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A NEW DIPLECTANID (MONOGENEA) GENUS AND SPECIES FROM THE GILLS OF THE BLACK SNOOK, *CENTROPOMUS NIGRESCENS* (PERCIFORMES: CENTROPOMIDAE) OF THE PACIFIC COAST OF MEXICO

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ABSTRACT: *Cornutohaptor nigrescensi* n. sp. (Diplectanidae) is described from the gills of the black snook, *Centropomus nigrescens* (Perciformes: Centropomidae) from the Pacific coast of Mexico. *Cornutohaptor* n. gen. is proposed for this new species and is characterized by possessing 2 intestinal ceca terminating blindly; a germarium looping right intestinal cecum; bilobed testis; 2 seminal vesicles; 7 pairs of hooks, each with protruding thumb; a grooved ventral bar and coiled male copulatory organ (MCO); an accessory piece comprising a ''baglike structure'' with an appendage; dorsal bars associated parallelly to body midline; and no adhesive accessory organs on the haptor. *Cornutohaptor* differs from all confamilial genera by including species with anchors with straight and deep root longest, hook pair 1 reduced in size, MCO with counterclockwise rings, and by the morphology of the accessory piece. *Cornutohaptor nigrescensi* most closely resembles species of *Murraytrema* Price, 1937, *Lobotrema* Tripathi, 1937, and *Murraytrematoides* Yamaguti, 1958, because of the absence of squamodiscs or lamellodiscs on the haptor and tegumental scales on the posterior portion of the body. *Cornutohaptor* differs from these genera in the position and number of haptoral bars (2 bars in *Lobotrema* spp., dorsal bars transversally associated in *Murraytrema* and *Murraytrematoides* spp.) and in having a coiled MCO (copulatory organ is a comparatively straight, poorly sclerotized tube in *Murraytrematoides* spp.). This is the first diplectanid described from a centropomid along the Pacific coast of Mexico.

Species of Diplectanidae Monticelli, 1903 (Polyonchoinea: Dactylogyridea) are predominantly gill parasites of freshwater and marine perciforms of Centropomidae, Megalopidae, Nemipteridae, Percichthiydae, Polynemidae, Sciaenidae, Serranidae, Sillaginidae, Sparidae, Sphyraenidae, Teraponidae, and Toxodidae (Beverley-Burton and Suriano, 1981; Kritsky and Thatcher, 1984; Kritsky and Beverley Burton, 1986; Dyer, 1995; Vidal-Martínez et al., 1997; Vidal-Martínez and Mendoza-Franco, 1998; Kritsky et al., 2000, 2001; Mendoza-Franco et al., 2004). In this article, a new genus and species of the Diplectanidae is described from the gills of the black snook, *Centropomus nigrescens* Günther, 1864, Centropomidae, from the Pacific coast of Mexico, and data on its prevalence and intensity of infection for each sampling site are provided. The diplectanid specimens described herein were collected as part of an ongoing study on metazoan parasite communities associated with parasite exchange among marine, estuarine, and freshwater fishes from the Pacific coast, in the state of Guerrero, Mexico.

MATERIALS AND METHODS

Hosts were captured by hook and line and throw nets from August to November 2003 in the Tres Palos (16°47′N, 99°39′W) and Coyuca (16°57′N, 100°02′W) lagoons along the Pacific coast of the state of Guerrero, Mexico (Fig. 1). Collected fish were stored whole at −20 C until examination. After thawing, gill arches were removed and placed in petri dishes with tap water. All parasites were detached from the gills and transferred individually to 70% ethanol. They were then stained with acid carmine and mounted in Hycel synthetic resin as permanent preparations. Unstained flattened specimens mounted in Gray and Wess's medium were used to obtain measurements and line drawings of haptoral structures and the copulatory complex. All other measurements were obtained from unflattened specimens stained in acid carmine. In addition, some specimens collected in 2005 from freshly killed fish were fixed with hot 4% formaldehyde and stained and mounted as described above. Drawings were made with the aid of a drawing tube, by using an Olympus microscope with Nomarski interference contrast. Measurements, all in micrometers, represent straight-line distances between extreme points of the structures measured and are expressed as the mean followed by the range and number (n) in parentheses; body length includes that of the haptor. Numbering of hook pairs follows the scheme illustrated in Kritsky et al. (2000, 2001). Prevalence was calculated as the percentage of host in a sample infected with *C. nigrescensi*, whereas intensity of infection was considered to be the mean number of monogeneans per infected fish in a sample (Bush et al., 1997). To determine differences in prevalence and mean intensity of infection values, an analysis of covariance (ANCOVA) test was applied. Type and voucher specimens are deposited in the National Helminthological Collection of Mexico (CNHE), Institute of Biology, National Autonomous University of Mexico, Mexico; The Natural History Museum, London, U.K., (BMNH); The Helminthological Collection of the Institute of Parasitology, České Budějovice, Czech Republic (IPCAS); and the U.S. National Parasite Collection, Beltsville, Maryland (USNPC), as indicated in the following description. Additional voucher lots, not examined for the present study, are available in the CNHE.

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DESCRIPTION

Cornutohaptor nigrescensi n. gen.

Diagnosis: Diplectanidae. Body somewhat flattened dorsoventrally, fusiform, comprising cephalic region, trunk, peduncle, and haptor. Tegument smooth, lacking tegumental scales and peduncular adhesive accessory organs. Two terminal, 2 bilateral cephalic lobes; head organs numerous. Cephalic glands at level of pharynx. Eyes present. Mouth subterminal, midventral; pharynx muscular, glandular; esophagus short to absent; 2 intestinal ceca terminating blindly posterior to gonads, lacking diverticula. Gonads tandem or slightly overlapping. Testis postgermarial, dorsal; vas deferens not looping intestinal cecum; 2 seminal vesicles as dilations of vas deferens. One prostatic reservoir; glandular masses dorsal to vagina. Copulatory complex comprising nonarticulated male copulatory organ (MCO), accessory piece; MCO a coiled tube with counterclockwise rings. Accessory piece enclosing terminal male genitalia. Germarium pretesticular, pyriform, looping right intestinal cecum dorsoventrally; seminal receptacle pregermarial; vaginal aperture sinistroventral. Genital pore midventral. Vitellaria well developed, coextensive with intestine. Haptor with ventral and dorsal pair of anchors, ventral bar and paired dorsal bars, 7 pairs of hooks with ancyrocephalinae distribution; hook pair 1 reduced in size. Anchors similar, each with robust and straight elongate deep root (deep root longest), prominent knoblike superficial root and recurved shaft (twisted shaft in the ventral anchors) with upright points. Ventral bar with longitudinal groove; parallelly associated dorsal bars to body midline. Parasites of the gills of brackish water fish (Perciformes: Centropomidae).

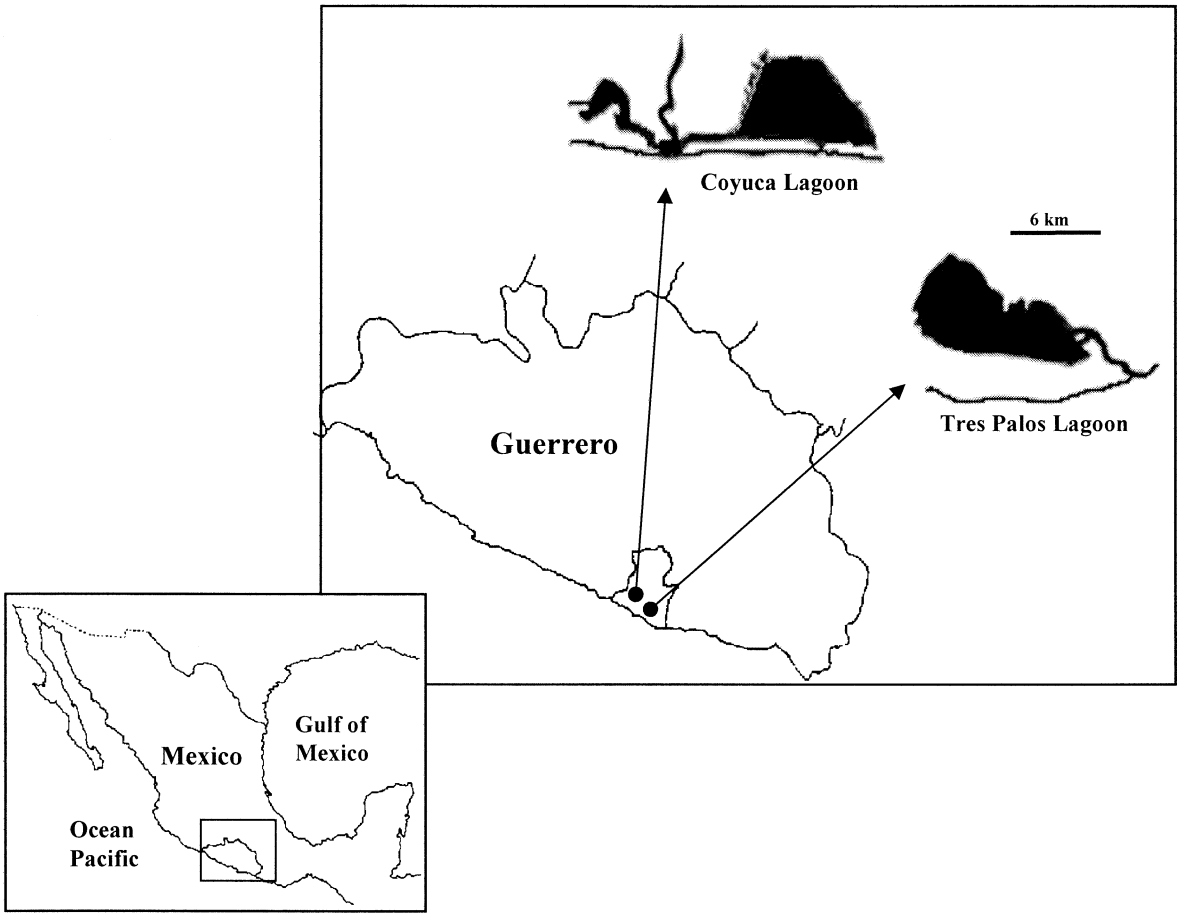


FIGURE 1. Map showing geographic sites from which fish of *C. nigrescens* were collected.

Taxonomic summary

Type species: Cornutohaptor nigrescensi n. sp.

Etymology: The generic name is derived from the Latin word *cornutus* = horned, appended to the term, ''haptor,'' commonly used in the Monogenea, and refers to the twisted shaft and upright points of the ventral anchors.

Cornutohaptor nigrescensi n. sp.
(Figs. 2–12)

Description (based on 19 specimens stained [14 measured] with acid carmine and 9 unstained specimens in Gray and Wess's medium): Body robust, fusiform to foliiform, 864 ± 217 (540–1270; n = 14) long; greatest width 305 ± 81 (210–490; n = 14) usually in posterior trunk near level of testis. Two terminal, 2 bilateral cephalic lobes poorly developed; head organs numerous along anterolateral margins of cephalic area; cephalic glands posterolateral to pharynx. Two pairs of minute eyes; posterior pair slightly larger than anterior pair; accessory granules usually absent. Mouth subterminal, ventral to pharynx. Pharynx subrectangular to ovate, 71 ± 14 (43–90; n = 13) in greatest width; esophagus short, obscured by vitellaria; intestinal ceca blind. Peduncle short to elongate. Haptor subrectangular, slightly bilobed and indented medially, 132 ± 19 (91–155; n = 11) wide. Ventral anchor 67 ± 2 (64–70; n = 11) long, base 52 ± 2 (48–55; n = 14) wide, with perpendicular knoblike superficial root. Dorsal anchor 49 ± 2.4 (45–52; n = 11) long, base 39 ± 2 (36–42; n = 8) wide, with erect knoblike superficial root. Ventral bar 51 ± 5.3 (45–63; n = 11) long, with tapered ends; paired dorsal bars, each 47 ± 4.07 (40–52; n = 10) long, bilobed internally. Hooks similar, each with protruding thumb, delicate point, dilated shank, tapered proximally; hook pairs 2, 3, 4, 5, 6, and 7, 20 ± 0.68 (17–21; n = 30) long; hooks pair 1, 14 ± 0.71 (13–15; n = 5) long; filamentous hooklet (FH) loop one-third shank length (pairs 2, 3, 4, 5, 6, 7), ½ shank length (pair 1). Male ejaculatory duct a conspicuous tube arising from pyriform sclerotized base, 28 ± 2 (24–33; n = 21) long, looping dorsoventrally and posteriorly forming complete clockwise ring to extend through the MCO. MCO a coiled tube comprising about 2 counterclockwise rings, 55 ± 6 (42–69; n = 14) proximal ring diameter, with bowl-like sclerotized base. Accessory piece a delicate ''baglike structure'' from which a U-shaped long appendage extends posteriorly at level of vaginal tube (Fig. 7). Testis, 133 ± 43 (87–215; n = 11) wide, bilobed. Vas deferens arising from anteromedial margin of testis, ascending along right side of copulatory complex, slightly constricted into proximal fusiform seminal vesicle with distinct wall, folded dorsally into distal (secondary) seminal vesicle with conspicuous thickened wall that empties dorsally into base of the ejaculatory duct (Fig. 7). Prostatic reservoir subspherical, 51 ± 6 (43–63; n = 8) long, anterodorsal to MCO. Prostatic cells (glands), immediately posterior to intestinal bifurcation, lying to left of body midline forming extensive mass directed posteriorly (Fig. 2). Germarium 130 ± 35 (65–186; n = 12) wide. Oviduct and seminal receptacle observed in few specimens; ootype not observed. Egg tetrahedral, with elongate proximal filament, 82 long (excluding filament), 35 wide (Fig. 10). Vagina oval shaped from which sclerotized L-shaped tube originates.

Taxonomic summary

Type host: Black snook, *C. nigrescens* (Perciformes: Centropomidae).

Site of infection: Gills.

Type locality/collection date: Tres Palos lagoon (16°47′N, 99°39′W), Pacific coast of Guerrero, Mexico, August 2003.

Another locality: Coyuca lagoon (16°57′N, 100°02′W), Pacific coast of Guerrero state, Mexico, November 2003.

Specimens deposited: Holotype, CNHE (5432); 9 paratypes in CNHE

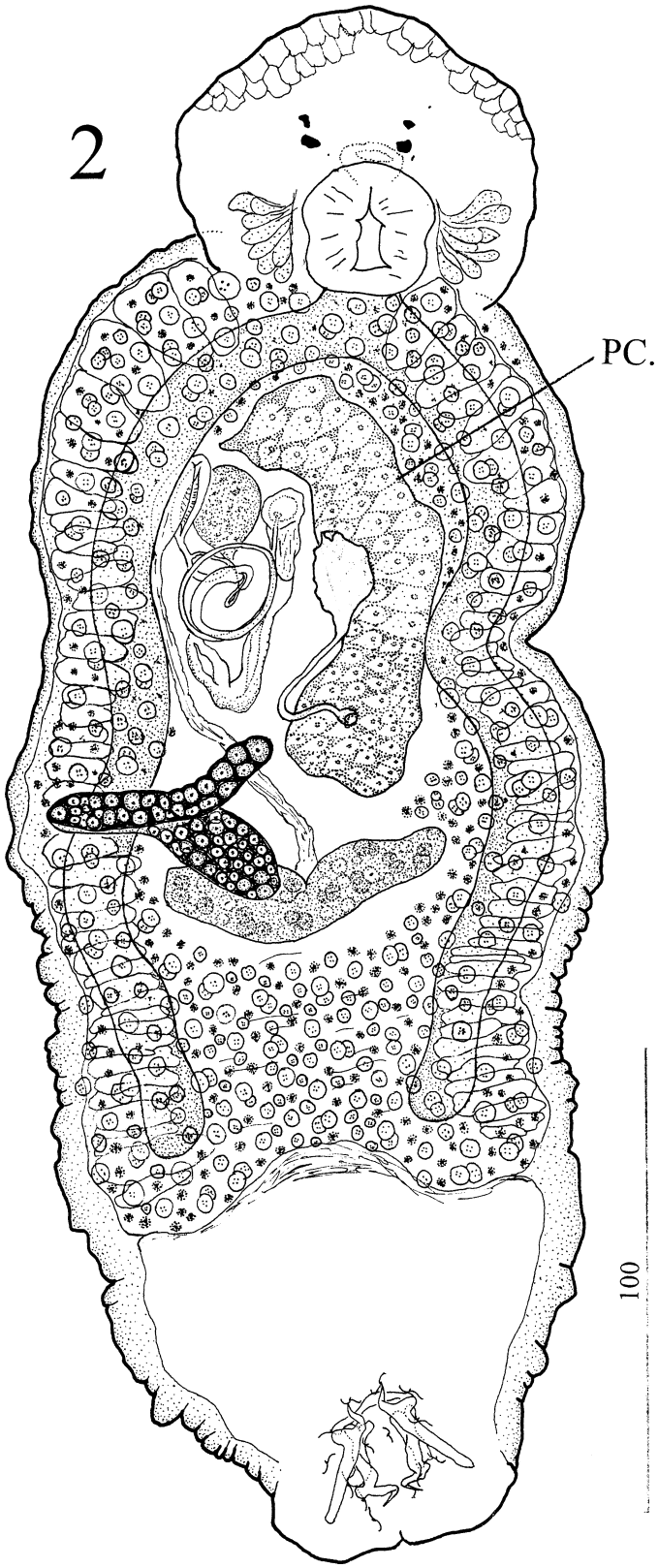


FIGURE 2. *C. nigrescensi* n. gen. and n. sp. Whole mount (composite, ventral).

(5433), 3 paratypes in BMHN (2006.4.6.1–3); 5 reference specimens, IPCAS (m-418); and 10 paratypes, USNPC (97290).

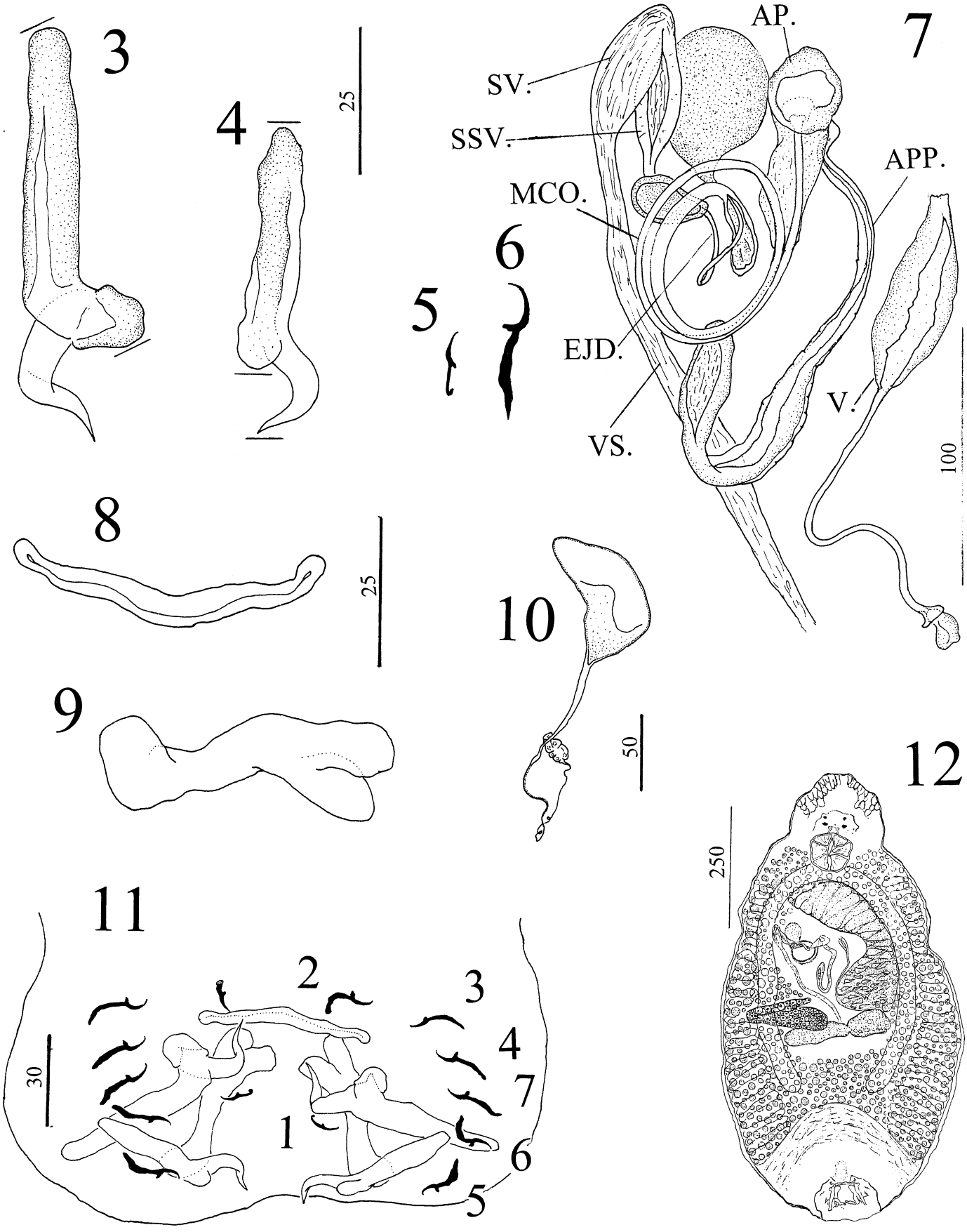
Prevalence and intensity of infections: Sixteen fish (average size 26 ± 4 cm of total length) infected of 49 examined (33%); mean intensity of infection 10 ± 4 worms per infected fish from Tres Palos lagoon; 6 (31 ± 3 cm of total length) of 9 fish examined from Coyuca lagoon (67%; 15 ±13).

Etymology: C. nigrescensi is named after its host.

Remarks

Cornutohaptor n. gen. is monotypic. The general morphology of the haptoral structures and internal organ systems of its type, *C. nigrescensi*, justifies its placement in Diplectanidae. The presence of blindly ending intestinal ceca, the germarium looping the right intestinal cecum (symplesiomorphic feature for all members of Diplectanidae), a copulatory complex comprising MCO and accessory piece (when present), hooks of similar shape (each with depressed thumb), grooved ventral bar, and paired dorsal bars are generally used to assign monogeneans to this family (Boeger and Kritsky, 1993; Kritsky et al., 2001; Mendoza-Franco et al., 2004). *Cornutohaptor nigrescensi* has several unique haptoral features that markedly differ from that of other Diplectanidae species, i.e., the presence of anchors with a robust and straight elongate deep root (deep root longest), a prominent knob on the superficial surface of the anchor base, and hornlike shaft and upright points. Deep roots with much less elongation than those from *C. nigrescensi* and a superficial knob on the base of the ventral and dorsal anchors also have been reported in a few species of *Diplectanum* Diesing, 1858, *Pseudolamellodiscus* Yamaguti, 1953, *Lamellodiscus* Johnston and Tiegs, 1922, and some species of *Schilbetrema* Paperna and Thurston, 1968 (Dactylogyridae) from African Schilbeidae (Siluriformes) (Kritsky and Kulo, 1992; Kritsky et al., 2000). The presence of a ''baglike structure'' with a strong appendage of the accessory piece located at the terminal male genitalia is another unusual feature of *Cornutohaptor*. Another unusual characteristic of *C. nigrescensi* is the reduced size of hook pair 1 in the haptor. In this species, 6 pairs of hooks of similar size are marginal, and 1 pair (posteromedian) is of different size.

The Diplectanidae is composed of 4 subfamilies based on the morphology and presence/absence of the haptor's accessory adhesive organs: Diplectaninae Monticelli, 1903 (''squamodiscs'' composed of concentric rows of sclerotized rodlets); Lamellodiscinae Oliver, 1969 (''lamellodiscs'' composed of concentric lamellae); Rhabdosynochinae Oliver, 1987 (lateral ''placodiscs'' [= as delicate membranous frill in Kritsky et al., 2001] unarmed); and Murraytrematoidinae Oliver, 1982 (accessory adhesive organs absent) (Oliver, 1987; Desdevises et al., 2001). *Cornutohaptor* resembles 3 diplectanid genera apparently belonging to the latter subfamily, i.e., *Murraytrema* Price, 1937, *Lobotrema* Triparthi, 1937, and *Murraytrematoides*Yamaguti, 1958, in its absence of squamodiscs or lamellodiscs on the haptor and tegumental scales on the posterior portion of the body (Caballero et al., 1955; Yamaguti, 1958). *Cornutohaptor* differs from these latter diplectanid genera in the position and number of haptoral bars (2 bars in *Lobotrema* spp. and dorsal bars horizontally associated in *Murraytrema* and *Murraytrematoides* spp.) and by possessing a coiled MCO (copulatory organ is a comparatively straight, poorly sclerotized tube in species of *Murraytrematoides*). The new genus differs in several unique characteristics, to the extent that the proposal of a new family and/or subfamily to accommodate it is tempting. However, evolutionary relationships of the genus are unclear, even though *Cornutohaptor* apparently shares several characters considered derived from the 18 genera (excluding the present genus) comprising the family (Desdevises et al., 2001; Mendoza-Franco et al., 2004) and morphological affinities with species of *Murraytrema*, *Lobotrema* and *Murraytrematoides*, which are basally into the phylogeny of Diplectanidae (Desdevises et al., 2001). The known geographic distribution of Diplectanidae species ranges from the western Indian Ocean (Red Sea and the Persian Gulf) to subtropical a tropical areas (Gulf of Mexico, Brazil, Australia, Madagascar, Maccasar, and South China Sea) (Beverley-Burton and Suriano, 1981; Kritsky and Thatcher, 1984; Kritsky and Beverley Burton, 1986; Dyer, 1995; Vidal-Martínez et al., 1997; Vidal-Martínez and Mendoza-Franco, 1998; Kritsky et al., 2000, 2001; Mendoza-Franco et al., 2004). Known diplectanid species infecting centropomids are restricted to the Gulf of Mexico and southwestern Atlantic Ocean (Florida, Puerto Rico, and Brazil) and belong to *Rhabdosynochus* (Bunkley-Williams and Williams, 1994,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1995; Kritsky et al., 2001). *Cornutohaptor nigrescensi* represents the first diplectanid described from a centropomid from the Pacific Ocean infecting 1 (*C. nigrescens*) of a total of 12 *Centropomus* spp. in Mexico (Secretaría de pesca, 1994).

Although relatively few specimens (9) of *C. nigrescens* were examined from Coyuca Lagoon compared with the number collected (49) from Tres Palos Lagoon, the former were more heavily infected (differences in prevalence values $G = 83.49$, $P < 0.01$, mean intensity of infection: ANCOVA, $F_{1,19} = 5.31$, $P < 0.05$). These differences may be related to the 2 lagoons' hydrological characteristics. The Coyuca Lagoon has a short channel opening to the sea that serves as an important route of migration for marine fish species in and out of the lagoon. Tres Palos Lagoon, in contrast, has a long, sinuous channel connecting it to the sea that restricts fish migration. Thus, fish such as *C. nigrescens* cannot easily reach the sea from Tres Palos Lagoon and must reside in the lagoon for longer periods (Fig. 1). This temporary isolation mechanism may explain the possible endemism of *C. nigrescensi* from the Mexican Pacific.

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FIGURES 3–12. *C. nigrescensi* n. gen. and n. sp. **3.** Ventral anchor (parallel lines indicate dimension measured). **4.** Dorsal anchor. **5.** Hook pair 1. **6.** Hook pairs 2–7. **7.** Enlargement of worm at level of reproductive organs (composite, ventral). **8.** Ventral bar. **9.** Dorsal bar. **10.** Egg. **11.** Ventral view of haptor showing positions of hook pairs. **12.** Whole mount of a contracted specimen. All figures are drawn to the 25-μm scale, except 2, 7, 10, 11, and 12 (100-, 100-, 50-, 30-, and 250-μm scales, respectively). Abbreviations: AP, accessory piece; APP, appendage; EJD, ejaculatory duct; MCO, male copulatory organ; PC, prostatic cells; SV, seminal vesicle; SSV, secondary seminal vesicle; V, vagina; VS, vas deferens.