ± 15.7 (93–153) wide at level of vagina; pharynx 34.8 ± 2.9 (26–40) at widest point. Dorsal gripus with short shaft, long guard and arched blade (Fig. 5, DG); dimensions: $a = 24.8 \pm 0.9$ (23–26), $b = 19.8 \pm 0.6$ (18–21), $c = 4.9 \pm 0.5$ (3–6), $d = 10.4 \pm 0.9$ (8–12), $e = 9.4 \pm 0.7$ (7–11). Dorsal transverse bar (Fig. 5, DB); dimensions: $x = 36.3 \pm 4.1$ (29–46), $w = 4.1 \pm 0.3$ (3–5), $h =$

15.2 ± 1.2 (12–18), $y = 15.1 \pm 2.1$ (12–21). Ventral gripus similar to dorsal (Fig. 5, VG); dimensions: $a = 29.6 \pm 0.8$ (28–32), $b = 24.9 \pm 0.7$ (23–26), $c = 5.2 \pm 0.6$ (4–6), $d = 11.3 \pm 1$ (8–13), $e = 10.8 \pm 0.6$ (9–13). Ventral transverse bar 'V'-shaped (Fig. 5, VB); dimensions: $x = 33.3 \pm 1.5$ (30–37), $w = 4.2 \pm 0.5$ (3–6). Uncinulus I = 15.1 ± 0.6 (14–16) long; uncinulus II = 12.3 ± 0.4 (11–13); marginal uncinulus III = 33.2 ± 1.2 (30–36), IV = 36 ± 2.2 (32–40), V = 37.7 ± 1.1 (35–40), VI = 36 ± 1.1 (33–37), VII = 33.5 ± 1.1 (31–36) (Fig. 5). Male copulatory complex with arched tubular penis (Fig. 5, Pe); Pe = 92 ± 3 (87–101) long, characterised by large basal bulb and thickened base. Accessory piece (linked to basal bulb) massive, lightly arched with hook-shaped extremity; Ap = 36.2 ± 3.2 (32–42) (Fig. 5, Ap). No auxiliary plate. Long tubular vagina V = 66.2 ± 3.2 (31–42), lightly sclerotised sinuous and folded in middle (Fig. 5, Vg).

Discussion

This species is distinguished from all known *Cichlidogyrus* spp. by the morphology of the vagina and the accessory piece of the male copulatory complex. The name *C. flexicolpos* n. sp. reflects the peculiar fold of the vagina.

Cichlidogyrus louipaysani n. sp.

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Rice fields in the village of Koba, Guinea. This species was also found on the same host in Senegal (Somone Lagoon, Senegal River and at the junction of the Sine and Saloum Rivers) and in the Gambia (at the mouth of the Gambia River at Banjul).

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

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 222 HF-Tk 26. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): 222 HF-Tk 27; at The Natural History Museum (London): Reg. No. 1993.5.14.11; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.341.

Description (Fig. 6)

Adult individuals 684 ± 89.3 (478–872) long, 141.9 ± 21.7 (81–182) wide at level of vagina; pharynx 34.7 ± 2.8 (27–39) at widest point. Dorsal gripus with short shaft, long guard and thin blade regularly arched (Fig. 6, DG); dimensions: $a = 44.4 \pm 1.5$ (39–47), $b = 36.1 \pm 1.4$ (32–39), $c = 2.8 \pm 1$ (1–6), $d = 12.8 \pm 1.7$ (9–18), $e = 13.5 \pm 0.7$ (11–15). Dorsal transverse bar thick (Fig. 6, DB); dimensions: $x = 53.7 \pm 3.7$ (46–61), $w = 10.5 \pm 1.8$ (8–17), $h = 17.5 \pm 1.8$ (12–21), $y = 23.8 \pm 2.2$ (19–29). Ventral gripus with short shaft and guard (Fig. 6, VG); dimensions: $a = 41.2 \pm 1.3$ (38–44), $b = 38.4 \pm 1.4$ (35–41), $c = 3.9 \pm 1.2$ (2–6), $d = 9.7 \pm 1.4$ (6–12), $e = 14.8 \pm 0.9$ (12–17). Ventral transverse bar 'V'-shaped (Fig. 6, VB); dimensions: $x = 44.6 \pm 0.9$ (42–47), $w = 6.6 \pm 0.9$ (5–8). Uncinulus I =

13.6 ± 0.7 (11–15) long; uncinulus II = 11.7 ± 0.4 (10–12); marginal uncinulus III = 17.2 ± 0.7 (16–19), IV = 22.7 ± 0.8 (20–24), V = 23.5 ± 0.9 (21–26), VI = 19.4 ± 0.6 (17–20), VII = 17 ± 0.5 (15–18) (Fig. 6). Thin regularly arched penis, with straight heel on basal bulb (Fig. 6, Pe); $Pe = 87.4 \pm 3.3$ (74–91). Accessory piece (Fig. 6, Ap) attached at basal bulb, forms straight blade, bends into inverted 'S', marked by serrations on distal convex edge; $Ap = 34.1 \pm 2.2$ (30–41). No auxiliary plate. Vagina sinuous (Fig. 6, Vg); $V = 50.2 \pm 3.8$ (44–58).

Discussion

This species is easily distinguished by the small size of marginal uncinulus III to VII. Two other *Cichlidogyrus* spp. (*C. digitatus* and *C. cubitus*) from *T. guineensis* have this character. The described species is clearly distinguished from *C. digitatus* by the size of uncinulus I, which is smaller in *C. louipaysani* n. sp., and the morphology of the male copulatory complex. It resembles *C. cubitus* in the morphology of the accessory piece, penis and vagina. However, the size of these various pieces, as well as the shape of the distal half of the accessory piece, are significant and constant differences. This parasite is named *C. louipaysani* n. sp. for Mr Louis Paysan, who kindly provided the first parasitised fish host from the Somone Lagoon.

Cichlidogyrus vexus n. sp.

Type-host: *Tilapia guineensis* (Bleeker, 1862).

Site: Gills.

Type-locality: Tiassalé, Bandama River, Ivory Coast. This species was also found at the research station at Layo on the Ebrié Lagoon, Ivory Coast, on the same host, and in Lake Kossou on the Bandama River, Ivory Coast, on both *T. guineensis* and *T. zillii*.

Material studied: 20 individuals stained and mounted in Malmberg's solution.

Type-material: Holotype deposited at the Muséum National d'Histoire Naturelle (Paris): 219 HF-Tk 20. Paratypes deposited at the Muséum National

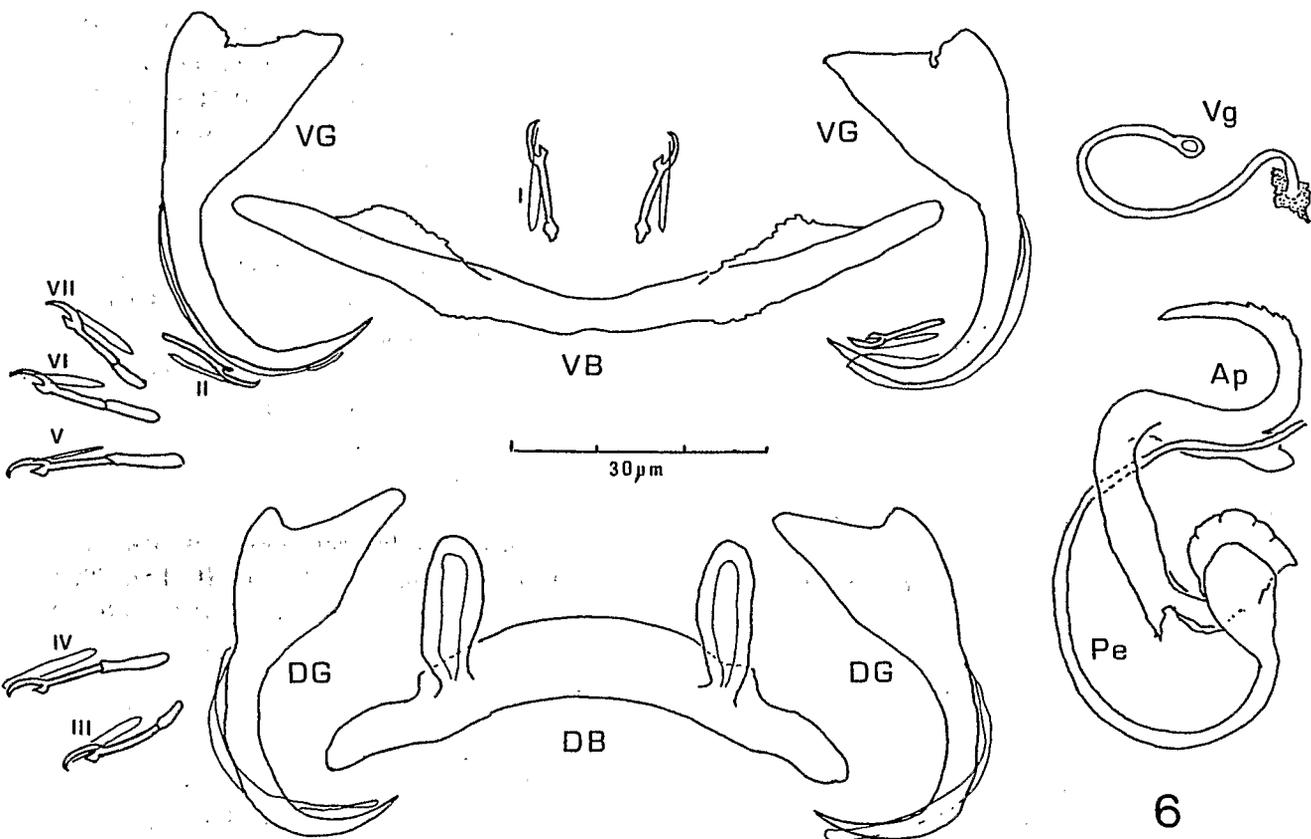


Fig. 6. *Cichlidogyrus louipaysani* n. sp. Abbreviations: Ap, accessory piece; DG, dorsal gripus; DB, dorsal bar; Pe, penis; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

d'Histoire Naturelle (Paris): 219 HF-Tk 21; at The Natural History Museum (London): Reg. No. 1993.5.14.12; at the Musée Royal d'Afrique Centrale (Tervuren): MRAC 37.339.

Description (Fig. 7)

Adult individuals 622.9 ± 121 (436-916) long, 131.3 ± 21 (80-157) wide at level of vagina; pharynx 39.9 ± 4.1 (31-46) at widest point. Dorsal gripus with guard longer than shaft and thin blade curved in distal third (Fig. 7, DG); dimensions: $a = 26.9 \pm 1.1$ (24-29), $b = 21.7 \pm 0.9$ (20-23), $c = 5.8 \pm 0.7$ (4-7), $d = 10.6 \pm 0.7$ (8-12), $e = 9.9 \pm 0.6$ (8-11). Dorsal transverse bar (Fig. 7, DB) dimensions: $x = 40.8 \pm 4$ (31-49), $w = 5.9 \pm 0.8$ (4-8), $h = 16.9 \pm 1.4$ (13-20), $y = 15.9 \pm 1.5$ (11-17). Ventral gripus similar to dorsal (Fig. 7, VG); dimensions: $a = 32 \pm 1$ (30-34),

$b = 27 \pm 0.9$ (25-29), $c = 6.2 \pm 0.8$ (4-7), $d = 11.5 \pm 1$ (9-13), $e = 11.2 \pm 0.6$ (9-12). Ventral transverse bar 'V'-shaped (Fig. 7, VB); dimensions: $x = 38.5 \pm 2.1$ (33-43), $w = 5.4 \pm 0.8$ (4-6). Uncinulus I = 16.7 ± 0.8 (14-18) long; uncinulus II = 12.6 ± 0.7 (10-13); marginal uncinulus III = 34.2 ± 1.5 (32-37), IV = 38.6 ± 1.8 (34-43), V = 38.8 ± 1.6 (36-43), VI = 36.3 ± 1.7 (32-39), VII = 34.2 ± 1.6 (31-37) (Fig. 7). Oval basal bulb forming acute angle with thin arched tubular penis (Fig. 7, Pe); Pe = 70.3 ± 1.9 (67-75). Accessory piece linked to base of penis by semicircular thickening, with triangular proximal half opposite basal bulb; distal half globular, with extremity folded back (Fig. 7, Ap); Ap = 47.6 ± 3.2 (31-37). No auxiliary plate. Vagina: V = 20.9 ± 1.2 (18-22), with thickened lining and short, narrow cylindrical section (Fig. 7, Vg).

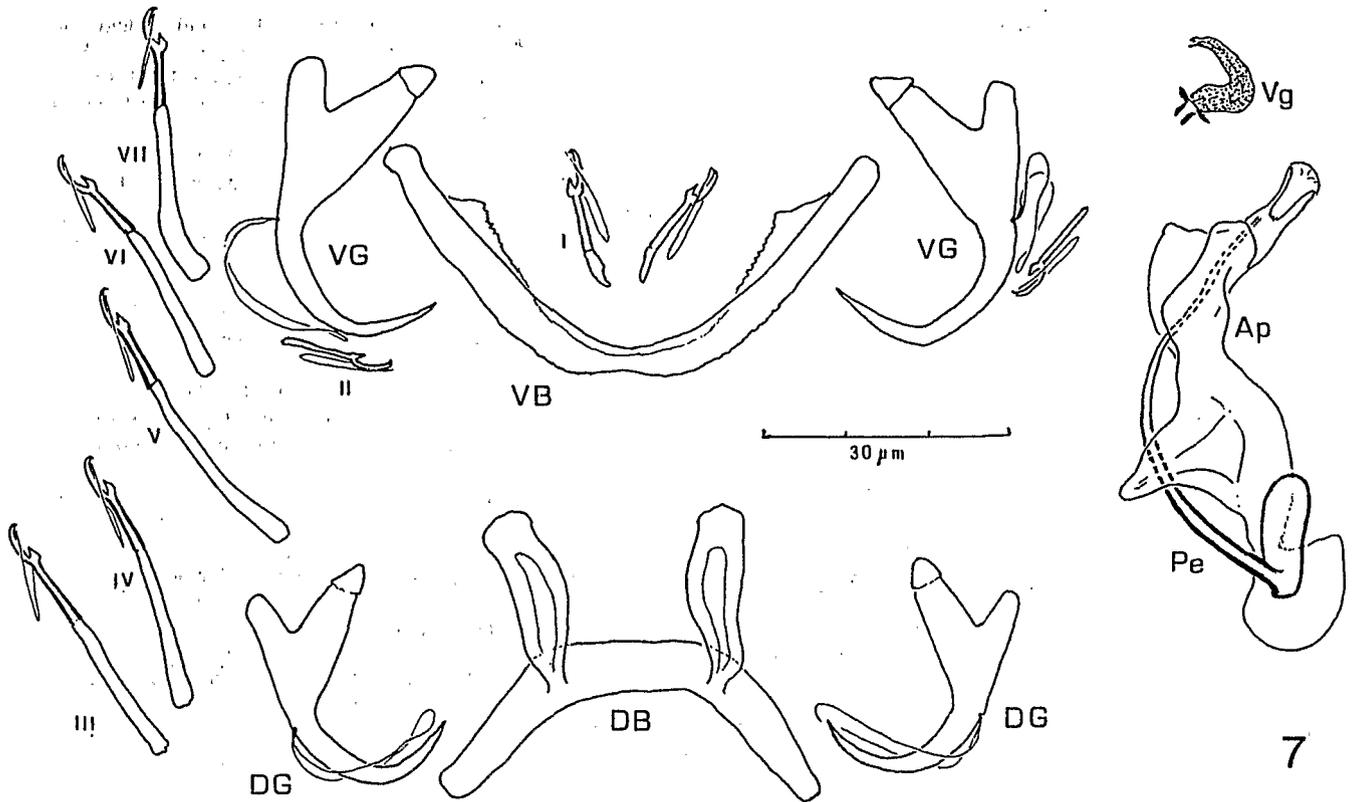


Fig. 7. *Cichlidogyrus vexus* sp. Abbreviations: Ap, accessory piece; DG, dorsal gripus; DB, dorsal bar; Pe, penis; VG, ventral gripus; VB, ventral bar; Vg, vagina; I-VII, marginal uncinuli.

Discussion

The presence of large uncinuli III to VII and the absence of the auxiliary plaque associated with the male copulatory complex, places this species of *Cichlidogyrus* in the group which includes *C. tiberianus* Paperna, 1960, *C. anthemocolpos* Dossou, 1982, *C. ergensis* Dossou, 1982 and *C. flexicolpos* n. sp. It is distinguished from these species by the morphology of the accessory piece, penis and vagina. The name *C. vexus* n. sp. is proposed with reference to the peculiar morphology of the distal extremity of the accessory piece.

Discussion

As suggested by Dossou (1985), the twelve *Cichlidogyrus* species currently observed or described from *Tilapia guineensis* comprise several groups of species distinguished according to the morpho-

logy of the sclerotised pieces of the haptor and the male copulatory complex.

The first group, with small marginal uncinuli I to VII includes: *C. cubitus* and *C. louipaysani* n. sp.

The second group, with a large uncinulus I and with the other uncinuli being small, includes: *C. digitatus*.

All other *Cichlidogyrus* species found on *T. guineensis* have a small uncinulus I and large uncinuli III to VII. The presence or absence of an auxiliary piece associated with the male copulatory complex places them in two distinct groups:

The third group, with an auxiliary plaque, includes: *C. aegypticus*, *C. agnesei* n. sp., *C. bilongi* n. sp. and *C. gallus* n. sp.

The fourth group, without an auxiliary plaque, includes: *C. anthemocolpos*, *C. ergensi*, *C. flexicolpos* n. sp., *C. tiberianus* and *C. vexus* n. sp.

The existence of these distinctly different morphological groups, not only on *T. guineensis*

but also on the majority of cichlids, poses the problem of the mono- or polyphyletic origin of the genus *Cichlidogyrus*. Furthermore, the presence of the same species on *T. guineensis*, as well as on *T. zillii*, suggests varying degrees of host specificity amongst these monogeneans.

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