TWO NEW SPECIES OF *CICHLIDOGYRUS* PAPERNA, 1960 (MONOGENEA, ANCYROCEPHALIDAE) GILL PARASITES ON *HEMICHROMIS FASCIATUS* (PISCES, CICHLIDAE) IN AFRICA, WITH REMARKS ON PARASITE GEOGRAPHICAL DISTRIBUTION

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Summary:

The examination of gill parasites from *Hemichromis fasciatus* Peters, 1858 (Pisces, Cichlidae) in Africa revealed the presence of nine species of Monogenea, three belong to *Onchobdella* Paperna, 1968 and the others to *Cichlidogyrus* Paperna, 1960. Seven have been previously described (*O. aframae* Paperna, 1968; *O. bopeleti* Bilong Bilong & Euzet, 1995; *O. voltensis* Paperna, 1968; *C. dageti* Dossou & Birgi, 1984; *C. euzeti* Dossou & Birgi, 1984; *C. falcifer* Dossou & Birgi, 1984 and *C. longicirrus* Paperna, 1965); two, belonging to the latter genus, are considered as new species: *C. sanseoi* n. sp. and *C. teugelsi* n. sp. As parasitic species are not present in all the host distribution area, we think that *H. fasciatus* is made up of two distinct populations (or even sister species).

KEY WORDS: Monogenea, Ancyrocephalidae, *Cichlidogyrus sanseoi* n. sp., *Cichlidogyrus teugelsi* n. sp., Freshwater fish, Cichlidae, *Hemichromis fasciatus*, Africa.

Résumé: DEUX ESPÈCES NOUVELLES DE *CICHLIDOGYRUS* (MONOGENEA, ANCYROCEPHALIDAE) PARASITES BRANCHIAUX D'*HEMICHROMIS FASCIATUS* (PISCES, CICHLIDAE) EN AFRIQUE, AVEC DES REMARQUES SUR LA DISTRIBUTION GÉOGRAPHIQUE DES PARASITES

L'examen des parasites branchiaux d'*Hemichromis fasciatus* Peters, 1858 (Pisces, Cichlidae) en Afrique révèle la présence de neuf espèces de Monogènes, trois appartenant à *Onchobdella* Paperna, 1968, les autres à *Cichlidogyrus* Paperna, 1960. Sept avaient déjà été observées (*O. aframae* Paperna, 1968; *O. bopeleti* Bilong Bilong & Euzet, 1995; *O. voltensis* Paperna, 1968; *C. dageti* Dossou & Birgi, 1984; *C. euzeti* Dossou & Birgi, 1984; *C. falcifer* Dossou & Birgi, 1984 et *C. longicirrus* Paperna, 1965); deux, appartenant à ce dernier genre, sont considérées comme nouvelles: *C. sanseoi* n. sp. et *C. teugelsi* n. sp. Les différentes espèces de parasites n'étant pas présentes sur l'ensemble de l'aire de répartition de l'hôte, nous pensons qu'*H. fasciatus* est composée de deux populations distinctes (voire de deux espèces jumelles).

MOTS CLÉS: Monogenea, Ancyrocephalidae, *Cichlidogyrus sanseoi* n. sp., *Cichlidogyrus teugelsi* n. sp., Poissons d'eau douce, Cichlidae, *Hemichromis fasciatus*, Afrique.

INTRODUCTION

In 1965 and 1969 Paperna described *Cichlidogyrus longicirrus* on *Hemichromis fasciatus* Peters, 1858 (type host) and *Pelmatochromis guentheri* (Sauvage, 1882) (syn. *Chromidotilapia guentheri*) from the Volta River and Coastal systems in Ghana. Paperna (1968) observed among *Hemichromis fasciatus* (type host) and *H. bimaculatus* Gill, 1863 two new species belonging to the new genus *Onchobdella*: *O. aframae* and *O. voltensis*. In 1984 Dossou and Birgi found, on *Hemichromis fasciatus* from the Ouémé (Benin) and Nyong (Cameroon) basins, the three previous species of Paperna, and described three new *Cichlidogyrus*: *C. dageti*, *C. euzeti* and *C. falcifer*. Bilong Bilong & Euzet (1995) described a new species *Onchobdella bopeleti* on *Hemichromis fasciatus* from the Ejambwé

and Sanaga Rivers (Cameroon). A recent increase in locations examined for *Hemichromis fasciatus* parasitism in Africa (Gambia River in the Gambia and Senegal, Kounougou River and coastal lowlands in Ivory Coast and Niger River in Mali) showed the presence of nine species of gill Monogenea. Seven have previously been described (see above and Table I). Two are considered new species and are herein described.

MATERIALS AND METHODS

Fish were caught in Gambia (Gambia River at Banjul), Ivory Coast (Kounougou River; Adiopodoumé, Km 17 Dabou Road; and Grand Lahou Lagoon), Mali (Niger River at Selingue) and Senegal (Niokolokoba National Park), using gill nets or cast nets. 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, the fish specimens were 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

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	Senegal	Gambia	Mali	Ivory Coast	Ghana	Benin	Congo	Cameroon
<i>O. aframae</i>	+		+	+	+	+	+	+
<i>O. bopeleti</i>	+		+					+
<i>O. voltensis</i>				+	+	+	+	+
<i>C. dageti</i>						+		+
<i>C. euzeti</i>						+	+	+
<i>C. falcifer</i>	+	+	+	+		+	+	+
<i>C. longicirrus</i>					+	+	+	+
<i>C. sanseoi</i> n. sp.	+		+	+				
<i>C. teugelsi</i> n. sp.	+		+	+				

Table I. – Geographical distribution of *Hemicbromis fasciatus* gill Monogenea (new locations in bold).

Fig. 1. – Measurements used in this study.

DB = dorsal transverse bar, h = length of auricle, w = maximum width, x = total length, y = distance between auricle; G = gripus, a = total length, b = blade length, c = root length, d = shaft length, e = point length; MA = male apparatus, Ap = accessory piece length, Pe = penis total length; U = uncinuli length; VB = ventral transverse bar, w = maximum width, x = length of one branch; Vg = vagina, L = total length, l = maximum width.

transferred individually on a slide with a mounted needle, directly 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 in micrometers, made with a digitiser, 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 haptor pieces is that adopted at ICOPA IV (Euzet & Prost, 1981). Terminology used is that of Pariselle & Euzet (1995).

RESULTS

The two new monogenean species found on the gills of *Hemicbromis fasciatus* belong to *Cichlidogyrus* (according to Paperna, 1960 and Pariselle *et al.*, 2003): Ancyrocephalidae. Three pairs of cephalic glands. Two posterior ocelli with crystalline

lenses. Two small inconsistent anterior ocelli. Median muscular pharynx. Simple intestinal caeca joined posteriorly. Two pairs of gripi, one dorsal and one ventral. Two transverse bars, one dorsal with two auricles, one ventral curved and articulated. Fourteen uncinuli. 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. Sub-median vaginal opening. Sclerotised vagina. Seminal receptacle present. Gill parasites of African Cichlidae and Nandidae.

DESCRIPTIONS

CICHLIDOGYRUS SANSEOI N. SP. (Figs 2 & 3)

Type host: *Hemicbromis fasciatus* Peters, 1858.

Site: gills.

Type locality: Kounougou River (Ivory Coast).

Other records: also found on the same host in Grand Lahou Lagoon (Ivory Coast), in Gambia River at Nio-

Fig. 2. – *Ciclidogyrus sanseoi* n. sp. haptoral sclerites.

DB = dorsal transverse bar; DG = dorsal gripus; VB = ventral transverse bar; VG = ventral gripus; I to VII = uncinuli. Bar = 30 μ m.

Fig. 3. – *Ciclidogyrus sanseoi* n. sp. Copulatory organs.

Ap = accessory piece; MA = male apparatus; Pe = penis; Vg = vagina. Bar = 30 μ m.

kolokoba National Park (Senegal), and in Niger River at Selingue (Mali).

Material studied: 30 individuals.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 236HG, TI 233. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 236HG, TI 233 bis; and at the Natural History Museum (London): n° 2004.9.15.14-15.

Adults: 564 ± 78.6 (415-775) long, 92 ± 10.6 (72-122) wide at level of vagina. Dorsal gripus with root three times shorter than shaft, blade arched at distal end: $a = 40 \pm 1.2$ (37-42), $b = 26 \pm 0.9$ (24-28), $c = 6 \pm 0.9$ (4-7), $d = 16 \pm 11.1$ (13-18), $e = 12 \pm 0.8$ (10-14). Dorsal transverse bar: $x = 36 \pm 2.1$ (32-41), $y = 12 \pm 1.3$ (10-15), $w = 7 \pm 0.5$ (6-8), $h = 11 \pm 1.1$ (8-14). Ventral gripus, slightly heavier than dorsal, with root two times shorter than shaft, blade regularly arched: $a = 36 \pm 1.1$ (33-38), $b = 31 \pm 1.2$ (29-33), $c = 5 \pm 0.8$ (3-7), $d = 11 \pm 1$ (8-13), $e = 15 \pm 1.1$ (12-17). Ventral transverse bar arched: $x = 35 \pm 1.6$ (32-39), $w = 5 \pm 0.3$ (4-5). Uncinuli I large = 32 ± 1.4 (28-36) long, II = 11 ± 0.4 (10-12) long, III = 19 ± 0.9 (17-22) long, IV = 21 ± 1.1 (18-24) long, V = 27 ± 0.8 (25-29) long, VI = 22 ± 1.1 (18-23) long, VII = 19 ± 0.7 (17-21) long. Penis, beginning in spherical bulb without heel, extremely long (more than twice the total body length): $Pe = 1418 \pm 98.3$ (1288-1625), spirally coiled around accessory piece, likewise spiral shaped ending with a straight portion: $Ap = 213 \pm 16.4$ (165-245). Vagina in four por-

Fig. 4. – *Cichlidogyrus teugelsi* n. sp.

Ap = accessory piece; DB = dorsal transverse bar; DG = dorsal gripus; MA = male apparatus; Pe = penis; VB = ventral transverse bar; VG = ventral gripus; Vg = vagina; I to VII = uncinuli. Bar = 30 μ m.

tions, from the aperture: simple tube followed by spiral (double pitch), then another simple straight portion ending in a second spiral (simple pitch), it was felt that no viable measurement could be done on this very complex vagina.

Comments

This species is characterised by the spiral shape of the penis. Only few *Cichlidogyrus* present this particularity, even though the same shape for the penis can be found in other genera of Monogenea (e.g. *Annulotrema spiropenis* Paperna, 1969; *Thaparocleidus euzeti* Pariselle *et al.*, 2002); these are *C. arthracanthus* Paperna, 1960 described on *Tristamella simonis* (Günther, 1864), *C. euzeti* and *C. longicirrus* both from *Hemichromis fasciatus*. It can be easily distinguished from all these species by the length of the penis and the number of turns: 130 μ m and one to two turns for *C. arthracanthus*¹; 375–390 μ m and four to five turns for *C. euzeti*; 400–500 μ m and eight to nine turns for *C. longicirrus* vs. 1288–1625 μ m; and 14 to 15 turns for *C. sanseoi* n. sp.

The name *Cichlidogyrus sanseoi* n. sp. is given for François Sanseo, technician from IRD (ex-ORSTOM) who helped us in collecting material.

CICHLIDOGYRUS TEUGELSI N. SP. (Fig. 4)

Type host: *Hemichromis fasciatus* Peters, 1858.

Site: gills.

Type locality: Kounougou River (Ivory Coast).

Other records: also found, on the same host, in a little river at Adiopodoumé, Km 17 Dabou Road (Ivory Coast), in Gambia River at Niokolokoba National Park (Senegal), in Niger River at Selingue (Mali).

Material studied: 30 individuals.

Type material: holotype deposited at the Muséum National d'Histoire Naturelle (Paris): n° 237HG, TI 234. Paratypes deposited at the Muséum National d'Histoire Naturelle (Paris): n° 237HG, TI 234 bis; and at the Natural History Museum (London): n° 2004.9.15.12-13.

Adults: 528 $\pm$ 55.9 (403–605) long, 86 $\pm$ 9.6 (68–100) wide at level of vagina. Dorsal gripus with root three times shorter than shaft, blade arched at distal end: a = 41 $\pm$ 1.6 (35–45), b = 27 $\pm$ 1.2 (25–31), c = 5 $\pm$ 0.9 (3–7), d = 17 $\pm$ 1.7 (12–20), e = 11 $\pm$ 0.7 (10–13). Dorsal transverse bar: x = 35 $\pm$ 1.7 (32–38), y = 12 $\pm$ 1 (10–13), w = 8 $\pm$ 0.9 (7–10), h = 11 $\pm$ 1.2 (8–14). Ventral gripus, slightly heavier than dorsal: a = 36 $\pm$ 1.1 (33–38), b = 31 $\pm$ 1.4 (29–34), c = 5 $\pm$ 1 (3–7), d = 11 $\pm$ 1.5 (8–14), e = 15 $\pm$ 1.2 (12–17). Ventral transverse bar arched: x = 34 $\pm$ 2.7 (31–39), w = 6 $\pm$ 0.5 (4–7). Large uncinulus I = 31 $\pm$ 1.6 (28–37) long, uncinulus II = 10 $\pm$

¹ According to the drawing in Ergens, 1981, p. 206.

0.5 (9-12) long, III = 18 ± 1.2 (17-23) long, IV = 20 ± 1.5 (18-25) long, V = 24 ± 1.2 (21-29) long, VI = 21 ± 1.1 (19-23) long, VII = 18 ± 0.8 (16-20) long. G-shaped penis, beginning in sub-spherical bulb with irregular heel: Pe = 99 ± 4.3 (90-111). The accessory piece, linked to the junction between heel and basal bulb, is made of two parts: a large sclerotised extremity with a large semi-circular expansion, and a thin base with a moderate trapezoidal expansion: Ap = 74 ± 3.9 (69-87). The vagina is a narrow and sinuous tube, with a slightly sclerotized plate close to the aperture: V = 72 ± 7.2 (61-88), v = 3 ± 0.3 (3-4).

Comments

This parasite belongs to the group of *Cichlidogyrus* with large uncinulus I, short uncinuli III to VII and a long (between 60 and 150 μ m) non spirally coiled penis². This group includes *C. bychowskii* (Markevich, 1934) described on *Hemichromis bimaculatus*; *C. nandidae* Birgi & Lambert, 1986 described on *Polycentropsis abbreviata* Boulenger, 1901; *C. arfii* Pariselle & Euzet, 1995 described on *Pelmatochromis buettikoferi* (Steindachner, 1894); and *C. albareti* Pariselle & Euzet, 1998 described on *Tilapia brevimanus* Boulenger, 1911. The parasite herein described is easily distinguishable from all these species by the shape of the penis:

- from *C. arfii* and *C. albareti* (thin and G-shaped *vs* large and slightly sinuous or thin and slightly C-shaped).

- from *C. bychowskii* and *C. nandidae* (G-shaped *vs* looped).

The name *Cichlidogyrus teugelsi* n. sp. is given in memory of Dr. Guy Teugels, ichthyologist from the Musée Royal d'Afrique Centrale (Tervuren, Belgium) recently deceased and who provided a great deal of material from numerous locations in Africa.

DISCUSSION

The examination of geographical distribution of *Hemichromis fasciatus* gill Monogenea shows that two groups of species (*C. dageti*/*C. euzeti*/*C. longicirrus* and *C. sanseoi*/*C. teugelsi*, highlighted in Table I) are not present in all the host distribution area. The first one is only from Southern part, when the second one is only from Northern part, the limit seems to be the border between Ghana and Ivory Coast. Moreover, *C. longicirrus* (Southern distribution) is morphologically related to *C. sanseoi* (Northern distribution). This distribution pattern (i.e. disjunct areas) and morphological similarity of these two parasitic species

[as observed by Bilong Bilong & Euzet (1995) on two *Onchobdella* species (*O. spirocirra* and *O. bopeleti*) coming from two different but related host species (*Hemichromis fasciatus* and *H. bimaculatus*)] suggest a vicariant speciation between two isolated populations of parasites, thus of hosts. These data lead us to think that two closely related host species are both designated as *Hemichromis fasciatus*. The late G. Teugels (pers. comm.), ichthyologist from the Musée Royal de l'Afrique Centrale (Tervuren), supported the same hypothesis after morphological studies.

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