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Research Note

New Metacestodes of Gryporhynchid Tapeworms (Cestoda: Cyclophyllidea) from Carp (*Cyprinus carpio* Linnaeus, 1758) from Mozambique, Africa

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ABSTRACT: Larvae of 2 species of gryporhynchid tapeworms (Cestoda: Cyclophyllidea) were found in common carp (*Cyprinus carpio* L.) from Mozambique, Africa. Metacestodes of *Parvitaenia samfyia* Mettrick, 1967, a species never reported since the original description of its adults from herons (Ardeidae) in Zambia were found in the intestinal wall, whereas larvae of an unidentified species of *Cyclusteria* Fuhrmann, 1901, closely resembling *Cyclusteria magna* (Baer, 1959), a species with larvae previously reported from *Tilapia zillii* (Gervais) in Africa, were encapsulated in the liver of carp. Larval stages of both gryporhynchids are reported from fish for the first time. The present findings of metacestodes in common carp provide evidence that this economically important fish, which is nonnative in Africa and was introduced for aquaculture, may become infected with larvae of native gryporhynchid cestodes. The morphology of both species is described and their rostellar hooks, which are crucial for species identification of metacestodes, are illustrated.

KEY WORDS: Helminths, cestodes, Gryporhynchidae, morphology, cyprinid fish, life cycle, zoogeography.

Fish-eating birds, such as herons, ibises, spoonbills (Ciconiiformes), cormorants (Phalacrocoraciformes), among others, harbor a high number of helminth parasites, including gryporhynchid tapeworms (Cestoda: Cyclophyllidea), previously placed in the Dilepididae (Bona, 1975, 1994). The life cycles of these cestodes are not well known, but field data, supported by a very few laboratory experiments (Jarecka, 1970a, b; Sysolyatina-Andakulova, 1979), indicate that freshwater and brackish-water fish serve as the second-intermediate hosts (Baer and Bona, 1960; Bona, 1975; Scholz et al., 2004).

Metacestodes from only 2 species have been reported from fish in Africa, namely *Amirthingamia*

macracantha (Joyeux and Baer, 1935) from the liver and intestinal wall of *Oreochromis niloticus* (Linnaeus) and *Tilapia zillii* (Perciformes: Cichlidae) from Kenya and Sudan, and *Cyclusteria magna* (Baer, 1959) from the intestinal wall of *T. zillii* from Kenya (Bray, 1974; Aloo, 2002; Scholz et al., 2004).

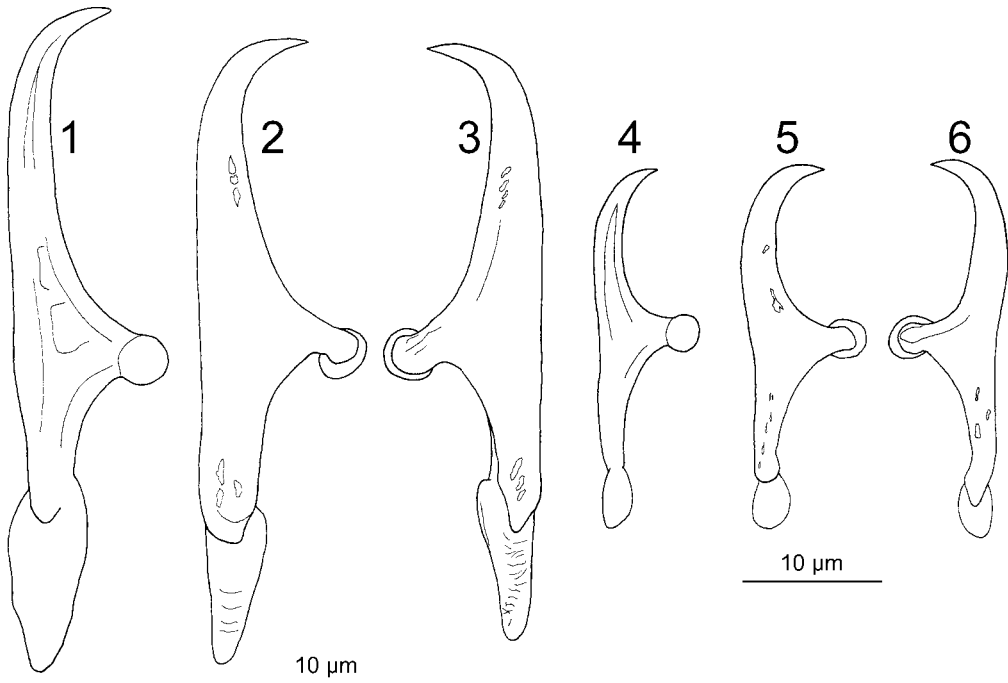
In addition, unidentified larvae, supposedly belonging to the Gryporhynchidae, have been reported from the intestinal wall and intestinal lumen of tilapias from Nigeria, Sudan, Uganda, and Zambia (Aderounmu and Adeniyi, 1972; Khalil and Thurston 1973; Batra, 1984; Ezeri, 2002). In the present account, metacestodes of 2 gryporhynchid tapeworms found in common carp (*Cyprinus carpio* L.) in Mozambique are reported for the first time.

Metacestodes

Parvitaenia samfyia Mettrick, 1967 (Figs. 1–6)

Description: (Measurements in micrometers; based on 10 unflattened specimens fixed with Berland's fluid, stained with carmine, and mounted as permanent preparations in Canada balsam); Metacestodes (merocercoids according to Chervy, 2002) elongate, 674–1,200 long by 151–333 wide, encapsulated individually or in groups of up to 11 larvae in intestinal wall mucosa. Scolex invaginated, with 4 suckers and well-developed rostellum armed with 20 hooks arranged in 2 circles, each of 10 hooks. Distal (larger) hooks (Figs. 2, 3; $N = 5$), 44–47 long; blade curved, 22.5–27 long, pointed in its terminal part; handle straight, 22–26 long (blade/handle ratio, 0.88:1.13); guard slightly directed posteriorly. Proximal (smaller) hooks (Figs. 5, 6; $N = 6$), 26–28.5 long; blade, 13–16 long, curved in its terminal part; handle straight, 14–17 long (blade/handle ratio 0.79:1.10); guard perpendicular to longitudinal axis of hooks.

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Figures 1–6. Hooks of *Parvitaenia samfya* Mettrick, 1967. **1.** Distal (larger) hook of adult (holotype) from *Ardea purpurea*, Zambia (modified from Bona, 1975). **2, 3.** Distal (larger) hooks of larvae from the intestinal wall of common carp (*Cyprinus carpio*), Mozambique. **4.** Proximal (smaller) hook of adult (holotype) from *Ardea purpurea*, Zambia (modified from Bona, 1975). **5, 6.** Proximal (smaller) hooks of larvae from the intestinal wall of common carp (*Cyprinus carpio*), Mozambique.

Deposition of specimens: The Natural History Museum (BMNH), London, U.K. (BMNH 2007.9.5.16–17); Helminthological Collection of the Institute of Parasitology (IPCAS), České Budějovice, Czech Republic (IPCAS C-469); U.S. National Parasite Collection (USNPC), Beltsville, Maryland (USNPC 100236).

Host: Common carp, *Cyprinus carpio* Linnaeus, 1758 (Cypriniformes: Cyprinidae).

Site: Intestinal wall.

Localities: River Limpopo and Lake Chuali, Mozambique (January/February and July/August of 2004 and 2005).

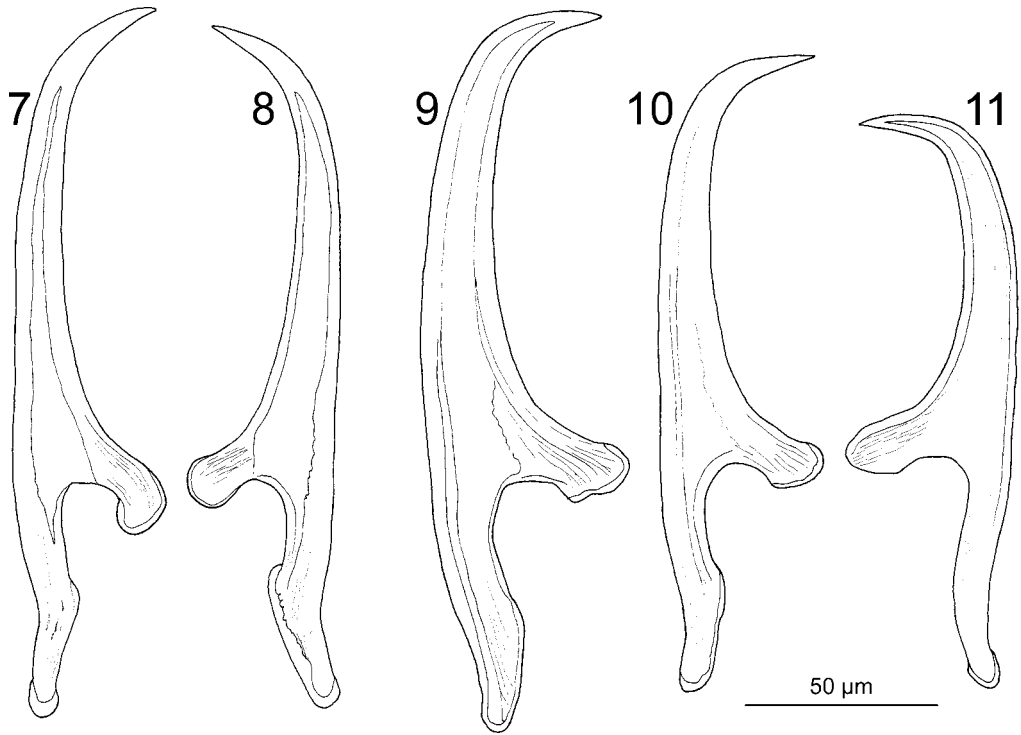
Prevalence, mean intensity, and range: River Limpopo: 22 of 201 fish infected (11%, 103, ± 101 1–600); Lake Chuali: 18 of 200 fish infected (9%, 31, ± 31 3–102). Infection rates were always higher in wet seasons.

Remarks: Metacestodes correspond in the morphology and size of their rostellar hooks to those of *Parvitaenia samfya*, a species described by Mettrick (1967) from 2 species of herons, *Ardea purpurea* L.

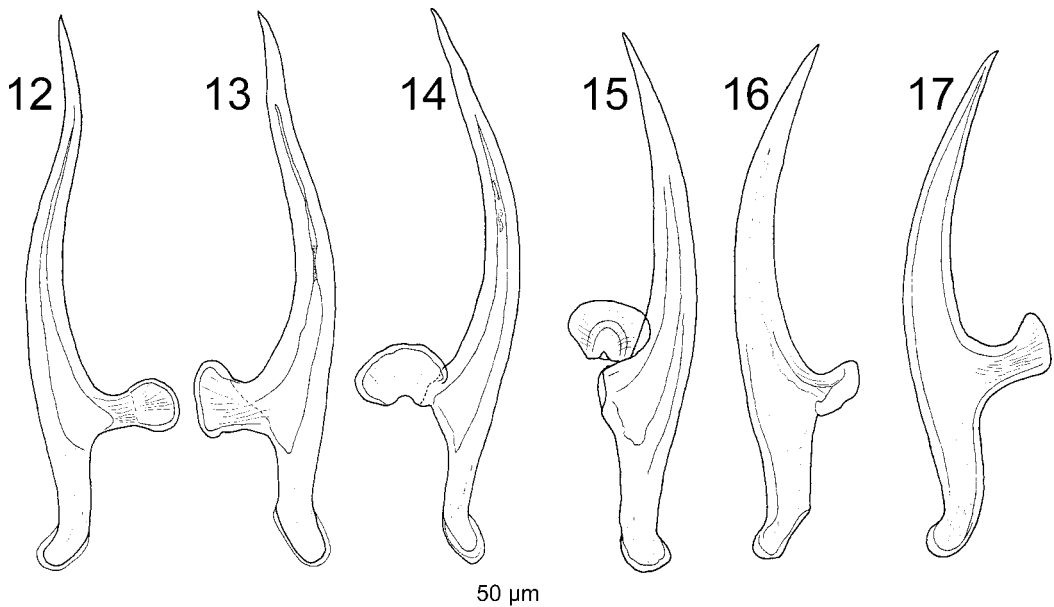
(type host) and *Ardeola ralloides* (Scopoli), from Zambia and then redescribed by Bona (1975). The larger and smaller hooks of adult tapeworms measured 46–48 μm (blade, 24–25; handle, 24; blade/handle ratio, 1.00:1.04) and 25.5:27.5 μm (blade, 11.5–13; handle, 15; blade/handle ratio, 0.77:0.87), respectively (Bona, 1975), and have identical shape (Figs. 1, 4). This is the first finding of larvae of *P. samfya*, the adults of which have never been found since its original description (Mettrick, 1967).

Metacestodes *Cyclustera* sp. (Figs. 7–21)

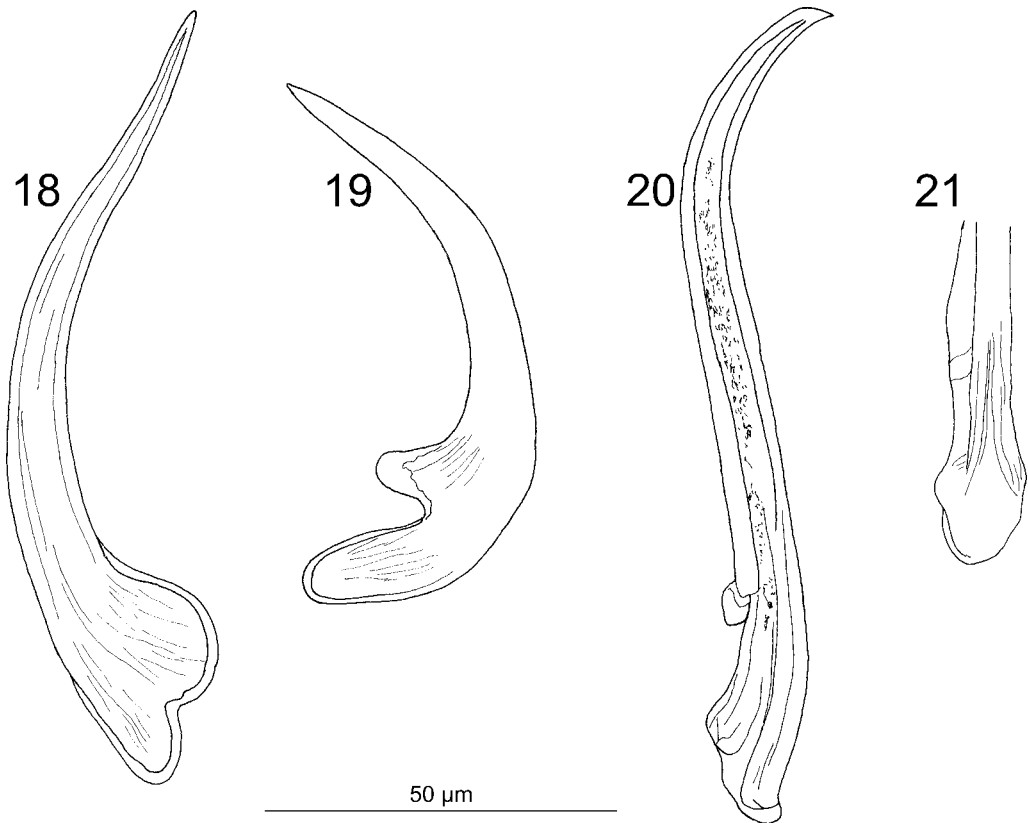
Description: (Measurements in micrometers; based on 2 unflattened specimens fixed with Berland's fluid, stained with carmine, and mounted as permanent preparations in Canada balsam; and 1 flattened scolex mounted in glycerin jelly): Metacestodes (merocercoids according to Chervy, 2002), elongate, 2,066 long by 666 wide, divided in 2 parts. Anterior part with scolex, 833 long by 333 wide, with 4 suckers



Figures 7–11. Distal (larger) hooks of *Cyclusteria* spp. **7, 8.** *Cyclusteria* sp. larvae from the liver of common carp (*Cyprinus carpio*), Mozambique. **9, 10.** *Cyclusteria magna* (Baer, 1959) adults from *Mycteria ibis*, Congo (redrawn from Bona, 1975). **11.** *Cyclusteria magna* larva from intestinal wall of *Tilapia zillii*, Kenya, IPCAS C-293 (redrawn from [Scholz et al., 2004](#)).



Figures 12–17. Proximal (smaller) hooks of *Cyclusteria* spp. **12–14.** *Cyclusteria* sp. larvae from the liver of common carp (*Cyprinus carpio*), Mozambique. **15, 16.** *Cyclusteria magna* (Baer, 1959) adults from *Mycteria ibis*, Congo (redrawn from Bona, 1975). **17.** *Cyclusteria magna* larva from intestinal wall of *Tilapia zillii*, Kenya, IPCAS C-293 (redrawn from [Scholz et al., 2004](#)).



Figures 18–21. Sclerite-like hooklets on the top of the rostellum of *Cyclustera* sp. larvae from the liver of common carp (*Cyprinus carpio*), Mozambique. **18, 19.** Drawn from flattened scolex mounted in glycerin-jelly. **20.** Unflattened specimen stained with carmine and mounted in Canada balsam; hooklet not in plane. **21.** Unflattened specimen stained with carmine and mounted in Canada balsam; base of hooklet.

and well-developed rostellum, armed with 28 massive hooks arranged in 2 circles, each of 14 hooks. Distal (larger) hooks ($N = 7$) 171–187 long; blade 108–122 long, curved mainly in its terminal part; handle slightly concave, 60–72 long (blade/handle ratio, 1.59:2.00); guard directed posteriorly (Figs. 7–8). Proximal (smaller) hooks ($N = 8$), 139–149 long; blade 94–103 long, slightly curved (convex) in its proximal part but straight to concave in distal part, with pointed end; handle short, 54–57 in length, straight, curved in basal part (blade/handle ratio, 1.69:1.89) guard, short and wide, perpendicular to longitudinal axis of hooks (Figs. 12–14). In addition, 2 semilunar sclerites, 76–115 long, with widened base (13–22 wide), and curved, pointed distal part present on top of rostellum (Figs. 18–21). Posterior part of larvae oval, 1,233 long and 666 wide.

Deposition of specimens: The Natural History Museum, London, U.K. (BMNH 2007.9.5.10); Hel-

minthological Collection of the Institute of Parasitology, České Budějovice, Czech Republic (IPCAS C-476).

Host: Common carp, *Cyprinus carpio* Linnaeus, 1758 (Cypriniformes: Cyprinidae).

Site: Liver.

Localities: River Limpopo, Mozambique (27 December 2004 and 5 January 2005).

Prevalence, mean intensity, and range: 2 of 21 fish infected (1%, 2.5, range 2–3).

Remarks: Metacestodes from carp possess massive, large rostellar hooks, with striation in the basal part of the handle and guard, which is a typical feature of members of *Cyclustera* Fuhrmann, 1901 (see Bona, 1975, 1994). According to Scholz et al. (2004), there are 2 species of *Cyclustera* described from fish, with the rostellum armed with 28 hooks, namely *Cyclustera*

Table 1. Morphometric features of metacestodes of *Cyclustera* Fuhrmann, 1901, from fish with 28 rostellar hooks.

Feature	<i>Cyclustera</i> sp.	<i>Cyclustera capito</i>	<i>Cyclustera magna</i>
Site of infection	Liver	Mesenteries	Intestinal wall
Host	<i>Cyprinus carpio</i>	<i>Floridichthys polyommus</i>	<i>Tilapia zillii</i>
Country	Mozambique	Mexico	Kenya
Reference	Present study	Scholz et al. (2004)	Scholz et al. (2004)
Metacestode	2,066 × 666	4,060 (length)	904–1,480 × 496–740
Distal (large) hooks			
Total length	171–187	221–234	179–198 + 154–163*
Blade	108–122	112–122	93–141
Handle	60–72	118–125	64–96
Blade/handle ratio	1.59–2.00	0.94–0.97	1.14–1.96
Proximal (small) hooks			
Total length	139–149	173–182	138–147
Blade	94–103	90–93	92–102
Handle	54–57	99–105	61–70
Blade/handle ratio	1.69–1.89	0.85–0.93	1.33–1.68
Sclerites			
Number	2	—	—
Length	76–115	—	—

* All distal hooks are of similar shape, but 4 are markedly larger than the remaining 10 hooks.

capito (Rudolphi, 1819) and *Cyclustera magna* (Baer, 1959). The morphometric features of these species are presented in Table 1. The shape, size, and blade/handle ratio of the hooks of *C. capito* are completely different from those of *Cyclustera* metacestodes found in Mozambique (see Scholz et al., 2004).

The shape and size of the hooks of carp metacestodes are similar to those of *C. magna* (Figs. 7–17), but there are the following differences: (1) *C. magna* possesses distal hooks of 2 different sizes, 4 larger (length 179–198 µm) and 10 smaller (length 154–163 µm) (Scholz et al., 2004 incorrectly listed 4 + 6 hooks in metacestodes in their Table 1, but the correct number, i.e., 4 + 10, was given in the description of larvae on p. 134), whereas those of *Cyclustera* sp. from Mozambique are all ($N = 14$) of similar size (171–187 µm long); (2) the tip of distal hooks in *C. magna* is more curved (both in adults [Figs. 9, 10] and larvae [Fig. 11]) than that of metacestodes from carp (Figs. 7, 8); (3) the rostellum of the larvae from Mozambique is armed with 2 semilunar, hook-like sclerites that are absent in *C. magna*; and (4) the blade/handle ratio of the proximal hooks of *Cyclustera* metacestodes from carp is slightly higher than that of *C. magna* (1.33–1.68) (Bona, 1975; Scholz et al., 2004) (new measurements of *C. magna* metacestodes from *Tilapia zillii*, Kenya, IPCAS C-293). Therefore, the larvae from Mozambique are provisionally designated as *Cyclustera* sp.

Larvae of both gryporynchid tapeworms were found in common carp from free waters (a river and

a lake). However, the infection of this fish species, which was introduced to Mozambique for aquaculture, with indigenous parasites indicates that some cestode larvae may not be so strictly specific at the level of fish intermediate host and may establish even in nonnative fish species. Whereas larvae of *Cyclustera* sp. were very rare, those of *P. samfyia* were fairly common (prevalence 9–11%) and very abundant (mean intensity 31–103 metacestodes per fish), with as many as 600 larvae in the most heavily infected fish host. The existing data from Europe and former Soviet Union, although fragmentary and scarce, indicate that some larvae, especially those parasitic in the gall bladder, may cause health problems in cultured carp (Jara and Olech, 1964; Bauer et al., 1981; Körting, 1984). The pathogenicity of metacestodes found during the present study will be investigated in the near future.

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