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New evidence of a lateral transfer of monogenean parasite between distant fish hosts in Lake Ossa, South Cameroon: the case of *Quadriacanthus euzeti* n. sp.

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Abstract

Species of the monogenean genus *Quadriacanthus* mainly infect fish belonging to the Siluriformes, especially the genera *Clarias*, *Heterobranchus* or *Bagrus*, and their host specificity is strict (oioxenous) or narrow (stenoxenous). An examination of the gills of 19 *Papyrocranus afer* from Lake Ossa, South Cameroon, revealed for the first time the presence of a species of *Quadriacanthus* from a fish host belonging to the Notopteridae. The morphology and the size of sclerotized parts of haptor and the male and female copulatory complexes suggest that this monogenean is a new species named *Quadriacanthus euzeti* n. sp. The fish genus *Papyrocranus* differs taxonomically from the usual fish hosts of *Quadriacanthus* and hence the presence of a species belonging to this genus on the gills of this host suggests the occurrence of a lateral transfer of *Quadriacanthus* from species belonging to *Clarias* or *Bagrus* which live sympatrically with *P. afer* in Lake Ossa.

Introduction

Fish belonging to the Notopteridae are represented in lower Guinea by two species, *Papyrocranus afer* (Günther, 1868) and *Xenomystus nigri* Günther, 1868 (Roberts, 1992; Paugy *et al*., 2003; Lavoué & Sullivan, 2004; Stiassny *et al*., 2007). In Cameroon, *P. afer* is reported in the basins of Sanaga, Cross, Meme and Wouri rivers while *X. nigri* is only known from the latter (Stiassny *et al*., 2007). Up until now, both species were declared free of monogenean parasites (Birgi, 1987). In a recent parasitological survey on monogenean fish parasites from Cameroon, the gills of *P. afer*, which were sampled in Lake Ossa (Sanaga River basin), unexpectedly revealed the presence of a new *Quadriacanthus* Paperna, 1961 species. In the present study we describe this monogenean species for the first time and its probable origin is discussed.

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Materials and methods

Collection and examination of fish hosts and monogeneans

Lake Ossa (3°45′–3°53′N; 9°58′–10°04′E, and 8 m above sea level) is located 20 km to the west of the city of Edéa and 30 km from the Atlantic Ocean (Kossoni, 2003). According to Wirrmann (1992), Wirrmann *et al.* (2001) and Kossoni (2003), Lake Ossa is in fact composed of several lakes, reaching a total surface of about 3800 ha. This system presents three main lakes: Mevia, which is located in the north, Ossa in the middle and Mwembe in the south. Ossa and Mevia, which are the two largest lakes,

communicate through a short channel, while Mwembe is isolated. In the south-eastern part, Lake Ossa and Lake Mwembe communicate with the Sanaga River by a sinuous outlet (fig. 1).

Specimens of *P. afer* ($n = 19$) were caught using hook-lines or gill-nets during the long dry season (December to February 2011). They were dissected immediately on the shore after fishing. The gill arches were isolated by two incisions, one ventral and another dorsal, then preserved in a 25-ml scintillation vial, and maintained at −15°C in a portable Engel fridge–freezer until examination. Each fish carcass was marked and kept in 10% formaldehyde. In the laboratory, monogenean parasites that were tenaciously attached to the gill filaments were first dislodged using an entomology needle mounted on a mandrel (Bilong Bilong, 1995), then transferred individually into a drop of ammonium picrate–glycerin (a mixture described by Malmberg, 1957) on a microscope slide. The preparations were covered with a cover slip and after 24 h they were sealed with Glyceel (made after Bates, 1997).

Morphometrics

The drawings of the sclerotized pieces of the haptor and of the copulatory complex were carried out using the camera lucida of a microscope Wild M.20 (Wild, Heerbrugg, Switzerland) and Corel Draw X4 software (ver 14.0.0.701; Corel Corporation, www.corel.com/); their measurements and numbering were carried out following Gussev (1962) modified by N'Douba *et al.* (1999) (fig. 2). These measurements are given in micrometres (μm) as follows: mean (minimum value–maximum value). Type specimens are deposited in the Royal Museum for Central Africa, Tervuren (RMCA); and the Muséum National d'Histoire Naturelle, Paris (MNHN) as indicated, remaining specimens have been kept in the collection of the Laboratoire de Parasitologie et d'Écologie, University of Yaoundé I, Yaoundé, Cameroon.

Results

Quadriacanthus euzeti *n. sp. Nack, Pariselle & Bilong Bilong*

Taxonomic summary

Type host. *Papyrocranus afer* (Günther, 1868).

Site. Gills.

Type locality. Lake Ossa, Cameroon (03°45′–03°53′N; 9°58′–10°04′E).

Type specimens. Holotype no. 37 782 and paratypes no. 37 783 RMCA; paratype no. HEL515 MNHN.

Material studied. Sixteen individual adult parasites

Parasitic indices. Number of fish infected = 14; prevalence = 73.7%; mean intensity = 8 (1–17).

Etymology. Named in honour of our mentor, the late Professor Louis Euzet.

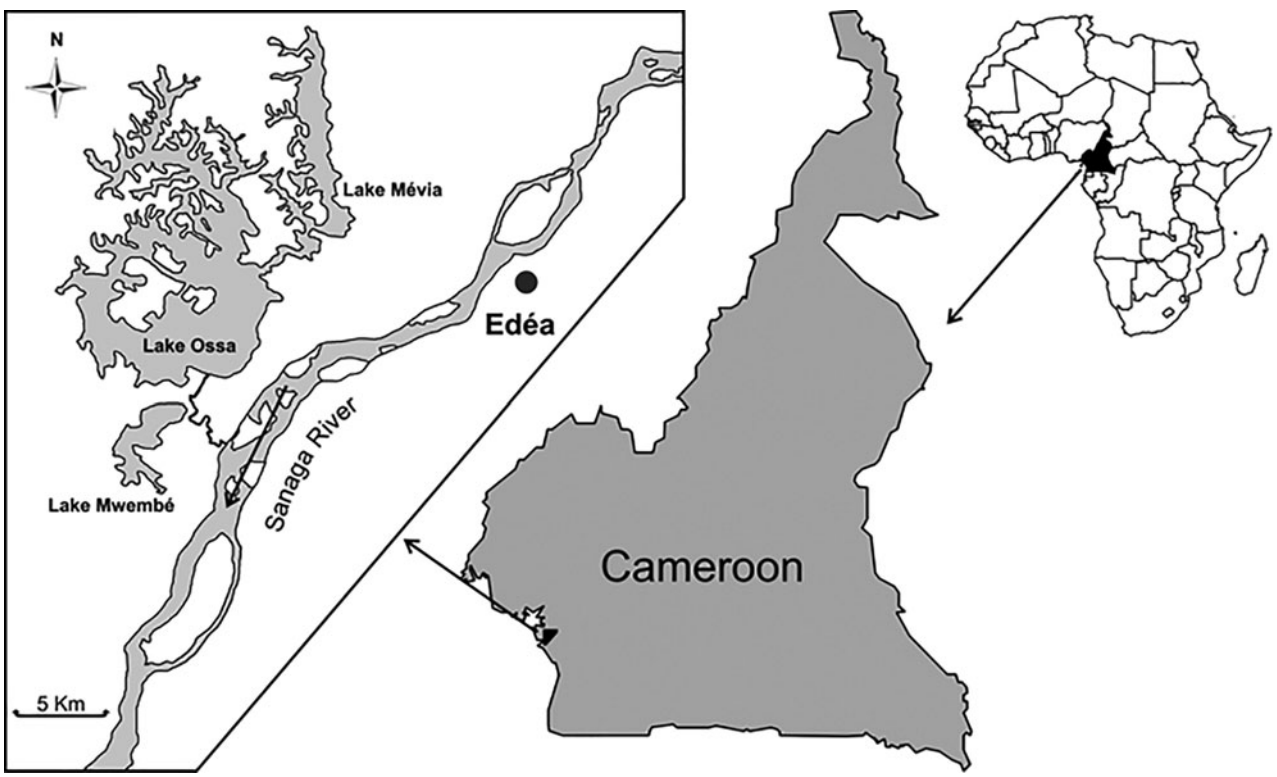

Fig. 1. Map to show the geographical location and hydrography of Lake Ossa.

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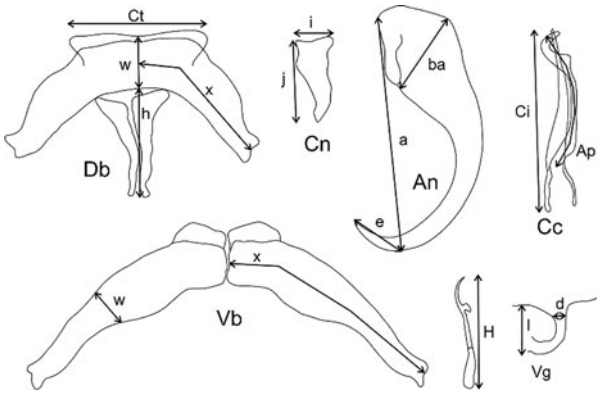

Fig. 2. Morphometrics of *Quadriacanthus* spp. used in this study are based on Gussev (1962) and modified by N'Douba *et al*. (1999). (An) Anchor: a, length; ba, base width; e, point length; (Cc) copulatory complex: Ap, accessory piece length; Ci, cirrus length; (Cn) cuneus: i, width; j, length; (Db) dorsal bar: Ct, centre length; h, median process length; w, width; x, length; (H) hooklet length; (Vb) ventral bar: w, width; x, length; (Vg) vagina: l, length; d, diameter.

Description

The anatomy of this ancyrocephalid parasite corresponds to the diagnosis of *Quadriacanthus* given by Paperna (1961) and amended by Kritsky & Kulo (1988): body divisible into cephalic region, trunk, peduncle, haptor. Tegument thin, smooth. Two bilateral, terminal cephalic lobes; four pairs of head organs; cephalic glands unicellular, comprising two bilateral groups posterolateral to pharynx. Ocellae present or absent; granules usually scattered in cephalic area, anterior trunk. Mouth subterminal, midventral; pharynx muscular, glandular; oesophagus short; two intestinal caeca, confluent posterior to gonads. Gonads intercaecal, overlapping; testis dorsal to ovary. Vas deferens looping left intestinal caecum; seminal vesicle a dilation of vas deferens, lying diagonally to left of midline in anterior trunk; two prostatic reservoirs, one C-shaped, wrapping around second. Copulatory complex comprising basally articulated cirrus, accessory piece. Oviduct short; uterus delicate; vagina sinistral; seminal receptacle intercaecal, ventral to anterior end of ovary; vitellaria well developed, dispersed in two bilateral bands coextensive with intestinal caeca; common vitelline duct anterior to seminal receptacle. Haptor armed with dorsal and ventral pairs of anchors, dorsal and ventral bars, posterior muscular pad between bars, 14 pairs of hooklets with ancyrocephaline distribution. Anchors with cuneus; ventral bar comprising two components articulating medially; dorsal bar with bilateral arms, expanded midregion. Hooklets pair IV with elongate dilated proximal shank; pairs I and III usually with short proximal dilation of shank; pairs II, V, VI and VII lacking dilated shank. Parasites of siluriform fish of Africa and Asia. Type species, host and locality: *Quadriacanthus clariadis* Paperna, 1961, from *Clarias lazera* Cuvier and Valenciennes, Lake Galilee, Israel.

Adults of *Q. euzeti* (figs 3 and 4) measure 630 (560–700) total length, haptor included, and 81.7 (70–90) width at the level of ovary. No ocelles, but many pigmented granules dispersed on the border of the pharynx measuring 37.5 (35–40) in diameter. Haptor wider than the rest of the body, 90 (80–100) in length and 100 (90–110) in width, armed with: four anchors (two dorsal and two ventral) each of them with a triangular cuneus and a thick filament, two transverse bars (one dorsal and one ventral). Dorsal anchors without differentiated guard and shaft, thick curved blade: a, 50.5 (49–53); ba, 14.6 (13–16); e, 9.4 (8–11). Cuneus: i, 8 (7–9); j, 18.2 (17–20). Dorsal transverse bar – a main piece (widely open V) associated with a posterior funnel-shaped sclerite and an anteriorly overlapping trapezoidal piece: Ct, 23 (22–24); x, 32.3 (31–33); w, 15 (14–16); h, 24 (22–27). Ventral anchors smaller than dorsal ones: a, 37.5 (33–40); ba, 12 (10–13); e, 13.7 (11–14). Cuneus: I, 4.5 (4–5); j, 11 (10–12). Ventral transverse bar formed of two articulated equal components: x, 53 (52–54); w, 11.5 (10–13). Fourteen hooklets arranged in seven symmetrical pairs are all similar, except those from the second and the fourth pairs, which are smaller (larval size) and larger, respectively. Hooklet pair I, 16.5 (16–17); II, 13.5 (13–14); III, 16.5 (16–17); IV, 24.5 (23–27); V, 16.5 (16–17); VI, 16.5 (16–17); VII, 16.5 (16–17). Tubular cirrus with flared base: Ci, 38 (36–40). Accessory piece attached to the base of the cirrus, ending with a distal hook: Ap, 27 (25–28). Short and funnel-shaped sclerotized vagina only observed in 10 individuals: l, 17 (16–18); d, 2.5 (2–3).

Differential diagnosis

Among the species of *Quadriacanthus* already described, *Quadriacanthus euzeti* n. sp. is close to *Q. levequei* Birgi, 1988 and *Q. nyongensis* Birgi, 1988, based on the morphology of the male copulatory complex. However, it is distinguished from these two species by the size of the sclerotized pieces of haptor and/or copulatory complex, of the hooklets, of the ventral and dorsal anchors, and of the ventral and dorsal transverse

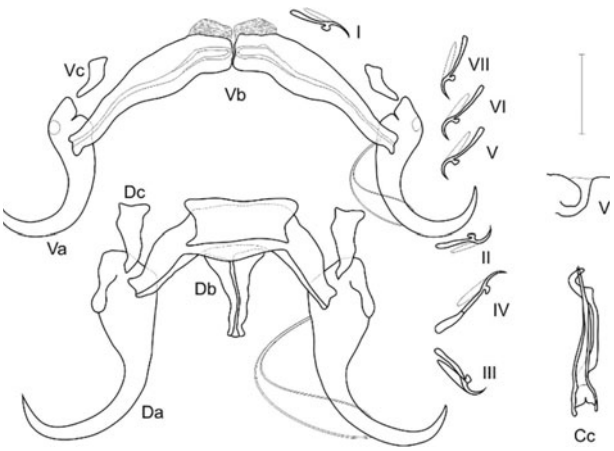

Fig. 3. Sclerotized parts of *Quadriacanthus euzeti* n. sp. Nack, Pariselle & Bilong Bilong: Cc, copulatory complex; Da, dorsal anchor; Db, dorsal bar; Dc, dorsal cuneus; I–VII, hooklets; Va, ventral anchor; Vb, ventral bar; Vc, ventral cuneus; Vg, vagina. Scale bar = 20 μm.

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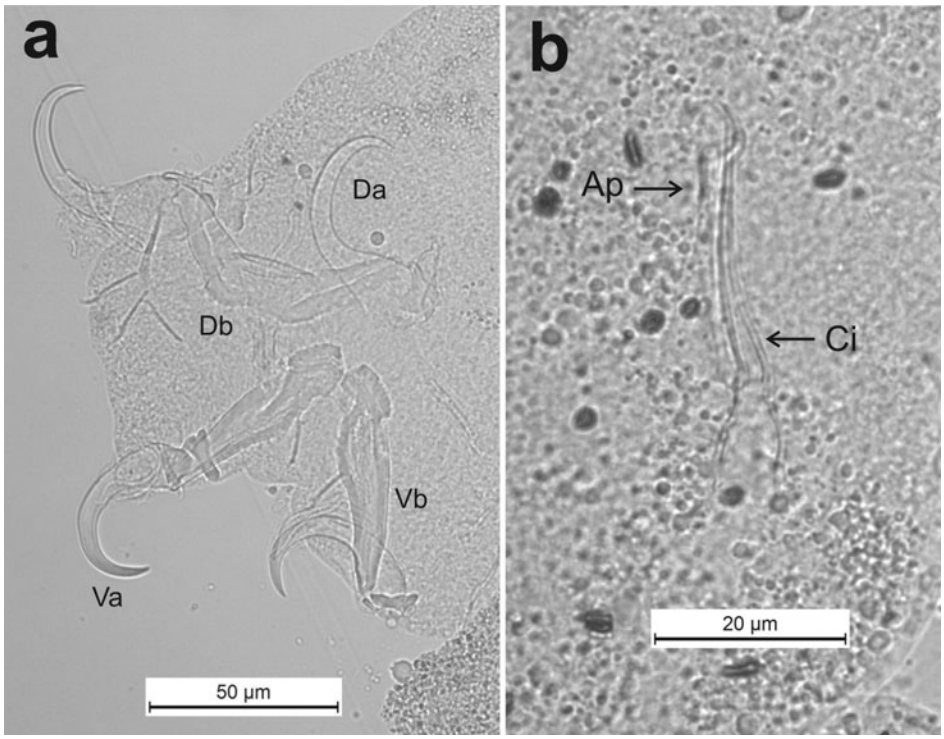

Fig. 4. Photomicrographs of hard parts of *Quadriacanthus euzeti* n. sp. (a) Haptor: Da, dorsal anchor; Db, dorsal bar; Va, ventral anchor; Vb, ventral bar; (b) copulatory complex: Ap, accessory piece; Ci, cirrus.

bars, which are all generally smaller than in either of these two species (Birgi, 1988). These observations allow us to assert that the parasite of *P. afer* is a new species.

Discussion

Before the finding and description of this new monogenean species, all *Quadriacanthus* species were reported only from Siluriformes and Perciformes hosts. Among Siluriformes, these parasites infect fish belonging to *Bagrus* Bosc, 1816 (Bagridae) (Paperna, 1979), *Clarias* and *Heterobranchus* (Clariidae) (Paperna, 1979; Shotter, 1980; Long, 1981; El-Naggar & Serag, 1986; Birgi, 1988; Kristky & Kulo, 1988; Douëllou & Chishawa, 1995; N'Douba *et al*., 1999; N'Douba & Lambert, 2001). Among Perciformes, Paperna (1973, 1979) noticed the presence of *Q. tilapiae* Paperna, 1973 on *Tilapia esculenta* (syn. *Oreochromis esculenta*) (Cichlidae); this could be the result of sample contamination, as this is the only report of a *Quadriacanthus* specimen on a cichlid host. The description of *Q. euzeti* n. sp. from *P. afer*: (1) broadens the host spectrum of *Quadriacanthus* to a new family (Notopteridae) and a new order (Osteoglossiformes); and (2) leads us to consider this parasitism as the result of a lateral transfer from Clariidae or Bagridae host species, since in Lake Ossa these fish live in sympatry with *P. afer* (Vivien, 1991; Roberts, 1992; Stiassny *et al.*, 2007). This recent or ancient lateral transfer could have been promoted by ecological and ethological changes (Combes, 1990; Bilong Bilong, 1995). For instance, in the same environment, a species of *Scutogyrus* Pariselle & Euzet, 1995, another genus of monogenean parasites usually recognized as specific to the mouthbreeder cichlid fish assigned to *Oreochromis* Günther, 1889 and *Sarotherodon* Rüppel, 1852, has recently and unexpectedly been described from *Tilapia* (*Coptodon*) *mariae* (Pariselle *et al.*, 2013). The second species of Notopteridae reported in Cameroon, *X. nigri*, is rare (Vivien, 1991) and was not captured during our research to reveal whether or not it hosts monogenean parasites.

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Conflict of interest

None.

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