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Redescription of *Pseudacanthostomum panamense* Caballero, Bravo-Hollis, and Grocott, 1953 (Digenea: Acanthostomidae), a Parasite of Siluriform Fishes of the Family Ariidae, with Notes on Its Biology

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ABSTRACT: The acanthostomid trematode *Pseudacanthostomum panamense* Caballero, Bravo-Hollis, and Grocott is redescribed on the basis of examination of its holotype and new material from *Galeichthys* (=*Ariopsis*) *seemani* (Günther) (type host) from Colombia (new geographical record), and *Ariopsis assimilis* (Günther) and *Arius guatemalensis* (Günther) (new host records) (all Siluriformes: Ariidae) from the Atlantic and Pacific coasts of Mexico (new geographical record). It was found that *P. panamense* possesses intestinal ceca that are connected with the excretory bladder near the posterior extremity and opening outside by an uroproct. The actual number of circumoral spines of the holotype is 27; the number of spines is stable, with most specimens possessing 27 spines and a very few 26 or 28. *Pseudacanthostomum floridensis* Nahhas and Short, described from *Galeichthys* (=*Arius*) *felis* (Linnaeus) from Florida, U.S.A., is considered a synonym of *P. panamense*. Metacercariae of *P. panamense* from the eleotrid fishes *Dormitator latifrons* (Richardson) and *Gobiomorus maculatus* (Günther) from the Pacific coast of Mexico (Jalisco state) are described for the first time.

KEY WORDS: *Pseudacanthostomum panamense*, Digenea, metacercariae, Acanthostomidae, taxonomy, catfish, Siluriformes, Ariidae, Pisces, Mexico, Colombia.

During parasitological examination of fish from Colombia and Mexico, acanthostomid trematodes were found, both as adults in catfish of the family Ariidae and as metacercariae in eleotrid fish. They were identified as *Pseudacanthostomum panamense* Caballero, Bravo-Hollis, and Grocott, 1953, a species described from *Galeichthys* (=*Ariopsis*) *seemani* (Günther, 1864) from Panama (Caballero et al., 1953). Examination of the holotype of *P. panamense* showed that its original description had not provided data on some taxonomically important features such as the morphology of the intestinal ceca; in addition, no information about intraspecific variability of this taxon was provided. Therefore, *P. panamense* is redescribed here on the basis of new material from different hosts and geographical regions. Metacercariae of this trematode are described for the first time, and the taxonomic status of *Pseudacanthostomum floridensis* Nahhas and Short, 1965, the only congeneric species, is discussed.

Materials and Methods

Trematodes studied were found in *Ariopsis seemani* (7 specimens examined) from Colombia (locality not known; May 1996); *Ariopsis assimilis* (Günther, 1864), from Laguna Bacalar near the village of Bacalar, Quintana Roo, Mexico, January 1995 (1 specimen), and from Chetumal Bay, Quintana Roo, Mexico, October 1996 (96 specimens); and *Arius guatemalensis* (Günther, 1864) (3 specimens) from Marismas de Chalacatepec, Jalisco, Mexico, May 1995. Metacercariae were found in the eleotrid fish *Dormitator latifrons* (Richardson, 1844) from Boca del Río San Nicolás, Jalisco, Mexico, September and November 1994 (21 fish examined), from Marismas de Chalacatepec, Jalisco, Mexico, March 1995 (24 specimens), and from the Cuitzmala River at the village of Emiliano Zapata,

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Jalisco, Mexico, September 1995 (7 specimens); and in *Gobiomorus maculatus* (Günther, 1859) from the Cuitzmala River at Emiliano Zapata, Jalisco, Mexico, January, March, and September 1995 (89 specimens).

Holotypes of *P. panamense* from *Ariopsis seemani* from Panama (National Helminthological Collection of the Institute of Biology, National Autonomous University of Mexico, Mexico City, Mexico-CNHE 947) and *P. floridensis* from *Galeichthys* (=*Arius*) *felis* (Linnaeus, 1766) from Florida (U.S. National Parasite Collection, Beltsville, Maryland, U.S.A.-USNPC 60087) were compared with the present material.

Measurements (length and width) of 59 undeformed, uncollapsed eggs of *P. panamense* (from *Ariopsis seemani,* Panama and Colombia and *A. assimilis,* Bacalar and Chetumal, Mexico) and *P. floridensis* (from *Arius felis,* Florida, U.S.A.) were compared by ANOVA (Tukey's HSD for unequal *N*; Spojotvoll/Stoline test).

The specimens studied are deposited in the helminthological collections of the Institute of Parasitology, České Budějovice, Czech Republic (IPCAS D-384); Institute of Biology, National Autonomous University of Mexico, Mexico City, Mexico (CNHE 3239); Laboratory of Parasitology, CINVESTAV-IPN Merida, Mexico (CHCM 181); and the U.S. National Parasite Collection, Beltsville, Maryland, U.S.A. (USNPC 87809, 87810). The nomenclature of the fish hosts (catfish) follows that presented by Eschmeyer (1998). Measurements are in micrometers unless otherwise noted.

Results

Comparison of acanthostomid trematodes occurring in *Ariopsis seemani* from Colombia and *A. assimilis* and *A. guatemalensis* from Mexico with the holotype of *Pseudacanthostomum panamense* from *A. seemani* from Panama revealed their conspecificity (Figs. 1, 2; Table 1). All specimens, including the holotype of *P. panamense* (Fig. 1), possess long intestinal ceca connected near the posterior extremity with the excretory bladder, thus forming an uroproct (Figs. 1D, 2D, F). Vitelline follicles are distributed between the ventral sucker and the anterior testis (Figs. 1B, 2A, C, F, G), ventrally forming 2 separate fields and, in the same specimens, are dorsally confluent at the ovarian level (Figs. 1F–H, 2C). The uterine loops are sinuous, filling the space between the ventral sucker and the posterior extremity (Figs. 1C, 2A, C, G). A thin-walled, coiled seminal vesicle is situated posterodextrally to the ventral sucker (Figs. 1B, 2C, F), and a genital pore is located just anterior to the ventral sucker (Fig. 1B). With the exception of 3 specimens, all trematodes ($N = 40$), including the holotype (Fig. 1A), had 27 circumoral spines (Table 2).

The present study also demonstrated that the trematodes studied are identical in all but 1 morphological and biometrical character to *P. floridensis,* a species described from *Arius felis* from Florida, U.S.A (Nahhas and Short, 1965; see Table 1). No significant difference between these 2 taxa was found in the size (length and width) of eggs (Fig. 3). The only difference between *P. panamense* and *P. floridensis* is the more anterior position of the vitelline follicles in the latter species. However, the distribution of the vitelline follicles is rather variable (Fig. 1E–H), and its suitability as a discriminative character between *P. panamense* and *P. floridensis* is doubtful. Consequently, *P. floridensis* is considered a junior synonym of *P. panamense.*

Because the original description of *P. panamense* was incorrect in some features (the number of circumoral spines, the presence of an uroproct, and the spination of the posterior part of the body), its redescription based on extensive material from 4 fish hosts is provided herein. In addition, metacercariae from the eleotrid fishes *Dormitator latifrons* and *Gobiomorus maculatus* from Mexico, considered to be conspecific with *P. panamense,* are described.

Pseudacanthostomum panamense Caballero, Bravo-Hollis, and Grocott, 1953 (Figs. 1, 2)

SYNONYMS: *Pseudacanthostomum floridensis* Nahhas and Short, 1965 (new synonymy).

Pseudacanthostomum sp. of Pineda-López et al. (1985) (new synonymy).

Pelaezia sp. of Scholz and Vargas-Vázquez (1998) (new synonymy).

DESCRIPTION: Adult (measurements in Table 1): Body elongate, densely covered with fine tegumental spines, including post-testicular region. Oral sucker terminal, cup-shaped, with large buccal cavity; ventral sucker small, pre-equatorial. Oral sucker surrounded by 1 row of 27 large, straight circumoral spines (Figs. 1A, 2B, J, K); exceptionally 26 or 28 spines present (Table 2). Prepharynx present and short (Fig. 1A) or absent (Fig. 2A); pharynx strongly muscular; esophagus very short. Intestinal bifurcation pre-equatorial; intestinal ceca long, connected with excretory bladder and opening outside by uroproct (Figs. 1D, 2D). Testes tandem, close to posterior extremity. Vas deferens forming numerous loops, widened near ventral sucker to form coiled seminal vesicle; cirrus-sac lacking, ejaculatory duct slightly curved, opening into hermaphroditic

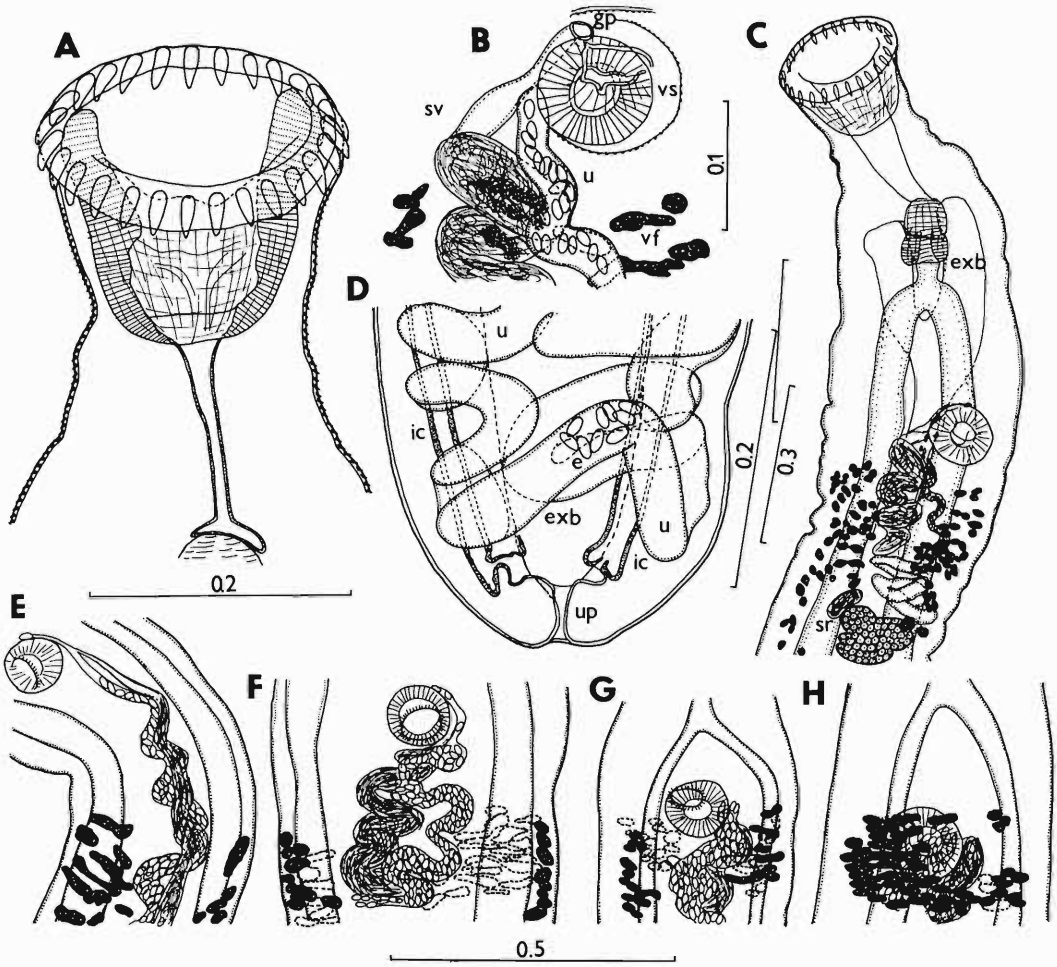

Figure 1. *Pseudacanthostomum panamense*. **A–D, holotype from *Galeichthys* (=*Arius*) *seemani*, Panama (IBUNAM 947), ventral view. A: oral sucker; B: ventral sucker and terminal genitalia; C: anterior part of body; note extent of vitelline follicles; D: posterior extremity; note connection of intestinal ceca with excretory bladder and presence of uroproct; E–H, acetabular region; note variation in anterior extent of vitelline follicles (E, F: specimens from *Ariopsis assimilis*, Mexico; G, H: specimens from *A. seemani*, Columbia; E: dorsal view, ventral follicles omitted; F, G: ventral view, dorsal follicles dashed; H: ventral view but dorsal follicles drawn in full and ventral follicles dashed). Scale bars in millimeters. Abbreviations: e, eggs; exb, excretory bladder; gp, genital pore; ic, intestinal ceca; sr, seminal receptacle; sv, seminal vesicle; u, uterus; up, uroproct; vf, vitelline follicles; vs, ventral sucker.**

duct; genital pore close to anterior margin of ventral sucker (Fig. 1B). Ovary transversely elongate, slightly lobate (Fig. 1C) or with almost indistinct lobes (Fig. 2A), pretesticular. Seminal receptacle oval, preovarial or anterolateral to ovary (Fig. 1C). Vitelline follicles numerous, dorsally filling space between ventral sucker and ovary, ventrally forming 2 lateral bands starting at acetabular level or posterior to ventral sucker and reaching posteriorly to anterior margin of anterior testis (Figs. 1E–G, 2G); exceptionally, vitelline follicles preacetabular. Uterus sinuous, with numerous loops, reaching to body extremity posteriorly and completely filling body posterior to ovary (Fig. 2A, G, F). Metraterm thin-walled, opening into hermaphroditic duct. Eggs operculate, rather variable in size (Figs. 3, 4). Excretory bladder Y-shaped, long, with anterior branches anterolateral to intestinal ceca, reaching to pharynx (Figs. 1C, 2A, C, F).

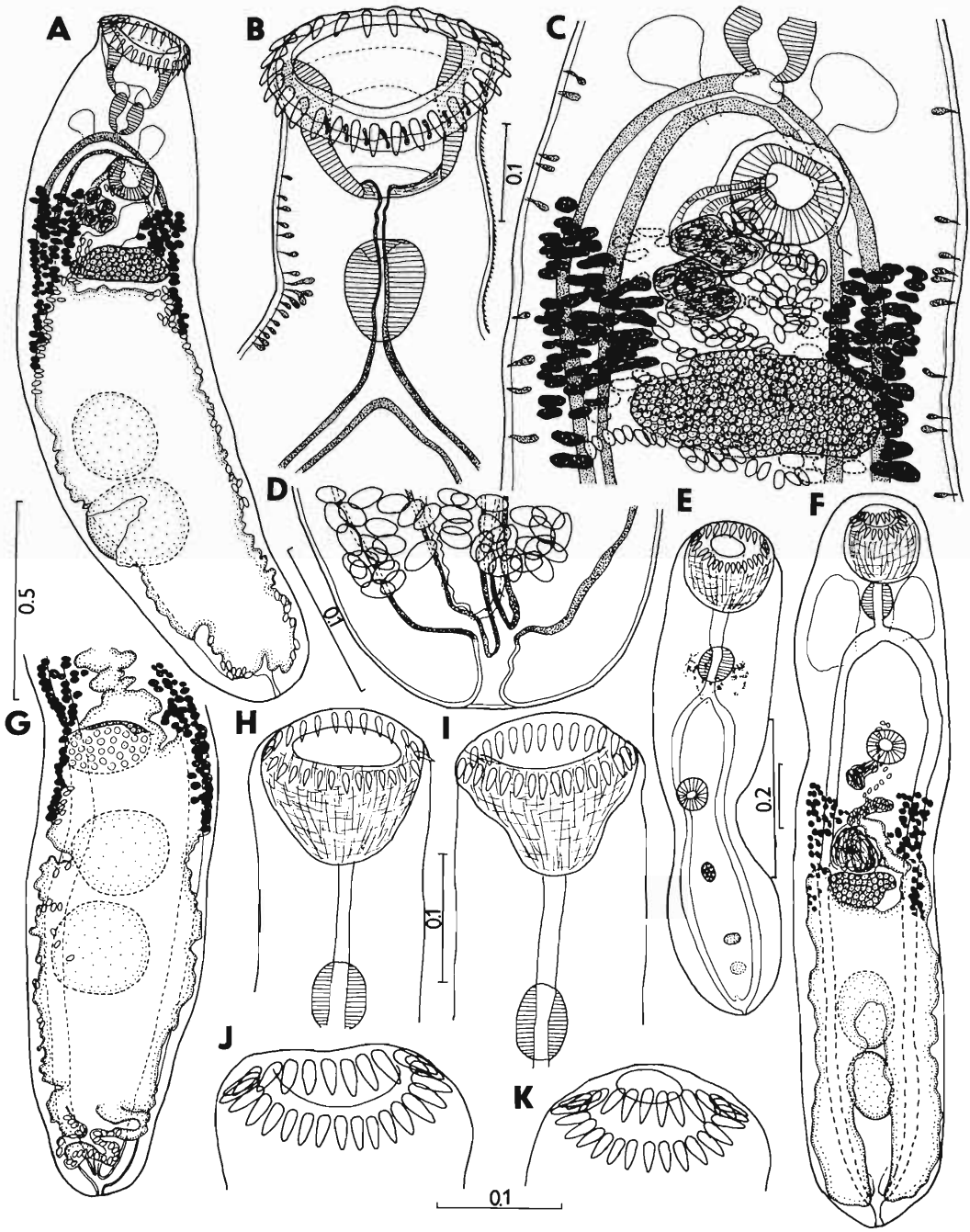

Figure 2. *Pseudacanthostomum panamense.* Adults from *Ariopsis seemani,* Colombia (A–D, G); metacercariae from *Dormitator latifrons*, Mexico (E, H, I); adults from *A. assimilis*, Mexico (F, J, K). A, E, F: total view. B, H–K: oral sucker with circumoral spines. B: tegumental spines on only the right side and subtegumental gland cells on the left side are illustrated. C: detail of acetabular region with terminal genitalia; note connection of dorsal vitelline follicles (dashed) at level of ovary. D: posterior extremity with connection of intestinal ceca, opening to the outside, with the excretory bladder (uroproct). G: posterior part of body; note vitelline follicles reaching posteriorly to level of anterior testis. Scale bars in millimeters.

Table 1. Measurements of *Pseudacanthostomum panamense* from different hosts* (in micrometers).

Species	*P. panamense*				*P. floridensis*	
Host	*A. seemani*		*A. assimilis*	*A. seemani*	*A. felis*	
Locality	Panama		Mexico	Colombia	U.S.A.	
Author	Caballero et al., 1953	Present data†	Present data	Present data	Nahhas and Short, 1965	Present data†
N	3	1	8	4	2	1
Body length	2,440–2,540	2,784	2,150–3,650	1,850–2,580	2,630–3,000	3,050
Body width	332–481	360	230–370	408–512	489–750	730
Oral sucker						
Length	76–133	211	123–195	186–208	180–294	266
Width	171–228	214	130–238	227–259	309–330	314
Spines (no.)	26	27	26–27	27	28	28
Spine length	30–38	31–37	28–45	37–54	42–60	26–59
Spine width	11	12–13	8–13	9–12	18–24	15–19
Prepharynx	95–133	154	30–138	45–56	—	15
Pharynx						
Length	122–171	125	78–105	99–122	129–206	218
Width	95–106	99	63–98	85–102	—	144
Esophagus	11–19	14	13–42	22–23	v. short	—
Ventral sucker						
Length	87–114	83	70–103	82–108	118–155	154
Width	106–114	86	68–103	83–118	155–170	170
Sucker ratio	0.33–0.50	0.40	0.41–0.68	0.38–0.51	0.54	0.56
Anterior testis						
Length	175–232	173	180–300	214–250	283–309	278
Width	114–194	118	78–180	179–256	180–283	173
Posterior testis						
Length	194–285	202	180–380	208–272	—	317
Width	125–228	128	115–220	205–266	—	176
Ovary						
Length	103–129	112	90–170	99–122	232–260	224
Width	133–236	141	55–190	230–272	298–309	317
Eggs						
Length	19–21	21.5–25	20–27.5	23–28	20–25	23–26
Width	11	12.5–13.5	10–14	12–14.5	11–14	12–13.5
Uroproct	absent	present	present	present	present	present

* Specimens from *A. assimilis* from Bacalar, Mexico, are not included because they were flattened during fixation.
† Measurements of the holotypes (CNHE 947 and USNPC 60087).

Table 2. Number of circumoral spines of *Pseudacanthostomum panamense*.

Host and country	Number of spines			Number of specimens
	26	27	28	
Ariopsis seemani (Panama)	—	1	—	1
Ariopsis seemani (Colombia)	—	4	—	4
Arius felis (U.S.A.)	—	—	1	1
Ariopsis assimilis (Mexico)	1	14	2	17
Arius guatemalensis (Mexico)	—	17	—	17
*Dormitator latifrons** (Mexico)	—	4	—	4
Total	1	40	3	44

* Metacercariae.

HOSTS: *Ariopsis seemani* (type host), *A. assimilis, Arius guatemalensis,* and *A. felis* (all Siluriformes: Ariidae) (Table 3).

SITE: Intestine.

GEOGRAPHIC DISTRIBUTION: Panama Viejo, Pacific coast, Panama (type locality); Colombia; Mexico (states of Tabasco and Quintana Roo, Atlantic coast; state of Jalisco, Pacific coast), U.S.A. (state of Florida) (Caballero et al., 1953; Nahhas and Short, 1965; Yamaguti, 1971; Pineda-López et al., 1985; Scholz and Vargas-Vázquez, 1998).

METACERCARIA: (based on 4 specimens from *Dormitator latifrons*; Fig. 2E, H, I): Body of excysted metacercariae elongate, 630–845 long by 147–182 wide. Oral sucker terminal, cup-

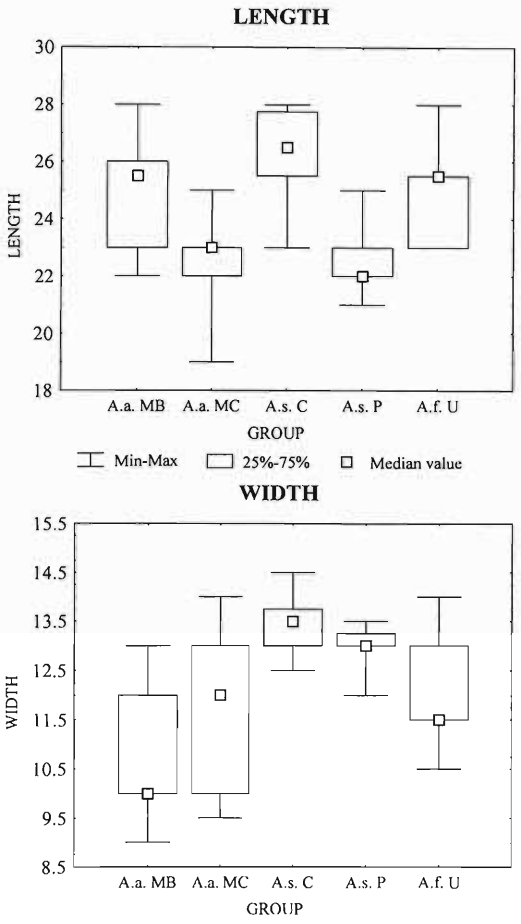

Figure 3. Length (above) and width (below) of eggs of *Pseudacanthostomum panamense* from different hosts and geographical regions. Measurements in micrometers. Groups: A.a. MB, *Ariopsis assimilis*, Bacalar, Mexico; A.a. MC, *A. assimilis*, Chetumal Bay, Mexico; A.s. C, *A. seemani*, Colombia; A.s. P, *A. seemani*, Panama (holotype: CNHE 947); A.f. U, *Arius felis*, Florida, U.S.A. (holotype of *P. floridensis*: USNPC 60087).

shaped, 111–124 long by 115–147 wide. Ventral sucker small, equatorial, 35–44 long by 35–41 wide. Sucker ratio 1:0.31–0.34. Oral sucker armed with 1 circle of 27 spines; spines on dorsal side 21–28 long by 4–7 wide; on ventral side 15–21 long by 4–5 wide. Prepharynx 49–90 long; pharynx oval, 52–59 long by 36–52 wide; esophagus short. Intestinal ceca long, connected with excretory bladder near posterior extremity and opening outside by uroproct. Primordium of ovary postacetabular; testis primordia tandem, near posterior extremity.

HOSTS: *Dormitator latifrons* and *Gobiomorus maculatus* (both Perciformes: Eleotridae) (Table 3).

SITE: Liver, more rarely musculature of gills, mesentery, intestinal wall, occasionally muscles, heart, gonads, fins, scales.

GEOGRAPHICAL DISTRIBUTION: Mexico (state of Jalisco, Pacific coast).

Discussion

Acanthostomid trematodes from 3 different definitive hosts, the ariid catfish *Ariopsis seemani, A. assimilis,* and *Arius guatemalensis,* and 2 geographical regions (Colombia and Mexico) were found to be conspecific with *Pseudacanthostomum panamense.* Examination of the holotype of *P. panamense* has shown that the original description (Caballero et al., 1953) was incorrect in reporting the following characters: 1) 26 circumoral spines (there are in fact 27 spines in the holotype; Fig. 1A); 2) the absence of tegumental spines in the post-testicular region, which is actually spined; and 3) the absence of an uroproct (i.e., a connection of the intestinal ceca with the excretory bladder), which is actually present (Fig. 1D). Consequently, the species diagnosis of *P. panamense,* the type species of the genus *Pseudacanthostomum* Caballero, Bravo-Hollis, and Grocott, 1953, is emended accordingly.

In 1965, Nahhas and Short described another species, *P. floridensis,* to accommodate 2 specimens from *Galeichthys* (=*Arius*) *felis* from Florida, U.S.A. The authors differentiated this species from *P. panamense* by the number of circumoral spines (28 compared with 26), the greater extent of the vitellaria, and the presence of an uroproct.

The presence of an uroproct in *P. panamense* was not reported by Caballero et al. (1953), who stated that there is no connection between the intestinal ceca and excretory bladder ("Los ciegos intestinales . . . no se abren en la vesícula excretora" [p. 121] and "Los ciegos intestinales no desembocan a la vesícula excretora" [p. 122]). However, this study has demonstrated that an uroproct is in fact present in *P. panamense* (Fig. 1D). Consequently, *P. panamense* and *P. floridensis* do not differ in this character (Table 1).

Although the number of circumoral spines is fairly stable in acanthostomid trematodes and can be species-specific (Brooks, 1980), some

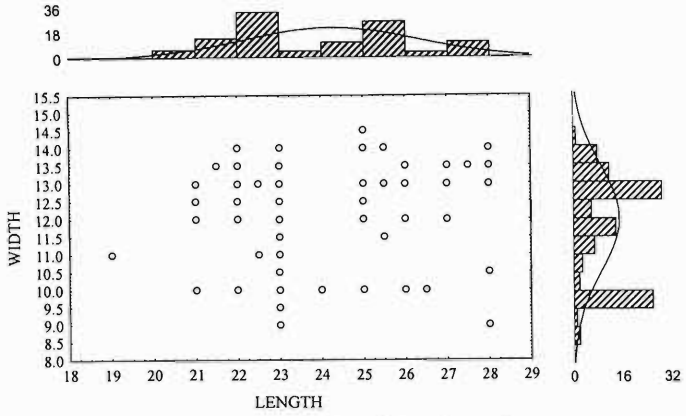

Figure 4. Range of size of eggs (length and width) of *Pseudacanthostomum panamense*. Measurements of all eggs measured (N = 59) grouped together. Values in micrometers.

variability apparently exists (Brooks and Overstreet, 1977; Ostrowski de Núñez, 1984; Scholz et al., 1995a, b). This is also the case in the present material (Table 2). Although a majority of specimens (93%) had 27 spines, including the holotype of *P. panamense* (see Results and Fig. 1A), a few specimens had a different number of spines. One trematode from *A. assimilis* from Bacalar (Mexico) possessed 26 spines, and 2 specimens from the same host (*A. assimilis*) from Chetumal (Mexico) had 28 spines (i.e., the identical number reported for *P. floridensis*) (Table 2).

The extent of distribution of vitelline follicles in the holotype of *P. floridensis* is actually more anterior than in *P. panamense* specimens. However, there is great variability in this feature. Trematodes from *Ariopsis seemani* have follicles reaching to the acetabular level (Fig. 1G) or even to the anterior margin of the ventral sucker (Fig. 1H), whereas those from *A. assimilis* have vitelline follicles mostly restricted to the postacetabular region (Fig. 1E, F) with vitelline follicles reaching to the posterior border of the ventral sucker in only a few specimens. It also seems that contraction of the body influences the position of follicles; in contracted specimens vitelline follicles usually reach to the acetabular level (Fig. 1G, H), whereas in protracted worms, the follicles start rather far posterior to the ven-

Table 3. Survey of hosts, localities, dates of collection, and parameters of infection with *Pseudacanthostomum panamense*.

Host	Country and locality	Date	No. of fish infected/ examined	Mean intensity	Minimum–maximum
Adults					
Ariopsis seemani	Colombia	5/96	4/7	1.5	1–2
Ariopsis assimilis	Bacalar, Quintana Roo, Mexico	1/95	1/1	12	—
	Chetumal Bay, Quintana Roo, Mexico	10/96	39/96	7.5	1–30
Arius guatemalensis	Marismas Chalacatepec, Jalisco, Mexico	3/95	3/3	24	9–52
Metacercariae					
Dormitator latifrons	Marismas Chalacatepec, Jalisco, Mexico	3/95	1/24	39	39
	Río San Nicolás, Jalisco, Mexico	11/94	1/5	52	52
		9/95	2/16	1	1
	Río Cuitzmala, Jalisco, Mexico	9/95	5/7	(not counted)	
Gobiomorus maculatus	Río Cuitzmala, Jalisco, Mexico	1/95	0/25	—	—
		3/95	2/37	3	1–5
		9/95	22/31	(not counted)	

tral sucker (Fig. 1E). It is evident that this character is not sufficiently stable and its taxonomic importance is questionable. Because *P. floridensis* was described on the basis of only 2 specimens, the anterior position of vitellaria should be confirmed in much more extensive material.

Statistical analysis of egg measurements has revealed a great intraspecific variability in egg length and width (Fig. 4). Nevertheless, this analysis has not demonstrated any significant differences in the length and width of eggs of *P. panamense* and *P. floridensis* (Fig. 3). Eggs of *P. panamense* specimens from Colombia were larger than those of conspecific worms from Mexico, thus being more similar to eggs of *P. floridensis* (Fig. 3). Because of the identity of *P. floridensis* with *P. panamense* in almost all morphological and biometrical characters (the distribution of vitelline follicles is considered a doubtful and unsuitable taxonomic criterion for differentiation of these taxa), the former species is synonymized with *P. panamense.*

On the basis of the proposed synonymy, the genus *Pseudacanthostomum* becomes monotypic, currently containing only 1 species, *P. panamense.* In the presence of an uroproct, *P. panamense* resembles members of the genus *Pelaezia* Lamothe-Argumedo and Ponciano-Rodríguez, 1986, of the subfamily Acanthostominae Nicoll, 1914 (see Lamothe-Argumedo and Ponciano-Rodríguez, 1986). However, *Pelaezia* differs, as all other genera of the Acanthostominae, in that the uterus is never situated posterior to the testes (mostly completely preovarial), whereas its loops reach to the posterior extremity in *Pseudacanthostomum,* the type genus of the subfamily Pseudacanthostominae Yamaguti, 1958. In addition, both species of *Pelaezia, P. unami* (Peláez and Cruz-Lozano, 1953), the type species, and *P. loossi* (Pérez-Vigueras, 1957), have different numbers of circumoral spines (30 and 23, respectively; Peláez and Cruz-Lozano, 1953; Pérez-Vigueras, 1957; Brooks, 1980; Salgado-Maldonado and Aguirre-Macedo, 1991).

The subfamily Pseudacanthostominae Poche, 1926 contains only 2 genera, *Pseudacanthostomum* and *Pseudallacanthochasmus* Velasquez, 1961, members of which parasitize marine fish in the Americas and Southeast Asia, respectively (Yamaguti, 1971). This subfamily differs from the Acanthostominae in possessing a long prepharynx (Yamaguti, 1971, p. 212). However, as demonstrated in this study, the prepharynx is usually short or even absent (Fig. 2A, F) in many *P. panamense* specimens. Moreover, the length of the prepharynx is highly variable, depending mainly on the state of contraction of the worms. Therefore, this feature should not be used as a differential criterion for the diagnosis of this subfamily. In other features, the subfamiliar diagnosis presented by Yamaguti (1971)—i.e., the uterus extending to the posterior extremity (different from other acanthostomid subfamilies except for Anisocladiinae Yamaguti, 1958)—the ceca being equal and reaching to the posterior extremity, the ventral sucker being well apart from the anterior extremity, and the vitelline follicles being both anterior and posterior to the ovary (differing from Anisocladiinae) well characterize the subfamily Pseudacanthostominae.

Metacercariae found in eleotrid fishes from the Pacific coast of Mexico are considered to be conspecific with *P. panamense* because of their morphology (Fig. 2E, H, I), in particular the presence of 27 circumoral spines (Fig. 2H, I) and the morphology of the intestinal ceca, which are connected with the excretory bladder near the posterior extremity, thus forming an uroproct (Fig. 2E). This is the first record of *P. panamense* from the second intermediate host. It can be assumed that the life cycle of this taxon resembles that of other acanthostomid trematodes (Yamaguti, 1975). The first intermediate host is a mollusk (snail), in which the cercariae develop; the second intermediate hosts are fish in which the metacercariae are encysted. The definitive host, an ariid catfish, becomes infected by ingesting fish with metacercariae. *Dormitator latifrons* and *Gobiomorus maculatus* are fish living in brackish water, i.e., in the same habitat in which ariid catfish occur; the latter become infected after consuming prey fish harboring metacercariae.

Pseudacanthostomum panamense seems to be a common parasite of catfishes of the family Ariidae. Existing records of *P. panamense* from the southern U.S.A. (Florida), Mexico (both Atlantic and Pacific coasts), Panama (Pacific coast), and Colombia indicate that it is a species with a wide distribution in the Neotropical zoogeographical region on both the Pacific and Atlantic coasts.

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