ABSTRACT. – Host specimens were sampled in the River Sanaga (Cameroon) from January to October 2014 and August 2015. Three new species, ProtoanCylodiscoides sanagaensis n. sp., ProtoanCylodiscoides valentini n. sp. from Chrysichthys nigrodigitatus and Chrysichthys longidorsalis in the middle course and downstream, ProtoanCylodiscoides spirovagina n. sp. from Chrysichthys nigrodigitatus downstream, are herein described. These new helminths differ from the congeneric species by the size of the haptor sclerites, the male copulatory organ and the morphology of the vagina.

INTRODUCTION

As part of general duty, we here studied the monogenean parasites of the freshwater fish, Chrysichthys nigrodigitatus (Lacepède) and Chrysichthys longidorsalis Risch & Thys van den Audenaerde. Chrysichthys nigrodigitatus is known in several Western and Central African countries (Angola, Benin, Ivory Coast, Cameroon (Sanaga and Benoué Rivers), Egypt, Gabon, Gambia, Ghana, Mali, Senegal, Sierra Leone, Chad and Togo), while C. longidorsalis is endemic to the upper and middle course of the Sanaga River (Geerinckx et al. 2007). In this watercourse, both species are morphologically related (Geerinckx et al. 2007). A third congeneric one (C. auratus Geoffroy Saint-Hilaire) also lives in Cameroon (Sanaga River), its monogenean parasites have already been described (Bassock Bayiha et al. 2016). The species assigned to Chrysichthys are highly appreciated by local populations, which may explain their intense exploitation that threatened the stocks (Lalèyé 1995). Chrysichthys longidorsalis, considered as a particularly endangered species, has recently been classified as “vulnerable” in the IUCN Red List (Moelants 2010). The species belonging to Chrysichthys generally reach sufficient maximum sizes to be attractive for fish farming, for example, C. nigrodigitatus and C. longidorsalis have the observed maximum sizes of 290 mm SL and 205 mm SL respectively (Geerinckx et al. 2007). This interest is confirmed for C. nigrodigitatus and C. maurus (Valenciennes) which are already subject of intensive fish farming in Ivory Coast (Hem 1986, Otémé et al. 1996). In farming conditions parasitism, including that due to monogeneans, can affect host’s growth and reproduction (Paperna 1963, 1964) and may even cause the death of fish (Obiekezie et al. 1988, Okaeme et al. 1988). In fact, increase of fish population densities in facilities make easier the propagation and/or transfer of parasite on unusual hosts (Euzet & Pariselle 1996). To prevent infections, Bilong Bilong (1986) recommended that specific studies should be conducted on the parasite faunas of indigenous fish species before any proposed domestication. Also, to prevent transfers of introduced parasites, which are often more pathogen, Trewavas (1982) and Bilong Bilong (1995) recommend the use of native rather than allochtonous species for domestication. Chrysichthys nigrodigitatus has been the subject of only few parasitic studies in Africa, as was the case for the monogenean gill parasites of Chrysichthys spp. The first work, by Paperna (1969), was carried out in Ghana with the description of ProtoanCylodiscoides chrysichthys Paperna, 1969 on the gills of C. nigrodigitatus. El-Naggar (1987) described in Egypt, in the Nile River ProtoanCylodiscoides mansourensis El-Naggar, 1987 on C. auratus. The authors of the third study described in Cameroon, on the same host in the Sanaga River, ProtoanCylodiscoides auratum Bassock Bayiha, Nack & Pariselle, 2016 and ProtoanCylodiscoides combesi Bassock Bayiha, Nack & Pariselle, 2016. Seven other species belonging to this genus have been reported (but not published): ProtoanCylodiscoides sinonchium from C. nigrodigitatus by Dossou (Doctoral thesis 1985); ProtoanCylodiscoides sp. 1 from C. auratus, C. maurus
and *C. nigrodigitatus*; *Protoancylodiscoides* sp. 2 from *C. maurus* and *C. nigrodigitatus*, and *Protoancylodiscoides* sp. 3 from *C. nigrodigitatus* by Euzet et al. (1989); *Protoancylodiscoides* CD from *C. nigrodigitatus*, *Protoancylodiscoides* AE from *C. nigrodigitatus* and *C. maurus*, *Protoancylodiscoides* P* from *C. maurus* by N’Douba (Doctoral thesis 2000). Two other species have been described from host species belonging to Malapteruridae (Siluriformes): *Protoancylodiscoides malapteruri* Bilong Bilong, Birgi & Le Brun, 1997 and *Protoancylodiscoides* katii N’Douba & Lambert, 1999 both from Malapterurus electricus (Gmelin) (see Bassock Bayiha et al. 2016). *Protoancylodiscoides* CD has been recognized in this study and renamed *Protoancylodiscoides valentini* n. sp. This species and two other species described in this study are considered new to science.

**MATERIAL AND METHODS**

The number of host specimens examined was 45 *Chrysichthys nigrodigitatus* (29 from the middle course and 16 down stream Sanaga) and 9 *C. longidorsalis* (only from the middle course of the Sanaga River). The sampling sites selected were Belabo, Nanga-Eboko, Mbandjock and Nachtigal Falls upstream, and Edéa downstream (Fig. 1). Fish were caught using gillnets from January to October 2014 and in August 2015. They were preserved in a portable deepfreezer (Engel-fridge), then transported to the laboratory for parasitic and host investigations. After thawing, gill arches were removed and placed in Petri dishes containing tap water. Monogeneans, attached on the gill filaments, were isolated under a stereomicroscope Wild Heerbrugg, using an entomology needle mounted on a mandrel, then placed between slide and cover slip in a drop of ammonium picrate glycerin (Malmberg 1957) following Bassock Bayiha et al. (2016). After 24 hours, the slide was sealed with Glyceel (Bates 1997). The morphological study of the haptoral and copulatory complex sclerotized parts was made under binocular microscope Leica DM 2500. Measurements, taken with LAS 3.6 software, are those defined by Gussev (1962) and modified by N’Douba (2000) (Fig. 2). They are given in micrometers (µm) and expressed as follows: mean (minimum-maximum, number of measurements). The drawings were made from photos refined through software Coral Draw X4 (ver 14.0.0.701; Corel Corporation, www.corel.com/). Haptoral parts were numbered as suggested by Llewellyn (1963) and adopted at ICOPA IV (Euzet & Prost 1981); to prevent confusion the numbering following Mizelle (1936) method is also given. Mean intensity and prevalence are defined after Bush et al. (1997). Types were deposited in the helminth collection of the Royal Museum for Central Africa (MRAC, Tervuren, Belgium). The authors of the new taxa are different from the authors of this paper: Article 50.1 and Recommendation 50A of the International Code of Zoological Nomenclature.

**RESULTS**

*Protoancylodiscoides sanagaensis* Bassock Bayiha, Nack & Pariselle (Fig. 3)

Type host: *Chrysichthys nigrodigitatus* (Lacepède).

Other host: *Chrysichthys longidorsalis* Risch & Thys van den Audenaerde.

Site: secondary gill lamellae.

Locality: Nachtigal (4°21’10.5”N; 11°37’34.9”E), Mbandjock (4°28’21.3”N; 11°53’5.7”E), Nanga-Eboko (4°44’36.4”N 12°25’41.9”E), Belabo (4°57’47.3”N; 13°17’36.1”E) and Edéa (3°47’43.25”N; 10°8’12.18”E).

Material studied: 25 individuals.

Number of hosts examined: 29 *C. nigrodigitatus* and 9 *C. longidorsalis*, the latter from middle Sanaga only.

Prevalence: 51.1 % in *C. nigrodigitatus*, 44.4 % in *C. longidorsalis*.
NEW SPECIES OF PROTOANCYLODISCOIDES FROM CHRYSICHTHYS SPP. IN CAMEROON

Mean intensity: 2.3 in *C. nigrodigitatus*, 1 in *C. longidorsalis*.
Specimens deposited: 1 holotype MRAC n° 37974 and 2 paratypes MRAC n° 37975; 3 paratypes MRAC n° 37976.
Etymology: the name *sanagaensis* refers to the River Sanaga where fish hosts were captured.

**Description**

The new species is assigned to *Protoancylodiscoides* Paperna, 1969 as diagnosed by N’Douba (2000). Dorsal anchors (DA) each with a thick and long guard (= outer or superficial root), a distal end thinner and curved outwardly, a shaft (= handle, inner or deep root) shorter, thinner than the guard, blade with a thick base, arcuate and ending with a thick tip; thick filament from the middle of the blade and covering the top of the tip. Dorsal transverse bar (DB) chevron shaped, slightly curved, with rounded extremities pierced with circular holes and each terminated by a small extension folded towards the anterior face of the bar. Ventral anchors smaller than dorsal, with a roughly triangular large base with fenestration; presence of a hull beginning at the anterior end of the handle and ending at the base of the blade; thick filament attached to the rear end of the hull; blade thinner than the dorsal...
Table I. – Measurements of *Protoancylodiscoides valentini* n. sp., *P. sanagaensis* n. sp., *P. spirovagina* n. sp and the three other species already described in the genus *Protoancylodiscoides* from *Chrysichthys* spp.

<table>
<thead>
<tr>
<th>Specific names</th>
<th><em>P. valentini</em></th>
<th><em>P. sanagaensis</em></th>
<th><em>P. spirovagina</em></th>
<th><em>P. mansourensis</em> in El-Naggar (1987)</th>
<th><em>P. auratum</em></th>
<th><em>P. combesi</em></th>
<th><em>P. chrysichthys</em> in Kritsky &amp; Kulo (1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hosts</td>
<td>C. nigrodigitatus/longidorsalis</td>
<td>C. nigrodigitatus/longidorsalis</td>
<td>C. nigrodigitatus/longidorsalis</td>
<td>C. auratus</td>
<td>C. auratus</td>
<td>C. auratus/longidorsalis</td>
<td>C. nigrodigitatus</td>
</tr>
<tr>
<td>Total length</td>
<td>756 (474-1194, n = 15)</td>
<td>1201 (591-1734, n = 25)</td>
<td>980 (755-1147, n = 21)</td>
<td>835 (710-1000)</td>
<td>764 (520-925, n = 21)</td>
<td>577 (390-872, n = 31)</td>
<td>637 (410-884, n = 29)</td>
</tr>
<tr>
<td>Total width</td>
<td>132 (83-165, n = 15)</td>
<td>159 (82-248, n = 25)</td>
<td>154 (98-241, n = 15)</td>
<td>99 (79-140, n = 29)</td>
<td>126 (84-171, n = 21)</td>
<td>114 (83-184, n = 31)</td>
<td>90 (73-115, n = 33)</td>
</tr>
<tr>
<td>Haptoral length</td>
<td>133 (94-192, n = 15)</td>
<td>176 (125-271, n = 15)</td>
<td>176 (89-265, n = 15)</td>
<td>94 (74-127, n = 23)</td>
<td>147 (99-194, n = 21)</td>
<td>21 (87-179, n = 31)</td>
<td></td>
</tr>
<tr>
<td>Haptoral width</td>
<td>133 (94-192, n = 15)</td>
<td>176 (125-271, n = 15)</td>
<td>176 (89-265, n = 15)</td>
<td>94 (74-127, n = 23)</td>
<td>147 (99-194, n = 21)</td>
<td>21 (87-179, n = 31)</td>
<td></td>
</tr>
<tr>
<td>Pharyngeal diameter</td>
<td>38 (29-50, n = 13)</td>
<td>59 (38-77, n = 15)</td>
<td>76 (48-94, n = 13)</td>
<td>30 (23-43, n = 35)</td>
<td>54 (30-64, n = 21)</td>
<td>32 (22-63, n = 31)</td>
<td></td>
</tr>
<tr>
<td>Peduncle length</td>
<td>15 (11-21, n = 15)</td>
<td>19 (11-30, n = 15)</td>
<td>17 (12-27, n = 15)</td>
<td>30 (23-43, n = 35)</td>
<td>11 (7-17, n = 21)</td>
<td>12 (7-25, n = 31)</td>
<td></td>
</tr>
<tr>
<td>Dorsal anchor</td>
<td>a</td>
<td>82 (66-93, n = 30)</td>
<td>70 (70-82, n = 25)</td>
<td>70 (64-74, n = 22)</td>
<td>88 (81-93)</td>
<td>64 (56-70, n = 21)</td>
<td>66 (61-73, n = 31)</td>
</tr>
<tr>
<td>b</td>
<td>60 (49-69, n = 30)</td>
<td>56 (51-58, n = 25)</td>
<td>54 (49-59, n = 22)</td>
<td>64 (56-70, n = 21)</td>
<td>43 (39-49, n = 21)</td>
<td>50 (44-56, n = 31)</td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>6 (5-8, n = 30)</td>
<td>6 (5-13, n = 25)</td>
<td>6 (4-9, n = 22)</td>
<td>4 (4-5)</td>
<td>6 (4-9, n = 21)</td>
<td>6 (5-6, n = 31)</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>32 (23-41, n = 30)</td>
<td>34 (28-41, n = 25)</td>
<td>30 (27-34, n = 22)</td>
<td>28 (25-32)</td>
<td>27 (20-32, n = 21)</td>
<td>26 (22-29, n = 31)</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>15 (21-34, n = 30)</td>
<td>29 (23-34, n = 25)</td>
<td>26 (24-28, n = 22)</td>
<td>24 (22-25)</td>
<td>22 (18-25, n = 21)</td>
<td>23 (20-26, n = 31)</td>
<td></td>
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<tr>
<td>Dorsal transversal bar</td>
<td>x</td>
<td>44 (37-50, n = 30)</td>
<td>52 (48-57, n = 25)</td>
<td>48 (44-53, n = 22)</td>
<td>45 (40-48)</td>
<td>37 (33-43, n = 21)</td>
<td>37 (33-42, n = 31)</td>
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<tr>
<td>w</td>
<td>7 (6-9, n = 30)</td>
<td>7 (6-9, n = 25)</td>
<td>8 (6-9, n = 22)</td>
<td>5 (4-7, n = 21)</td>
<td>5 (4-7, n = 31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>36 (28-42, n = 30)</td>
<td>31 (30-33, n = 22)</td>
<td>30 (27-34, n = 22)</td>
<td>28 (25-32)</td>
<td>27 (20-32, n = 21)</td>
<td>26 (22-29, n = 31)</td>
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</tr>
<tr>
<td>c</td>
<td>7 (5-10, n = 30)</td>
<td>6 (8-12, n = 25)</td>
<td>7 (4-9, n = 22)</td>
<td>4 (3-5)</td>
<td>3 (2-4)</td>
<td>5 (3-7, n = 31)</td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>14 (10-19, n = 30)</td>
<td>15 (12-17, n = 25)</td>
<td>14 (11-18, n = 22)</td>
<td>17 (16-19)</td>
<td>11 (9-14, n = 21)</td>
<td>11 (9-13, n = 31)</td>
<td></td>
</tr>
<tr>
<td>e</td>
<td>21 (18-25, n = 30)</td>
<td>21 (18-26, n = 25)</td>
<td>20 (18-22, n = 22)</td>
<td>22 (19-24)</td>
<td>17 (14-19, n = 21)</td>
<td>19 (16-23, n = 31)</td>
<td></td>
</tr>
<tr>
<td>Ventral transversal bar</td>
<td>x</td>
<td>39 (34-44, n = 30)</td>
<td>41 (37-44, n = 25)</td>
<td>44 (41-47, n = 22)</td>
<td>41 (38-43)</td>
<td>36 (32-38, n = 21)</td>
<td>34 (29-38, n = 31)</td>
</tr>
<tr>
<td>w</td>
<td>6 (4-7, n = 30)</td>
<td>5 (4-6, n = 25)</td>
<td>6 (5-7, n = 22)</td>
<td>4 (3-5, n = 21)</td>
<td>4 (3-5, n = 31)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>II[V] (latoventral)</td>
<td>17 (15-20, n = 29)</td>
<td>18 (15-21, n = 23)</td>
<td>18 (15-20, n = 21)</td>
<td>14 (13-16)</td>
<td>17 (14-19, n = 17)</td>
<td>16 (15-18, n = 25)</td>
<td></td>
</tr>
<tr>
<td>V[IV] (lato-ventral)</td>
<td>15 (14-17, n = 30)</td>
<td>16 (15-17, n = 25)</td>
<td>16 (15-18, n = 22)</td>
<td>16 (14-17, n = 12)</td>
<td>16 (14-17, n = 21)</td>
<td>15 (13-16, n = 31)</td>
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</tr>
</tbody>
</table>
anchors ending with a shorter tip. Ventral transverse bar formed by two symmetrical rectilinear arms separated medially. Presence of 7 pairs of hooks of tree types according to their shape, size and position: latero-ventral hooks II [V], V [IV], VI [III], VII [II] of similar shape and size [i.e. thin, without shank (= distal subunit)], resembling those present in ancyrocephalid oncomiracidia (larval hook), corresponding to the proximal subunit (= handle + thumb + point) in Kritsky & Kulo (1999); medio-ventral hook pairs I [I] and IV [VII] enlarged with a thick and long shank; latero-dorsal hooks III [VI] with poorly developed shank. Presence of a longer than wider dorsal onchium. Copulatory complex formed by a tubular penis associated with a complex accessory piece, formed by two blades joined around a central structure. Vagina, sclerified in its basal part, more or less circular, ending in its distal portion by a clip-like structure.

The measurements of sclerotized parts of the haptor and reproductive system are given in Table I.

Remark

By the general morphology of sclerotized haptoral pieces and the male copulatory organ, *P. sanagaensis* n. sp. is close to the three congeneric species already described from *C. auratus* (*P. mansourensis*, *P. auratum* and *P. combesi*) and resembles *P. chrysichthes* described from *C. nigrodigitatus*. However it differs in the size of the dorsal anchor: 76(70-82) vs 88 (81-93), 64(61-73) and 64 (55-69) for *P. mansourensis*, *P. auratum*, *P. combesi* and *P. chrysichthes*, respectively. *Protoancylodiscoides sanagaensis* also differs from *P. chrysichthes* in the size of the dorsal bar 52 (48-57) vs 41 (34-46) and in the penis length (238 (202-330) vs 325 (302-347), 180 (141-217), 228 (132-299) and 255 (162-365)) for *P. mansourensis*, *P. auratum*, *P. combesi* and *P. chrysichthes*, respectively. The new species differs also from the above congeneric species by the morphology of the vaginal distal portion: it is relatively simple but flared in *P. mansourensis*, rectilinear in *P. combesi*, turned up and cup shaped in *P. auratum*, looped (1 turn) in *P. chrysichthes* and rectilinear but looped (> 1 turn) at its end portion in *P. sanagaensis*.

Protoancylodiscoides valentini *Bassock Bayiha, Nack & Pariselle* (Fig. 4)

Type host: *Chrysichthys nigrodigitatus* (Lacepède).

Other host: *Chrysichthys longidorsalis* Risch & Thys van den Audenaerde.

Site: secondary gill lamellae.

Locality: Nachtigal (4°21’10.5”N; 11°37’34.9”E), Mbandjock (4°28’21.3”N; 11°53’5.7”E), Nanga-Eboko (4°44’36.4”N; 12°25’41.9”E), Belabo (4°57’47.3”N; 13°17’36.1”E) and Edéa (3°47’43.2”N; 10°8’12.18”E).

Material studied: 30 individuals.

**Table I.** – Continued.

<table>
<thead>
<tr>
<th>Specific names</th>
<th>Hosts</th>
<th>Specific names</th>
<th>Hosts</th>
<th>Specific names</th>
<th>Hosts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>P. valentini</em></td>
<td><em>C. nigrodigitatus</em></td>
<td><em>C. longidorsalis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. sanagaensis</em></td>
<td><em>C. auratus</em></td>
<td><em>C. nigrodigitatus</em></td>
<td><em>C. longidorsalis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. mansourensis</em></td>
<td><em>C. auratus</em></td>
<td><em>C. nigrodigitatus</em></td>
<td><em>C. longidorsalis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. combesi</em></td>
<td><em>C. nigrodigitatus</em></td>
<td><em>C. longidorsalis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>P. chrysichthes</em></td>
<td><em>C. nigrodigitatus</em></td>
<td><em>C. longidorsalis</em></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurements</th>
<th>Unit</th>
<th><em>P. valentini</em></th>
<th><em>P. sanagaensis</em></th>
<th><em>P. mansourensis</em></th>
<th><em>P. auratum</em></th>
<th><em>P. combesi</em></th>
<th><em>P. chrysichthes</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ventral transverse bar</td>
<td>cm</td>
<td>15 (14-17, n = 31)</td>
<td>16 (15-17, n = 22)</td>
<td>16 (15-17, n = 22)</td>
<td>16 (15-17, n = 22)</td>
<td>16 (15-17, n = 22)</td>
<td>16 (15-17, n = 22)</td>
</tr>
<tr>
<td>Medio-dorsal onchium</td>
<td>cm</td>
<td>29 (24-34, n = 30)</td>
<td>32 (28-38, n = 30)</td>
<td>32 (28-38, n = 30)</td>
<td>32 (28-38, n = 30)</td>
<td>32 (28-38, n = 30)</td>
<td>32 (28-38, n = 30)</td>
</tr>
<tr>
<td>Diameter of vagina</td>
<td>cm</td>
<td>228 (202-330, n = 23)</td>
<td>255 (162-365, n = 5)</td>
<td>255 (162-365, n = 5)</td>
<td>255 (162-365, n = 5)</td>
<td>255 (162-365, n = 5)</td>
<td>255 (162-365, n = 5)</td>
</tr>
</tbody>
</table>

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Number of host examined: 29 *C. nigrodigitatus* and 9 *C. longidorsalis*, the latter from middle Sanaga only.

Prevalence: 66.6 % in *C. nigrodigitatus*, 88.8 % in *C. longidorsalis*.

Mean intensity: 3.2 in *C. nigrodigitatus*, 5.3 in *C. longidorsalis*.

Specimens deposited: 1 holotype MRAC n° 37977 and 3 Paratypes MRAC n° 37978; 6 paratypes MRAC n° 37979.

Etymology: the name *valentini* is given in honour of Pr Valentin N'Douba who first described this species in his Doctoral thesis.

**Description**

Dorsal anchors (DA) with a thick and long guard, bent outwardly at the distal end, very short handle; arched base blade terminated by a point. Thick filament covering the top of the tip. Dorsal transverse bar (DB) chevron-shaped slightly curved with rounded ends drilled by circular holes. Ventral anchors smaller than the dorsal, each with a short narrow handle and developed guard. Presence of an eccentric orifice at the base of each ventral anchor, of a hull and of a thick filament slightly sclerotised. V-shaped ventral transverse bar consists of two joined arms. Presence of 7 pairs of haptoral hooks similar to those described in *P. sanagaensis* n. sp. Presence of a dorsal onchium. Copulatory complex formed by a tubular and long penis, halfway curled. The vagina is coiled at the base and ends in a funnel portion.

The measurements of the haptoral sclerified parts and reproductive system are reported in Table I.

**Remark**

By the morphology of the sclerotized parts of the haptor and the penis accessory piece *Protoanlylodiscoïdes valentini* n. sp. is close to the four species already described from *Chrysichthys* spp. (*P. mansourensis*, *P. chrysichthes*, *P. auratum* and *P. combesi*). However, it is distinguishable by the size of the dorsal anchor 82 (66-93) vs 64(56-70), 66(61-73) and 64(55-69) for *P. auratum*, *P. combesi* and *P. chrysichthes*, respectively, by the penis length 482 (336-581) vs 238 (202-330), 325 (302-347), 180 (141-217), 228 (131-299) and 255 (162-365) for *P. sanagaensis*, *P. mansourensis*, *P. auratum*, *P. combesi* and *P. chrysichthes*, respectively, and by the morphology of the vagina which is coiled at the proximal end for *P. valentini* (3 to 4 turns, 15 to 20 μm in diameter), while that of *P. mansourensis* has 4-5 turns (24-27 μm in diameter), 2 to 3 turns in *P. combesi* (10 to 13 μm in diameter), *P. auratum* (8 to 12 μm in diameter) and *P. chrysichthes* (13 to 20 μm in diameter). One can also note large differences in the distal portion of the vagina, which is rectilinear and sclerotized in *P. valentini* n. sp., simple but flared in *P. mansourensis*, looped in *P. chrysichthes*, straight in *P. combesi* and turned up and cup shaped in *P. auratum*.

*Protoanlylodiscoïdes spirovagina Bassock Bayiha, Nack & Pariselle* (Fig. 5)

Type host: *Chrysichthys nigrodigitatus* (Lacepède).
Site: secondary gill lamellae.
Locality: Edèa 3°47’43.25”N; 10°8’12.18”E.
Material studied: 22.
Number of host examined: 16 *C. nigrodigitatus* from downstream and 29 in the middle course of the Sanaga River.

**Fig. 4.** – *Protoanlylodiscoïdes valentini* n. sp. DB, dorsal bar; VB, ventral bar; DA, dorsal anchor; VA, ventral anchor; I to VII, haptoral hooks; DOon, dorsal onchium; AP, accessory piece; Pe, penis; Vg, vagina. Scale bar = 20 μm. WM, whole mount parasite. Scale bar = 200 μm.
NEW SPECIES OF PROTOANCYLODISCOIDES FROM CHRYSICHTHYS SPP. IN CAMEROON

Prevalence: 31 % downstream and 0 % in the middle course Sanaga.
Mean intensity: 3.2 downstream.
Specimens deposited: 1 holotype MRAC n° 37970 and 2 paratypes MRAC n° 37971; 2 paratypes MRAC n° 37972; 3 paratypes MRAC n° 37973.

Etymology: the name spirovagina refers to the spiral shape of the vagina.

Description

Dorsal anchors (DA) with a thick and long guard, at bent outwardly the distal end, short handle, arched blade, a thick filament. Dorsal bar (DB) chevron-shaped with extremities drilled with more or less circular holes. Ventral anchors smaller than the dorsal ones, with a narrow handle and developed guard. Presence of a more or less triangular fenestration at the base of each ventral anchor, of a hull and of a thick filament slightly sclerotized. Ventral bar V-shaped. Presence of 7 pairs of haptoral hooks similar to those described in P. sanagaensis n. sp. Presence of a longer than wide dorsal onchium. Male copulatory complex made up of a long tubular penis associated with a heavy sclerotized accessory piece. The vagina is coiled at its base and straight at its distal end.

The measurements of the sclerotized parts of haptor and reproductive system are reported in Table I.

Remark

By the general morphology of the haptor and the male copulatory complex Protoancolodiscoides spirovagina n. sp. is close to the three species described from C. auratus (P. mansourensis, P. auratum and P. combesi) and to P. chrysichthes from C. nigrodigitatus. However P. spirovagina n sp. differs from P. valentini n. sp. in the size of dorsal anchors 70 (64-74) vs 82 (66-93), from the other species (P. sanagaensis, P. mansourensis, P. auratum, P. combesi and P. chrysichthes) in the length of the penis (683 (536-805) vs 238 (202-330), 325 (302-347), 180 (141-217), 228 (131, 5-299) and 255 (162-365), respectively, and in the morphology of the vagina. The vagina in P. spirovagina n. sp. is spirally coiled with the form of barrel, unobservable character in any species of the genus Protoancolodiscoides. This leads us to consider that P. spirovagina n. sp. is new to science.

DISCUSSION

Monogenean gill parasites fauna of C. nigrodigitatus and C. longidorsalis from Sanaga River are the same (P. valentini n. sp. and P. sanagaensis n. sp.) with one exception (P. spirovagina n. sp.) which is found only in the estuarine population of C. nigrodigitatus.

The sharing of the same parasitic species by these two sympatric hosts suggest a close phylogenetic relationship between them, since Geerinckx et al. (2004) and Bitja Nyom (2015) note that C. nigrodigitatus resembles C. longidorsalis.

The presence of P. spirovagina n. sp. only from C. nigrodigitatus in the lower Sanaga (from Edéa to the estuary) and its absence in the same host species (and its congener C. longidorsalis) in the middle Sanaga could be explained by the presence of geographical/physical barriers (relatively high waterfalls) that would prevent the migration of fish upstream. Indeed, these natural barriers have recently been identified as major obstacles which explain the absence of diadromous fish migrations from lower to middle Sanaga (Bèche, unpubl data). With Protoancolodiscoides chrysichthes described in C. nigrodigitatus from Togo (Paperna 1969), the discovery of three other species of Protoancolodiscoides in Chrysichthys nigrodigitatus from Sanaga River currently brings up at
least to four the number of species of monogenean gill parasites found in this host.

The parasite species of *Protoanyclyodiscoides* are known to exhibit a wide host specificity among Siluriformes (Dossou 1985). A part from the Claroteidae species studied in this work, *Protoanyclyodiscoides* is found in *Malapterurus* spp. (Malapteruridae) from Lake Ossa (Littoral region, Cameroon). Zoologia 33(4): e20160044.

Bassock Bayiha ED, Nack J, Pariselle A, Bilong Bilong CF 2016. Two new species of gill parasites assigned to *Protoanyclyodiscoides* has never been found (Birgi 1988, Nack et al. 2005, Bilong Bilong et al. 2007, Nack et al. 2015, Bahana et al. 2016), which is also corroborated by the genetics study on the Siluriformes by Sullivan et al. (2006).

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NEW SPECIES OF PROTOANCYLODISCOIDES FROM CHRYSICHTHYS SPP. IN CAMEROON


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