

Neotropical Monogenoidea. 53. *Gyrodactylus corydori* sp. n. and redescription of *Gyrodactylus anisopharynx* (Gyrodactylidae), parasites of *Corydoras* spp. (Siluriformes: Callichthyidae) from southern Brazil

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Abstract: Morphometric analyses are used to evaluate the taxonomic status of two sympatric variants of *Gyrodactylus anisopharynx* Popazoglo et Boeger, 2000 (forma “large-pharynx” and forma “small-pharynx”). The parasites were collected from the Piraquara River and the Miringuava River, State of Paraná, Brazil, between February 2005 and May 2006. A total of 132 parasites were measured from two hosts, *Corydoras ehrhardti* Steindachner and *Corydoras paleatus* (Jenyns). Eleven morphological features of the haptor sclerites and pharynx were measured and analysed by discriminant analysis and principal components analysis. The results indicate that the observed morphological variation cannot be associated to intraspecific variation or phenotypic plasticity ($P < 0.0001$). Consequently, the two variants previously allocated in *G. anisopharynx* represent two independent species. Since the holotype was defined as the variant “large-pharynx”, *Gyrodactylus corydori* sp. n. is proposed to accommodate specimens previously reported as “small-pharynx” variant of *G. anisopharynx*. Morphometric analyses showed that the hook, the anchor, and the pharyngeal bulb are significantly distinct ($P < 0.0001$) between *G. corydori* sp. n. and *G. anisopharynx* (s.s.). The new species is characterized by having hooks with point moderately curved, robust convex heel, convex shelf, toe concave moderately pointed with depression; deep bar with two submedial, posterior projections; anchors with robust superficial root; superficial bar with two small anterolateral projections; and male copulatory organ armed with two rows of spinelets.

Key words: *Gyrodactylus*, morphometry, *Corydoras*, sympatry

Gyrodactylidae comprises a group of oviparous and viviparous parasite species known mainly from bony fishes, although some species parasitize cephalopods and amphibians. In Gyrodactylidae, *Gyrodactylus* von Nordmann, 1832 is the most diverse genus, with more than 400 species described (Euzet and Combes 1998, Bakke et al. 2002, 2007, Boeger et al. 2003).

In the Neotropical Region, 39 species of Gyrodactylidae are presently known, of which 18 are species of *Gyrodactylus* (Boeger et al. 2006, Kritsky et al. 2007, Cohen and Kohn 2008). Individual species of *Gyrodactylus* are generally reported from only a single host species (Bakke et al. 2002). Nevertheless, several studies registered the occurrence of one species of *Gyrodactylus* on distinct sympatric hosts (Turgut et al. 1999, Boeger et al. 2003, Ziętara and Lumme 2003, Meinilä et al. 2004, Boeger et al. 2005).

Two distinct variants of *Gyrodactylus anisopharynx* Popazoglo et Boeger, 2000 were described from sympatric hosts, *Corydoras paleatus* (Jenyns) and *Corydoras ehrhardti* Steindachner, from southern Brazil. In the original description (Popazoglo and Boeger 2000), these two variants, named “small-pharynx” and “large-pharynx”, were discriminated on the basis of morphology of the distal and proximal pharyngeal bulb, but no conspicuous differences were detected in the morphology of their haptor sclerites. In the present study, we analysed the taxonomic status of the two variants of *G. anisopharynx* by morphometric techniques and re-examined their types and newly collected specimens.

MATERIALS AND METHODS

Corydoras paleatus (n = 60) and *C. ehrhardti* (n = 133) were collected from the Piraquara River (25°29'59"S, 49°02'40"W),

municipality of Piraquara; and from the Miringuava River (25°38'06"S, 49°05'07"W), municipality of São José dos Pinhais, State of Paraná, Brazil, between February 2005 and May 2006. Fish were captured by electrofishing, sacrificed by pitting, and kept in hot water (60°C) for few seconds before being fixed in 5% formalin or 95% ethanol. Host specimens were brought to the laboratory and immediately screened for species of *Gyrodactylus* under a stereomicroscope. A total of 132 specimens of the two variants of *G. anisopharynx* were found. All these specimens were used in the morphometric analyses.

Parasite specimens, fixed in formalin, were stained with Gomori's trichrome for analysis of soft structures or mounted in Hoyer's medium for study of haptor sclerites (Kritsky et al. 1995, Popazoglo and Boeger 2000). Only specimens freshly mounted in Hoyer's medium were used in the morphometric study. All parasites were photographed with a digital camera (Olympus QColor 5) connected to a phase-contrast microscope (Olympus BX 51). Based on these photographs, measurements were obtained with the software SigmaScan Pro 5.0 (SPSS, Inc.).

Morphological features of the attachment organ and pharynx were measured in accordance with Malmberg (1970) and Shinn et al. (1996, 2004). However, only point-to-point measurements with high Pearson's correlation ($r^2 > 0.90$), low coefficient of variation (C.V. < 20%), and absence of geometric redundancy were considered to avoid high misclassification rate, measurement error, and redundant measurements (Geets et al. 1999, Shinn et al. 2001, Du Preez and Maritz 2006). The coefficient of variation (C.V. = $100 \times$ the square root of the variance divided by the mean) was calculated according Geets et al. (1999). The coefficient of variation and Pearson's correlation were obtained using Statistica 6.0 (Statsoft, Inc.). Thus, based on these morphometric parameters, only nine morphological features of the haptor sclerites (Figs. 1, 2) and two morphological features of the pharynx (Fig. 3) were analysed in this paper: anchor aperture

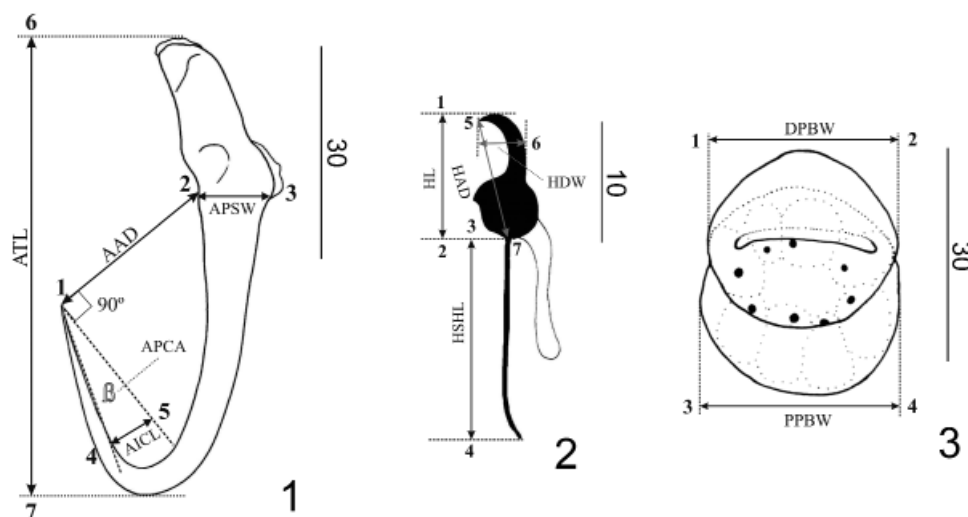
distance (AAD), anchor proximal shaft width (APSW), anchor point curve angle (APCA), anchor inner curve length (AICL), anchor total length (ATL), hook-shank length (HSHL), hooklet length (HL), hooklet aperture (HAD), hooklet distal width (HDW), distal pharyngeal bulb width (DPBW), and proximal pharyngeal bulb width (PPBW).

The data were analysed by stepwise discriminant analysis and principal components analysis (PCA), using Statistica 6.0 (Statsoft, Inc.). PCA was performed on the correlation matrix of log-transformed variables. Discriminant analysis and PCA were performed in two ways: the first analysis included all measurements of the anchor, hook, and pharynx; the second analysis included only measurements of haptor sclerites. Measurements are presented in micrometres.

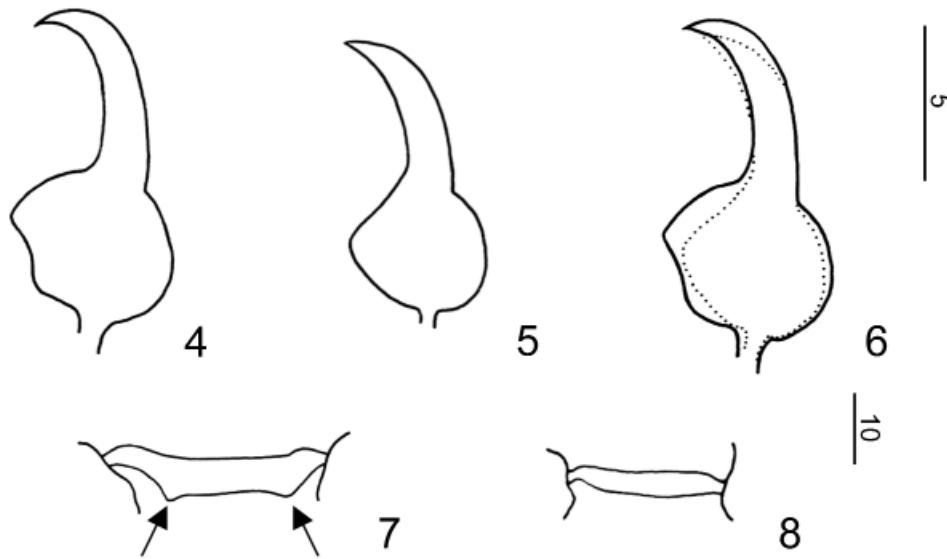
Types and vouchers were deposited in the following institutions: Museu de Zoologia da Universidade de São Paulo, Brazil (MZUSP); Coleção Helmintológica do Instituto Oswaldo Cruz, Brazil (CHIOC); United States National Parasite Collection, USA (USNPC); and Institute of Parasitology, České Budějovice, Czech Republic (IPCR); as presented in the respective descriptions. The types ($n = 46$) of *G. anisopharynx* by Popazoglo and Boeger (2000) were studied for comparison as indicated in the respective description/redescription.

RESULTS

All point-to-point measurements are presented in Table 1. The discriminant analysis indicated that the measurements of the anchor, hook, and pharynx of "small-pharynx" and "large-pharynx" variants of *G. anisopharynx* are significantly different (Wilks' Lambda = 0.14; $F = 46.49$; $P < 0.0001$; $n = 132$) (Table 2). Moreover, the shape and size of the hook (Figs. 4–6) and deep bar (Figs. 7, 8) were also notably different.



Figs. 1–3. Scheme of the eleven morphometric features of anchor, hook and pharynx of *Gyrodactylus* spp. **Fig. 1.** Anchor. 1-2 (AAD): anchor aperture distance; 2-3 (APSW): anchor proximal shaft width; 4-5 (AICL): anchor inner curve length; 6-7 (ATL): anchor total length; β (APCA): anchor point curve angle. **Fig. 2.** Hook. 1-2 (HL): hooklet length; 3-4 (HSHL): hook shank length; 5-7 (HAD): hooklet aperture; 5-6 (HDW): hooklet distal width. **Fig. 3.** Pharyngeal bulbs. 1-2 (DPBW): distal pharyngeal bulb width; 3-4 (PPBW): proximal pharyngeal bulb width. Scale bars: Figs. 1, 3 = 30 μ m; Fig. 2 = 10 μ m.



Figs. 4–8. Hook (Figs. 4–6) and deep bar (Figs. 7, 8) of two variants of *Gyrodactylus anisopharynx* (s.l.). **Fig. 4.** “Small pharynx” *Gyrodactylus corydori* sp. n. **Fig. 5.** “Large pharynx” *G. anisopharynx* (s.s.). **Fig. 6.** “Small pharynx” *G. corydori* sp. n. (continuous line) and “large pharynx” *G. anisopharynx* (s.s.) (dotted line). **Fig. 7.** “Small pharynx” *G. corydori* sp. n.; the arrows indicate two subterminal, posterior projections. **Fig. 8.** “Large pharynx” *G. anisopharynx* (s.s.). Scale bars: Figs. 4–6 = 5 µm; Figs. 7, 8 = 10 µm.

The discriminant analysis performed only with measurements of the anchor and hooks resulted in five steps but the discriminatory power was smaller (Wilks’ Lambda = 0.53; $F = 15.89$; $P < 0.0001$). In this analysis, the variants of *G. anisopharynx* were distinguished by two variables of the hook and three variables of the anchor (Table 3).

The discriminant analysis performed with all features (i.e. anchor, hook and pharynx) revealed that the variants of *G. anisopharynx* can be distinguished with 100% of precision by five morphometrical points: two of the pharynx and three of the anchor (Table 2). The univariate analysis of all measurements indicated that the three first steps in the stepwise discriminant analysis are considerably different between the two variants: PPBW ($F = 90.13$; $P < 0.0001$), ATL ($F = 76.95$; $P < 0.0001$), and DPBW ($F = 63.68$; $P < 0.01$). However, the two last steps (AAD and APSW) showed the highest discriminatory power.

The discriminant analysis performed only with anchor and hook measurements revealed five morphometrical points that were significantly different (HDW, HL, AAD, ATL, and APCA) but the last step showed the highest discriminatory power (APCA: Wilks’ Lambda = 0.55; $P < 0.0001$) (Table 3). In this analysis, the variants of *G. anisopharynx* could be discriminated in 87% of the cases.

In the first PCA (including anchors, hooks and pharynx measurements), the hooklet length (HL) and hooklet aperture (HAD) showed the highest coefficient on the first principal component (Table 4). In this analysis, the two first components accounted for 47% of the total variance. The majority of *G. anisopharynx* specimens were discriminated by the anchors, hooks and pharynx (Fig. 9).

The second PCA (including only anchors and hooks measurements) was less efficient in discrimination of the *G. anisopharynx* variants (data not shown). However, the anchor aperture distance (AAD), anchor point curve angle (APCA) and anchor inner curve length (AICL) had the highest coefficient on the first principal component (Table 5). In this analysis, the first two components accounted for 53% of the total variance.

The discriminant analysis and PCA revealed that PPBW (proximal pharyngeal bulb width), DPBW (distal pharyngeal bulb width), ATL (anchor total length), AAD (anchor aperture distance), APSW (anchor proximal shaft width), AICL (anchor inner curve length), APCA (anchor point curve angle), HL (hooklet length), HDW (hooklet distal width) and HAD (hooklet aperture) were the most informative variables for the differentiation between the forma “large-pharynx” and forma “small-pharynx” of *G. anisopharynx*.

The morphometric analysis and comparative morphology of the pharyngeal bulbs and haptoral sclerites revealed that the morphological variation between variants exceeds that observed within each variant ($F = 46.49$; $P < 0.0001$), rejecting the hypothesis of intraspecific variation associated to seasonal or geographic phenotypic plasticity. This result strongly supports the conclusion that *G. anisopharynx* was originally described based on specimens of two distinct species of *Gyrodactylus*.

Thus, *G. anisopharynx* is restricted to specimens originally allocated in the variant “large-pharynx”, among which the holotype was originally designated (Popazoglo and Boeger 2000). This species is redescribed below. Further, a new species, *Gyrodactylus corydori* sp. n., is

Table 1. Size range of characters of the haptoral sclerites and pharynx of two variants of *Gyrodactylus anisopharynx* (s.l.). Measurements in micrometres. The values represent the mean and the 95% confidence interval.

Variables	“Small pharynx” (n = 98) *	“Large pharynx” (n = 34) **
Aperture distance	23.5 (22.7–24.2)	25.2 (18.9–36.3)
Proximal shaft width	9.7 (9.4–9.9)	9.3 (7.2–11.8)
Anchor Inner curve length	5.3 (4.8–5.9)	3.6 (0–9.8)
Point curve angle	13.7 (12.1–15.2)	11.7 (2.2–36.8)
Total length	64.1 (63.4–64.8)	61.6 (56.1–68.5)
Shank length	16.9 (16.5–17.3)	17.2 (12.3–20.1)
Hooklet length	10.1 (10.0–10.3)	10.8 (9.5–11.9)
Hooklet distal width	4.0 (3.9–4.2)	5.5 (3.0–11.9)
Hooklet aperture	10.4 (10.2–10.5)	11.1 (9.7–12.0)
Pharynx Distal width	31.9 (29.7–34.1)	31.6 (21.9–43.1)
Proximal width	42.6 (40.5–44.8)	76.6 (50.7–103.8)

* *Gyrodactylus corydori* sp. n.; ** *G. anisopharynx* (s.s.)

Table 2. Discriminant analysis of the measurements of haptoral sclerites and pharynx of *Gyrodactylus anisopharynx* (s.l.). (Wilks’ Lambda = 0.14; $F = 46.49$; $P < 0.0001$).

Variables	Steps	Wilks’ lambda	F Value	Tolerance	P Value
Proximal pharyngeal bulb width	1	0.34	90.13	0.57	< 0.0001
Anchor total length	2	0.21	76.95	0.65	< 0.0001
Distal pharyngeal bulb width	3	0.17	63.68	0.63	< 0.0001
Anchor proximal shaft width	4	0.16	51.49	0.69	< 0.0001
Anchor aperture distance	5	0.16	46.49	0.57	< 0.0001

Table 3. Discriminant analysis of the measurements of haptoral sclerites of *Gyrodactylus anisopharynx* (s.l.) (Wilks’ Lambda = 0.53; $F = 15.89$; $P < 0.0001$).

Variables	Steps	Wilks’ lambda	F Value	Tolerance	P Value
Hooklet distal width	1	0.60	25.45	0.96	< 0.0001
Hooklet length	2	0.60	19.55	0.95	< 0.0001
Anchor aperture distance	3	0.67	18.16	0.59	< 0.0001
Anchor total length	4	0.62	18.84	0.70	< 0.0001
Anchor point curve angle	5	0.55	15.89	0.77	< 0.0001

Table 4. Component loadings for the first PCA (including haptoral sclerites and pharynx measurements) of *Gyrodactylus anisopharynx* (s.l.).

Variables	PC 1	PC 2
Anchor aperture distance	-0.11	0.72
Anchor proximal shaft width	-0.46	0.53
Anchor inner curve length	-0.18	-0.88
Anchor point curve angle	-0.06	-0.87
Anchor total length	-0.54	0.12
Hook shank length	0.09	0.11
Hooklet length	0.78	-0.10
Hooklet distal width	0.59	0.22
Hooklet aperture	0.82	0.01
Distal pharyngeal bulb width	0.34	0.00
Proximal pharyngeal bulb width	0.63	0.25

Table 5. Component loadings for the second PCA (including only haptoral sclerites measurements) of *Gyrodactylus anisopharynx* (s.l.).

Variables	PC 1	PC 2
Anchor aperture distance	0.70	-0.16
Anchor proximal shaft width	0.53	-0.46
Anchor inner curve length	-0.89	-0.21
Anchor point curve angle	-0.89	-0.10
Anchor total length	0.10	-0.59
Hook shank length	0.12	0.13
Hooklet length	-0.08	0.82
Hooklet distal width	0.21	0.53
Hooklet aperture	0.03	0.86

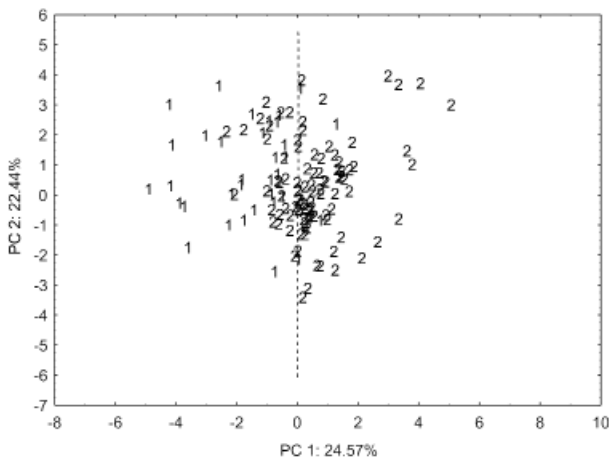


Fig. 9. Plot of 132 specimens of *Gyrodactylus anisopharynx* (s.l.) in the first PCA (including haptor sclerites and pharynx measurements). The dotted line separates “large pharynx” specimens, *G. anisopharynx* (s.s.) (1) at left and “small pharynx” specimens, *G. corydori* sp. n. (2) at right.

described to accommodate the specimens originally considered as members of the “small-pharynx” variant.

DESCRIPTIONS

Gyrodactylidae Van Beneden et Hesse, 1863
Gyrodactylus anisopharynx Popazoglo et Boeger, 2000

Figs. 5, 6, 8

Redescription (based on 18 types and 15 newly collected vouchers). Body fusiform, 491 (336–606; $n = 14$) long, 123 (86–159; $n = 14$) wide. Cephalic glands, head organs, spike sensilla conspicuous. Cephalic glands anterolateral, lateral, posterolateral to pharynx. Distal pharyngeal bulb muscular 40 (33–54; $n = 7$) wide; digitiform projections of distal pharyngeal bulb indistinct; proximal pharyngeal bulb glandular 77 (62–104; $n = 7$) wide. Male copulatory organ 16 (14–18; $n = 4$) wide, armed with 1 spine, 2 rows of spinelets; external row with 3–4 large spinelets, each with wide, truncate base; internal row with 2–3 small spinelets. Testis ovate 15 (11–22; $n = 3$) wide, posterior to germarium. Germarium ovate, 26 (22–33; $n = 4$) long, 28 (25–34; $n = 4$) wide. Uterus with up to 2 generations of embryos. Large syncytial follicles posterolateral to germarium. Anchor 61 (57–69; $n = 17$) long; shaft 37 (34–41; $n = 17$) long; straight point 23 (19–25; $n = 17$); deep root poorly developed, knob-like; superficial root robust. Hook with shaft, point evenly curved; toe moderately pointed; heel convex; shelf straight; shank 17 (15–19; $n = 11$) long; hooklet 11 (9–12; $n = 11$) long; filamentous hooklet (FH) loop approximately 2/3 of shank length. Deep bar 3 (2–4; $n = 10$) wide. Superficial bar 30 (25–37; $n = 8$) long, 9 (6–12; $n = 8$) wide, with 2 small anterolateral projections; shield trapezoidal.

Type host: *Corydoras paleatus* (Jenyns) (Siluriformes, Callichthyidae).

Other host: *Corydoras ehrhardti* Steindachner (Siluriformes, Callichthyidae).

Site of infection: Body surface.

Type locality: Piraquara River, Piraquara, Paraná, Brazil (25°29'59"S, 49°02'40"W).

Other locality: Miringuava River, São José dos Pinhais, Paraná, Brazil (25°38'06"S, 49°05'07"W).

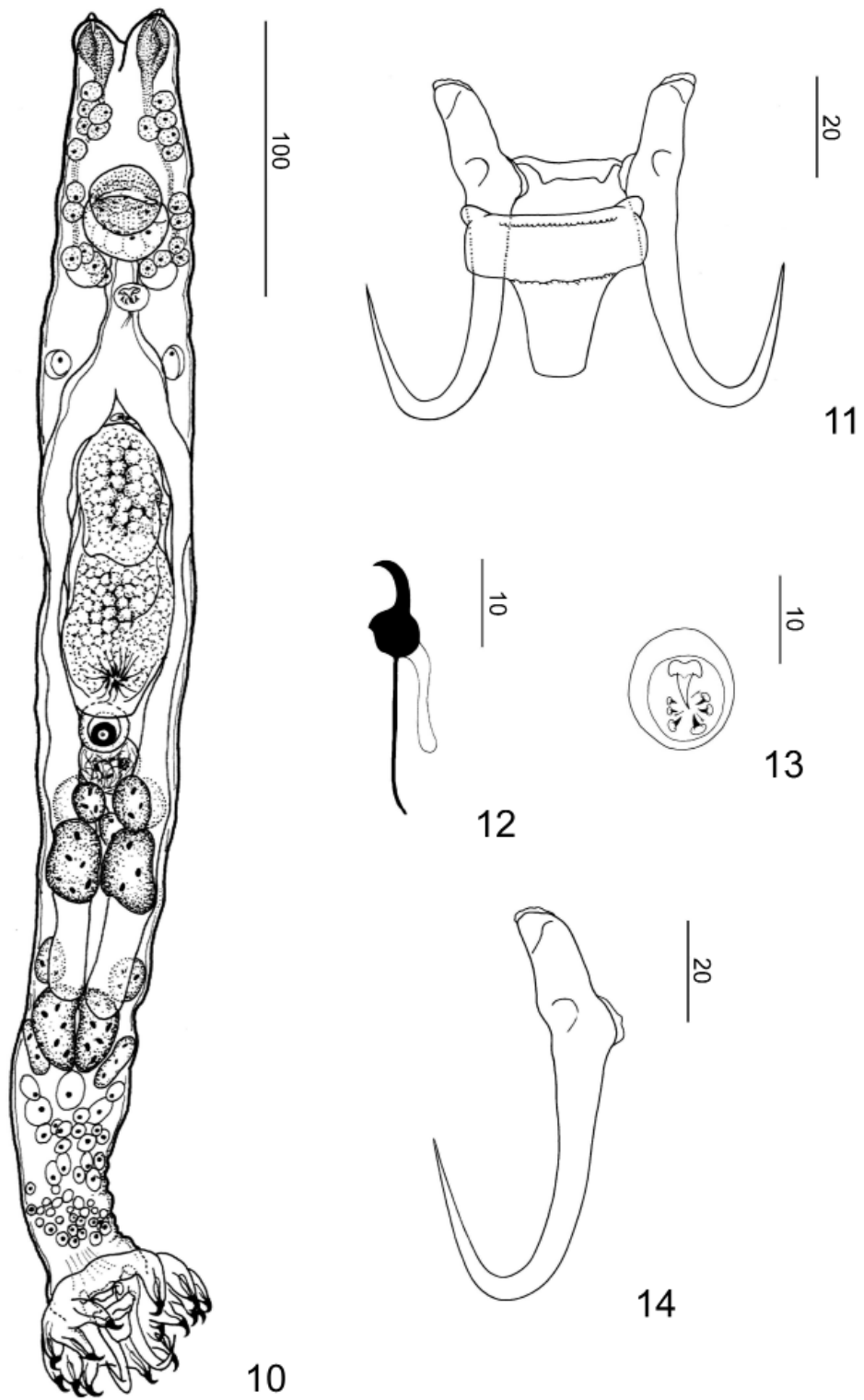
Specimens studied: 5 paratypes, CHIOC 34217a, 34217c, 34219, 34220, 34222; 2 paratypes, IPCR M-358; 3 paratypes, HWML 15197-6, 15197-9, 15197-17; 2 paratypes, MNHN 823HF/tk208, 823HF/tk213; 6 paratypes, USNPC 89396-MT3011H, 89396-MT30D, 89396-MT3011B, 89396-MT3011E, 89396-MT3011G, 89396-MT3011C; 9 vouchers, MZUSP 6381a-b, 6382, 6383, 6384a-d, 6385; 4 vouchers, USNPC 100323 257A-20/23; 2 vouchers, CHIOC 36909, 36910.

Remarks. *Gyrodactylus anisopharynx* (s.s.) can be distinguished from all other *Gyrodactylus* species from *Corydoras paleatus* and *C. ehrhardti*, i.e. *Gyrodactylus superbus* (Szidat, 1973), *G. samirae* Popazoglo et Boeger, 2000 and *G. corydori* sp. n., by morphology of the hook, with the toe moderately pointed and the shelf straight and sloping, and the proximal pharyngeal bulb, which is twice as wide as those of the other species. Further, the superficial bar of *G. anisopharynx* has two small anterolateral projections, which are absent on the superficial bars of *G. superbus* and *G. samirae*.

Gyrodactylus anisopharynx is restricted to the original variant “large-pharynx” described by Popazoglo and Boeger (2000) based on its designated holotype (see fig. 6 of Popazoglo and Boeger 2000). The figures by Popazoglo and Boeger (2000) are adequate and, therefore, wholemount specimens and sclerotized parts are not illustrated herein.

Gyrodactylus corydori sp. n. Figs. 4, 6, 7, 10–14

Description (based on 37 types). Body elongate, 587 (415–854; $n = 13$) long, 92 (59–143; $n = 13$) wide. Cephalic glands, head organs, spike sensilla conspicuous. Cephalic glands anterolateral, lateral, posterolateral to pharynx. Distal pharyngeal bulb muscular 33 (21–54; $n = 18$) wide; digitiform projections of distal pharyngeal bulb indistinct; proximal pharyngeal bulb glandular 45 (36–64; $n = 18$) wide. Male copulatory organ 17 (14–22; $n = 14$) wide, armed with 1 spine, 2 rows of spinelets; external row with 4–5 large spinelets, each with wide, truncate base; internal row with 2–3 small spinelets. Testis ovate 18 (16–19; $n = 5$) wide, posterior to germarium. Germarium ovate, 25 (19–33; $n = 12$) long, 29 (23–37; $n = 12$) wide. Uterus with up to 2 generations of embryos. Large syncytial follicles overlapping and immediately posterior to distal portions of caeca. Anchor 64 (46–73; $n = 23$) long; shaft 41 (29–45; $n = 23$) long; straight, delicate point 26 (19–29; $n = 23$); deep root poorly de-



Figs. 10–14. *Gyrodactylus corydori* sp. n. **Fig. 10.** Holotype (ventral). **Fig. 11.** Anchors, deep bar and superficial bar. **Fig. 12.** Hook. **Fig. 13.** Male copulatory organ. **Fig. 14.** Anchor. Scale bars: Fig. 10 = 100 µm; Figs. 11, 14 = 20 µm; Figs. 12, 13 = 10 µm.

veloped, knob-like; superficial root robust. Hook with straight shaft, point moderately recurved; heel convex; toe concave, moderately pointed, depressed; shelf convex; shank 17 (14–18; n = 17) long; hooklet 10 (8–11; n = 17) long; FH loop about 2/3 of shank length. Deep bar 4 (2–6; n = 19) wide, with 2 small subterminal, posterior projections. Superficial bar 31 (31–32; n = 8) long, 12 (10–14; n = 8) wide, with 2 small anterolateral projections; shield trapezoidal.

Type host: *Corydoras ehrhardti* Steindachner (Siluriformes, Callichthyidae).

Other host: *Corydoras paleatus* (Jenyns) (Siluriformes, Callichthyidae).

Site of infection: Body surface.

Type locality: Miringuava River, São José dos Pinhais, Paraná, Brazil (25°38'06"S, 49°05'07"W).

Other locality: Piraquara River, Piraquara, Paraná, Brazil (25°29'59"S, 49°02'40"W).

Specimens studied: holotype, MZUSP 6378; 6 paratypes, MZUSP 6379, 6380a-d, 6386; 10 paratypes, USNPC 89395-MT3011A, 100322-MT35:23-1/9; 10 paratypes, CHIOC 34216, 34221a, 34221c-f, 34223a, 34223b, 36911, 36912; 3 paratypes, HWML 15197-8, 15197-11, 15197-38; 5 paratypes, MNHN 823HF/tk207, 823HF/tk209, 823HF/tk210-212; 2 paratypes, IPCR M-471.

Etymology: The specific epithet is from Greek and refers to the hosts (species of *Corydoras*).

Remarks. *Gyrodactylus corydori* can be distinguished from its apparent closest relative, *G. anisopharynx*, by the morphology of the hook (with straight shaft, point moderately recurved, convex shelf, and toe concave and depressed), proximal pharyngeal bulb (with half width) and deep bar (with two subterminal, posterior projections). In addition, the morphology of the hook and deep bar of *G. corydori* allows discrimination of this species from *G. superbis* and *G. samirae*.

DISCUSSION

The main morphometric differences between *G. anisopharynx* and *G. corydori*, according to the discriminant analysis and the PCA, agree with the results of other studies on the efficiency of morphometric analysis in the discrimination of *Gyrodactylus* spp. (Shinn et al. 1996, 2001, 2004, McHugh et al. 2000). Hooks most contributed to the differentiation and characterisation of these two spe-

cies. This result confirms the taxonomic importance of the hook for the determination of species of *Gyrodactylus*, as previously suggested by other authors (Malmberg 1970, Geets et al. 1999, Turgut et al. 1999, Dmitrieva and Dimitrov 2002, Huyse and Volckaert 2002, Cable et al. 2005). It also points to the importance of the analysis of the haptoral sclerites and the pharynx for the taxonomy of the genus, and the discriminant analysis was the most efficient method to differentiate these two species.

Malmberg (1970) suggested that measurements of the pharynx may also help discrimination of species of *Gyrodactylus*. Indeed, our results showed that, at least in this case, the measurements of the pharynx have significant taxonomic value, since the morphometrical points PPBW and DPBW composed the three first steps in the discriminant analysis. Moreover, the discriminant analysis showed that the pharyngeal bulb size is related to some measurements of the anchor (ATL, APSW and AAD) (see Table 2), which is helpful in the differentiation of *G. anisopharynx* and *G. corydori*.

Morphology of the haptoral sclerites of *Gyrodactylus* spp. can be influenced by season, geography, and host species availability (Malmberg 1970, Mo 1991a, b, Harris 1998, Geets et al. 1999, Dmitrieva and Dimitrov 2002, Huyse and Volckaert 2002, Dávidová et al. 2005). However, specimens of each species of *Gyrodactylus* studied herein originated from two host species captured in several different circumstances, including distinct time of the year and geographic location. Thus, intraspecific variations presented in the morphometric analyses incorporate all variations eventually associated to these parameters and support the evolutionary identities of *G. corydori* and *G. anisopharynx*.

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