

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Investigations of the Ichthyofauna of
Nicaraguan Lakes

Papers in the Biological Sciences

1976

Helminths from Elasmobranchs in Central American Fresh Waters

Donald E. Watson
University of Lagos

Thomas B. Thorson
University of Nebraska-Lincoln

Follow this and additional works at: <https://digitalcommons.unl.edu/ichthynicar>



Part of the [Aquaculture and Fisheries Commons](#)

Watson, Donald E. and Thorson, Thomas B., "Helminths from Elasmobranchs in Central American Fresh Waters" (1976). *Investigations of the Ichthyofauna of Nicaraguan Lakes*. 52.
<https://digitalcommons.unl.edu/ichthynicar/52>

This Article is brought to you for free and open access by the Papers in the Biological Sciences at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Investigations of the Ichthyofauna of Nicaraguan Lakes by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Helminths from Elasmobranchs in Central American Fresh Waters

Donald E. Watson and Thomas B. Thorson

INTRODUCTION

As far as we have been able to determine, neither monogeneans nor cestodes have been reported from elasmobranchs in fresh waters of Costa Rica, Guatemala and Nicaragua. However, 11 species of monogeneans have been reported from teleosts in these areas. They are *Dactylogyrus mizellei* C. E. Price, 1967 from *Xiphophorus helleri* (Heckel), *Cleidodiscus chavarriae* E. W. Price, 1938 and *C. travassosi* E. W. Price, 1938 from *Rhamdia rogersi* Regan; *C. strombicirrus* C. E. Price and Bussing, 1967, *Anacanthocotyle anacanthocotyle* Kritsky and Fritts, 1970, *Gyrodactylus neotropicalis* Kritsky and Fritts, 1970, *Jainus hexops* Kritsky and Leiby, 1972, *Urocleidus costaricensis* (C. E. Price and Bussing, 1967) Kritsky and Leiby, 1972 and *U. heteroancestrum* (C. E. Price and Bussing, 1968) Kritsky and Leiby, 1972 from *Astyanax fasciatus* (Cuvier); and *Gyrodactylus bullatarudis* Turnbull, 1956 and *G. costaricensis* Kritsky and Fritts, 1970 from *Poecilia sphenops* (Cuv. and Val.). All are from Costa Rica except *D. mizellei* from Guatemala.

This paper covers Monogenea and Cestoda from two elasmobranchs: a shark, *Carcharhinus leucas* (Müller and Henle), and a sawfish, *Pristis perotteti* Müller and Henle, collected during the summers from 1963 to 1968. We collected sharks from the Río Dulce about 35 km upriver near San Felipe, Guatemala. In Nicaragua, we collected them from San Juan del Norte (Greytown) at the mouth of the Río San Juan, from El Castillo about 135 km upriver on the Río San Juan, from San Carlos about 185 km upriver where the Río San Juan leaves Lake Nicaragua, and from near Los Cocos and Zapatera Island at the northwest end of the lake about 345 km from the river mouth. We examined additional sharks at Barra del Colorado, Costa Rica, at the mouth of the Río Colorado, a major fork of the Río San Juan. Sawfish examined came from Los Cocos, San Carlos and Barra del Colorado. Native fishermen caught the fish.

MATERIALS AND METHODS

Specimens were relaxed in chloretone prior to fixation in formol-acetic acid-alcohol. They were stored in 70% ethyl alcohol, stained with trichrome, Delafield's haematoxylin or acidified alum carmine and mounted in either balsam or Permount. Measurements are in micra, unless otherwise stated, with averages in parentheses.

MONOGENEA

Suborder Monopisthocotylea Odhner, 1912
Family Microbothriidae Price, 1936

Dermophthirius maccallumi n. sp.

(Figures 1-4)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Skin.

Localities: Río Colorado, Barra del Colorado, Costa Rica; Río San Juan, San Carlos, Nicaragua.

Holotype: USNM Helm. Col. No. 71464.

Paratypes: USNM Helm. Col. No. 71465 (Nicaragua), 71466 (Costa Rica).

Description (Measurements on 10 specimens): Body oval, 2.44 to 2.85 mm (2.67) long by 1.93 to 2.47 mm (2.21) wide at ovarian level. Prohaptor two bothridia opening into oral cavity. Opisthaptor cup-like, variable in appearance, 548 to 824 long (710) by 356 to 575 (493) wide, unarmed. Oral aperture terminal, prepharynx 96 to 214 (161) long, pharynx 244 to 318 (294) long by 191 to 254 (221) wide with eight digitiform papillae in anterior half. Esophagus nearly absent. Intestine with branched lateral and medial diverticula. Excretory pores dorsal, level with posterior portion of pharynx. Eyes absent. Genital sinus circular to oval, 535 to 642 (599) long by 588 to 760 (688) wide. Testes oval, entire, side by side, 328 to 412 (359) long by 448 to 630 (541) wide, postequatorial. Vas deferens highly convoluted, passing anteriorly on left side, widening in anterior portion of genital sinus into long convoluted prostate lined with tall columnar cells. Cirrus muscular, ventral wall thickened, having on its thick ventral surface two rows of spines, the inner row 14 to 18 (16) in number, measuring 11 to 30 (25) long and the outer row of 10 to 14 (usually 12) measuring 71 to 87 (79) long. The thin dorsal wall bears a single row of 100 to 125 small spines decreasing in length from 16 to 3. Genital aperture unarmed, sinistral. Ovary median, immediately pretesticular, transversely elongate, 201 to 274 (243) long by 530 to 605 (572) wide. No seminal receptacle noted. Vitellaria follicular, filling major portion of body except that occupied by reproductive organs, prohaptor and opisthaptor. Vagina slender, sinistral, opening into common genital aperture. Uterus thin-walled. Eggs tripolar, single non-collapsed egg measuring 78 long by 51 wide

excluding spines. Single anterior spine 68 long, posterior spines 65 and 82.

Remarks: *Dermophthirius maccallumi* resembles *D. carcharhini* Macallum, 1926, the only other species in the genus, in general morphology. *Dermophthirius maccallumi*, however, tends to be wider and to have larger organ measurements. The major differences are in the number and sizes of the cirrus spines. In both species there is a double row on the ventral wall. In *D. carcharhini* the inner row has about 25 spines, 19 to 40 long, and the outer row has about 25 spines, 25 to 70 long. Our specimens have an inner row of 14 to 18 spines, 11 to 30 long, and an outer row of 10 to 14 spines, 71 to 87 long. The dorsal wall of the cirrus in *D. carcharhini* has about 28 spines with a maximum length of 20. The same area in *D. maccallumi* has 100 to 125 spines, maximum length 16.

Euzet and Maillard (1967) reported what they considered to be *D. carcharhini* from *Negaprion brevirostris* (Poey) and *Carcharhinus maculipinnis* (Poey) off Senegal. They reported, however, that their specimens differed from *D. carcharhini* by having 80 large spines 100 to 125 long and an additional nine parallel rows of small spines, about 50 long. It is possible that the Senegal specimens represent a third species in this genus, the major differences among the species apparently being in the cirrus armature.

A description of the opisthaptor is rather difficult. In all probability this organ is cup-shaped but in the present specimens removal from the host resulted in the removal of the placoid scale to which each worm was attached. Attachment was maintained even following relaxation, thus fixation resulted in the opisthaptor's retaining its holding shape. In none of the specimens were jaw-like cuticular structures observed. Staining with trichrome indicated the entire ventral surface of the opisthaptor to be covered by a thin layer of cuticle.

At Barra del Colorado 100% of *C. leucas* examined, other than newborns, were parasitized. At San Carlos eight of 37 sharks (21.6%) examined had this parasite.

The name *maccallumi* is in honor of Dr. George A MacCallum who named the genus.

Suborder Polyopisthocotylea Odhner, 1912

Family Hexabothriidae Price, 1942

Heteronchocotyle leucas Hargis, 1955

(Figures 5–9)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Gills.

Localities: About 30 meters offshore from mouth of Río San Juan, San Juan del Norte, Nicaragua; Río San Juan, San Juan del Norte; Río San Juan, San Carlos, Nicaragua; Zapatera Island, Lake Nicaragua, Granada, Nicaragua; Río Colorado, Barra del Colorado, Costa Rica; and Río Dulce, San Felipe, Guatemala.

Specimens deposited: USNM Helm. Col. No. 61316 and No. 71469.

Remarks (measurements on 13 specimens): Hargis (1955) originally reported this species from *C. leucas* in the brackish waters of Lake Ponchartrain, Louisiana. We found it on the same host throughout the Lake Nicaragua-Río San Juan-Río Colorado system, as well as just offshore where the surface waters were reported to be "sweet," and in the Río Dulce. As with *Dermophthirius maccallumi*, all specimens seemed to be alive at the time of collection.

There is a constant difference between the shapes of the two large hooks. Hargis does not mention it, but he shows it in his diagram. The dextral hook is shorter and has a shorter radius than the sinistral hook. The dextral hook is 276 to 416 (321) long, the sinistral 288 to 469 (349).

Erpocotyle carcharhini n. sp.

(Figures 10–13)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Gills.

Localities: Río San Juan, about 100 meters from mouth, San Juan del Norte, Nicaragua; Río Colorado, Barra del Colorado, Costa Rica.

Holotype: USNM Helm. Col. No. 61317.

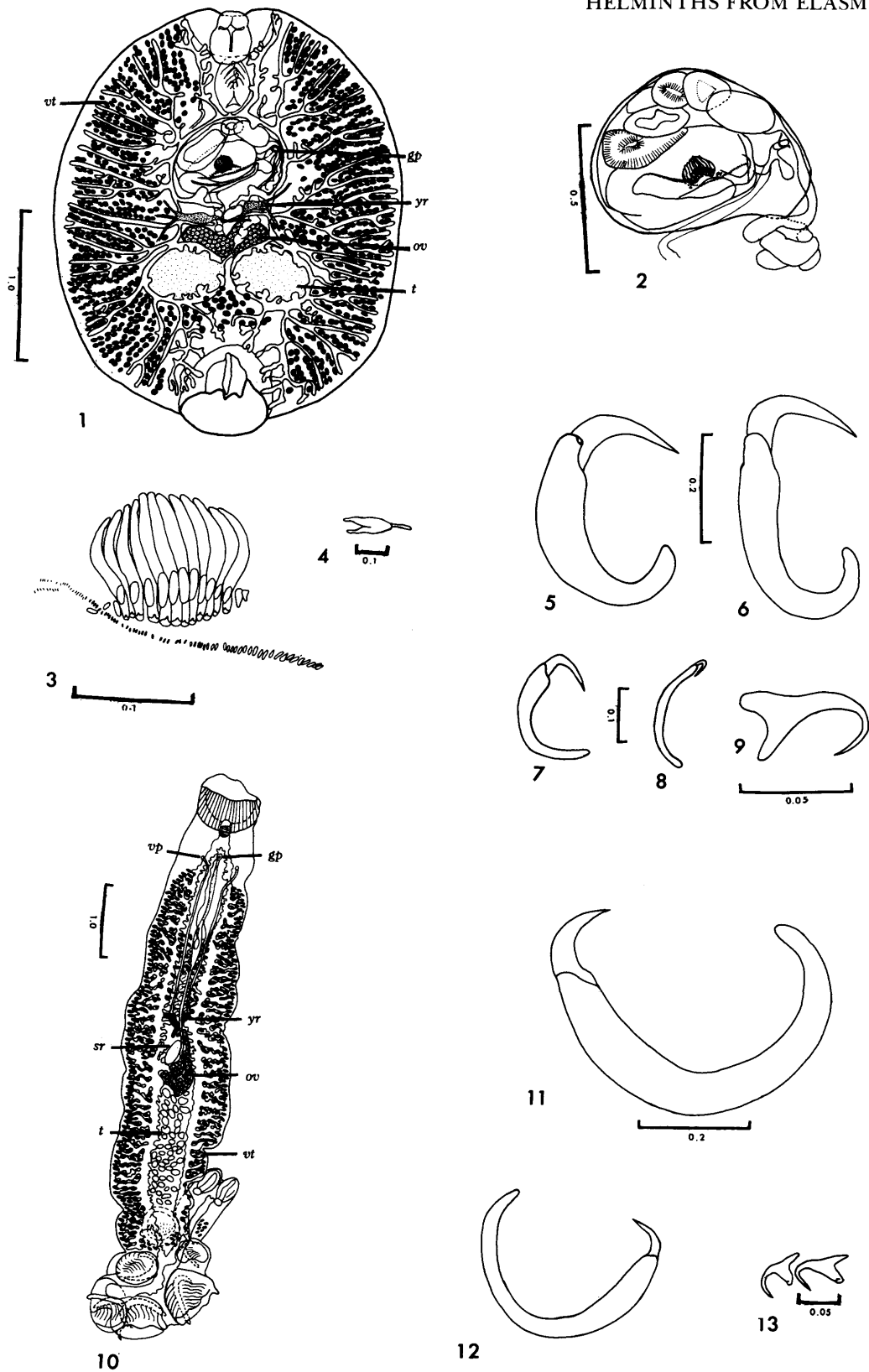
Paratype: USNM Helm. Col. No. 71467.

Description (measurements on 8 specimens): Body elongate, 4.82 to 8.00 mm (6.47) long by 1.46 to 2.04 mm (1.67) in maximum width at level of ovary, tapering gradually anteriorly. Oral sucker terminal, 653 to 756 (703) long by 780 to 1176 (920) wide, inner lining covered with minute papillae. Pharynx nearly spherical, 105 to 176 (127) long by 105 to 121 (114) wide, followed by esophagus, 44 to 121 (84) long. Short lobe extending anteriorly from base of esophagus, ventral to and slightly beyond pharynx. Ceca with branched lateral diverticula along entire length in body proper, with lobe-like protuberances medially except for branched diverticula in ovarian zone. Ceca uniting in posterior part of body; common cecum entering opisthaptor, dividing with one branch to appendix, one remaining in opisthaptor. Opisthaptor rectangular, 1.76 to 3.16 mm (2.46) long by 1.26 to 2.10 mm (1.79) wide. Six suckers, minute papillae on inner lining, on opisthaptor, each armed with single hollow hook; anterior pair 615 to 803 (728) long by 90 to 121 (111) wide; median pair 525 to 840 (752) long by 110 to 149 (124) wide; posterior pair smaller, 392 to 554 (483) long by 61 to 88 (76) wide. Proportion of "handle" to "blade" differing between anterior two pairs and posterior pair, "blade" comparatively smaller in posterior pair (Fig. 11–12). Appendix cylindrical, 980 to 1395 (1263) long by 336 to 700 (538) wide. Two small suckers at tip of appendix, 375 to 420 (402) long by 158 to 203 (186) wide; constricted near base. Two small, anchor-like hooklets, 79 to 89 (81) long, between appendix suckers. Anterior half of suckers separated by cleft in appendix.

Testes number 85 to 110 (98), filling intercecal area in posterior third of body. Sinuous seminal vesicle present just anterior to midbody. Genital pore median, just posterior to intestinal bifurcation.

Ovary median, folded, starting about midbody, passing posteriorly to level of anteriormost testes, bending medially to midline, then anteriorly to level of posterior end of prominent seminal receptacle. Mehlis' gland near seminal receptacle. Eggs elliptical, 196 to 240 (215) long by 55 to 57 (55) wide, two short recurved filaments, one on each end, measuring 96 to 121 (113) long. Vitelline reservoir median, just anterior to ovary, appearing Y-shaped. Follicular vitellaria in two lateral bands from level of intestinal bifurcation into first third of appendix, confluent dorsally from junction of anterior and middle thirds of body to level of vitelline reservoir. Uterus fairly straight, extending along midline. Two vaginal pores ventral or slightly lateral to ceca and slightly posterior to genital pore. Vaginae entering transverse vitelline ducts separately.

Excretory system not observed.



FIGURES 1-4. *Dermophthirius maccallumi*. FIG. 1. Whole mount, ventral view. FIG. 2. Cirrus sac. FIG. 3. Cirrus spines. FIG. 4. Egg. FIGURES 5-9. *Heteronchocotyle leucas*. FIG. 5. Left large hook. FIG. 6. Right large hook. FIG. 7. Intermediate hook. FIG. 8. Small hook. FIG. 9. Hooklet. C, Cirrus; Ce, Cecum; Ej, Ejaculatory duct; Gp, Genital pore; Ov, Ovary; Sr, Seminal receptacle; T, Testes; Ut, Uterus; V, Vagina; Vp, Vaginal pore; Vt, Vitellaria; Yr, Yolk reservoir. FIGURES 10-13. *Erpocotyle carcharhini*. FIG. 10. Whole mount, ventral view. FIG. 11. Posterior hook. FIG. 12. Anterior hook. FIG. 13. Hooklet.

Remarks: *Erpocotyle carcharhini* differs from all other reported species in the genus by the combination of short-filamented eggs, a non-ribbed oötype, posterior pair of hooks being the smallest, vitellaria extending into appendix and absence of cecal branching in opisthaptor and appendix.

The name *carcharhini* is for the host.

Erpocotyle caribbensis n. sp.

(Figures 14–16)

Host: *Pristis perotteti* Müller and Henle, 1841.

Location: Gills.

Localities: Río Tipitapa, Los Cocos, Nicaragua; Río San Juan, San Carlos, Nicaragua.

Holotype: USNM Helm. Col. No. 61318.

Paratypes: USNM Helm. Col. No. 71468.

Description (measurements on 7 specimens): Body elongate 5.25 to 14.40 mm (10.53) long by 1.48 to 1.94 mm (1.69) in maximum width at level of ovary, tapering anteriorly; constriction at level of genital pore; tapering slightly posteriorly prior to joining opisthaptor. Oral sucker 360 to 728 (552) long by 600 to 855 (734) wide, surrounded by small membranous oral hood bearing two to three rows of small papillae. Prepharynx short, 21 to 53 (39) long; pharynx oval, 120 to 192 (157) long by 101 to 128 (118) wide; esophagus 15 to 187 (102) long. Digestive ceca with branched lateral and medial diverticula. Ceca uniting in posterior part of body; common cecum entering opisthaptor, dividing into three major branches which further branch. Opisthaptor somewhat circular, 1.01 to 2.54 mm (2.01) long by 1.76 to 2.30 mm (2.01) wide. Three pairs of suckers on opisthaptor, lacking papillae but provided with cuticular striations, each armed with single hook. Anterior hooks smallest, 480 to 715 (602) long by 90 to 143 (120) wide; median pair largest, 563 to 770 (691) long by 112 to 166 (138) wide; posterior pair 540 to 717 (625) long by 83 to 150 (122) wide. Short conical appendix present, 429 to 803 (589) long, bearing two small anchor-like hooklets, 68 to 81 (76) long. One specimen out of eight shows what might be a small appendix sucker, measuring 116 long by 100 wide.

About 100 to 125 (113) testes, irregular in shape, filling intercecal area in posterior third of body. Seminal vesicle intercecal, highly coiled, just anterior to midbody, emptying into tightly coiled, rather clear, ejaculatory duct, following midline forward to cirrus. Genital pore median, ventral, just posterior to intestinal bifurcation.

Vaginal pores lateral, extracecal at level of genital pore or slightly posterior. Vaginae parallel, sinuous, median to ceca; partially filled with sperm, posterior portion filled with vitelline material. Vaginae entering transverse yolk ducts separately. Ovary about middle of body, folded, passing posteriorly on right side of body, bending medially to about midline, then turning forward. Seminal receptacle an ovoid enlargement of oviduct, to left of ovary. Uterus passing forward along midline ventral to ejaculatory duct; eggs 160 to 182 (173) long by 46 to 54 (50) wide, a single filament present on each end, about same length as egg proper, small bulb-like enlargement present where filament attached to egg. Vitellaria lateral, extending medially posterior to testes but not crossing body completely, from level of origin of cirrus to posterior end of body, not entering opisthaptor.

Excretory system not observed.

Remarks: *Erpocotyle caribbensis* differs from all other

species in the combination of seminal vesicle being an enlargement of the oviduct, anterior hooks being the smallest, vitellaria not entering opisthaptor and cecum branching in opisthaptor but not in appendix.

The name *caribbensis* is for the general locality.

Pristionchocotyle intermedia n. g., n. sp.

(Figures 17–21)

Host: *Pristis perotteti* Müller and Henle, 1841.

Location: Gills.

Localities: Río Tipitapa, Los Cocos, Nicaragua; Río San Juan, San Carlos, Nicaragua.

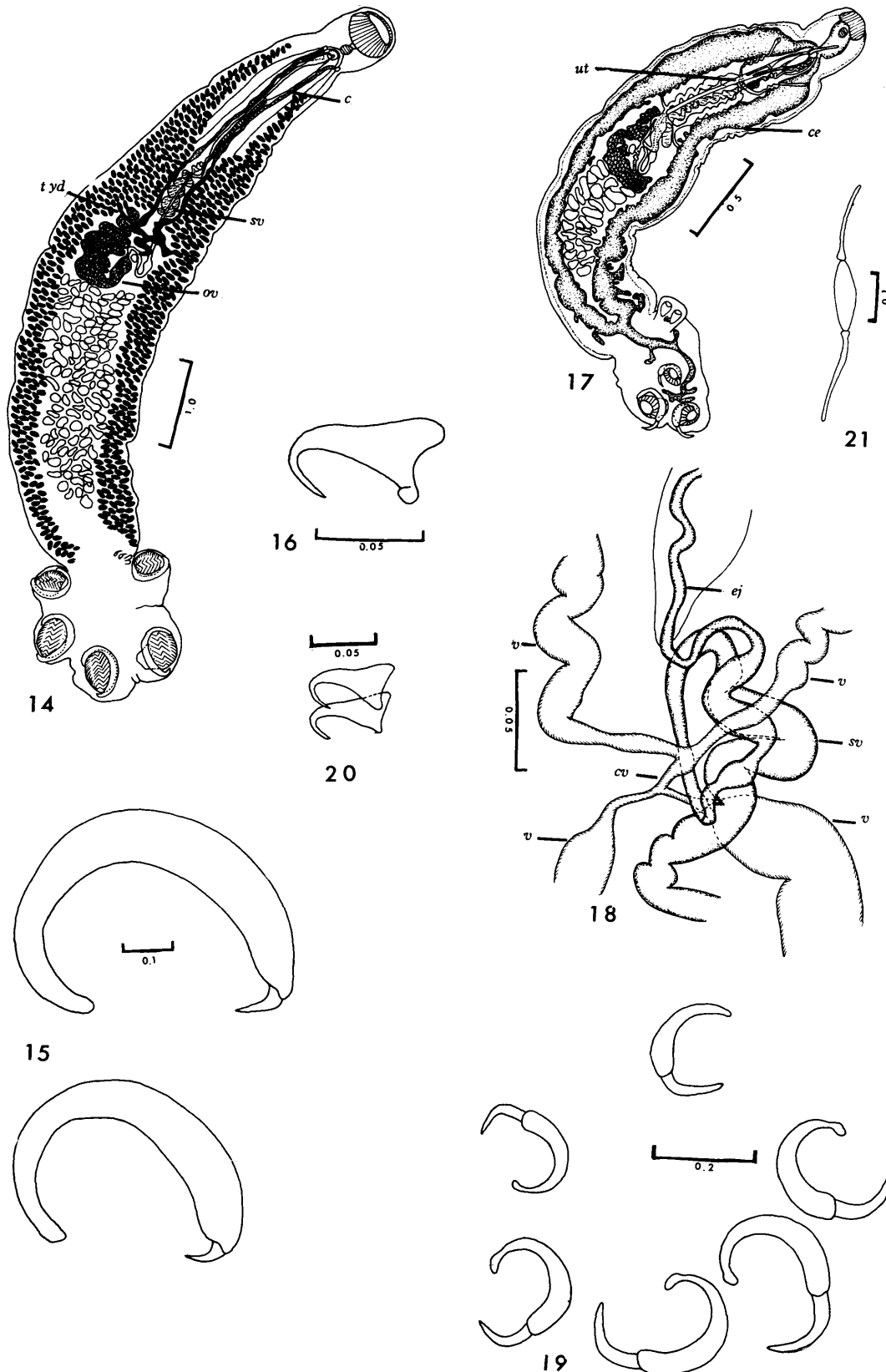
Holotype: USNM Helm. Col. No. 61319.

Paratypes: USNM Helm. Col. No. 71470.

Description (measurements on 5 specimens): Body short, sides almost parallel but widest at ovarian level, narrowing abruptly at level of genital pore, anterior end rounded. Constriction between opisthaptor and body proper. Cuticula rather thick. Length of body 2.62 to 2.73 mm (2.65), maximum width 0.492 to 0.672 mm (0.601); opisthaptor 372 to 645 (473) long by 920 to 1103 (1009) wide. Paratype with six hooks and suckers on opisthaptor; holotype, however, with three and evidence of recent loss of fourth. Hooks of different sizes (Fig. 19). Anterior hook measures 154 to 224 (189) long by 29 to 46 (39) wide, remaining hooks appear in a row, measuring from left to right 214 to 268 (234) by 36 to 49 (43), 219 to 268 (250) by 41 to 46 (45), 214 to 248 (232) by 38 to 49 (41), 182 to 214 (197) by 34 to 41 (38), and 150 to 182 (169) by 30 to 41 (34). Papillae lacking on opisthaptoral suckers. Appendix 225 to 493 (340) long by 180 to 256 (221) in maximum width near terminal end. Appendix with two suckers, 71 to 97 (87) in diameter; two anchor-like hooklets at bases of suckers, 57 to 65 (62) long by 28 to 32 (29) wide. Oral sucker terminal, 116 to 161 (158) long by 165 to 214 (196) wide, with minute papillae; prepharynx short; pharynx 54 to 78 (62) long by 49 to 61 (56) wide; esophagus 450 long on holotype. Ceca with few lateral and medial diverticula. Ceca fusing, entering opisthaptor, giving off short branches.

Approximately 40 irregularly shaped testes in third quarter of body. Long coiled seminal vesicle in middle third of body, continuing forward to level of ejaculatory duct, turning posteriorly for short distance, then turning forward, emptying into very sinuous, hyaline ejaculatory duct. Cirrus weakly muscular, thin, unarmed. Genital pore posterior to intestinal bifurcation.

Vaginal pores lateral, posterior to genital pore. Vaginae filled with sperm, sinuous, passing posteriorly and medially, fusing just anterior to seminal vesicle to form short median tube about 15 long, then dividing into two tubes, narrow at first then expanding (Fig. 18), entering transverse vitelline ducts separately. Yolk reservoir tubular, elongate, left of anterior part of ovary. Much-folded ovary dextral, near middle of body, extending posteriorly, bending into left side of body. Small, oval seminal receptacle present, medial to dextral part of ovary, 57 to 89 (77) long by 46 to 61 (53) wide. Uterus at first winding, then following straight, median course. Vitellaria lateral, extending from just anterior to vaginal pores to about posterior end of testes; two transverse vitelline ducts anterior to ovary. Eggs (Fig. 21) with filament at each end, anterior shorter than posterior. Egg proper 136 to 147 (142) long by 32 to 36 (34) wide. Filaments variable in length, anterior 35 to 161 (119) long by 18 wide at base tapering to 7 at tip, posterior 67 to 207 (157) long with same general width measurements.



FIGURES 14–16. *Erpocotyle caribbensis*. FIG. 14. Whole mount, ventral view. FIG. 15. Hooks. FIG. 16. Hooklet. FIGURES 17–21. *Pristionchocotyle intermedia*. FIG. 17. Whole mount, ventral view. FIG. 18. Vaginal fusion and separation and seminal vesicle. FIG. 19. Hooks. FIG. 20. Hooklet. FIG. 21. Egg. Cv, Common vagina; Tyd, Transverse yolduct. Other abbreviations as before.

Excretory system not observed.

Generic diagnosis of Pristonchocotyle: Polyopisthocotylea: Hexabothriidae. Oral sucker terminal. Opisthaptor wider than long, suckers and hooks unequal in size. Appendix present with two terminal suckers and two small hooklets. Pharynx small; esophagus present; ceca with lateral and medial diverticula, uniting posteriorly, bifurcating in opisthaptor, not entering appendix. Testes numerous, post-ovarian, in posterior third of body. Cirrus unarmed, weakly muscular; genital pore postbifurcal. Vaginal pores lateral, posterior to genital pore. Vaginae sinuous, uniting to form short median stem then bifurcating, entering transverse vitelline ducts separately. Vitellaria lateral. Eggs provided with stout bipolar filaments. Excretory system unknown. Parasites of sawfish.

Remarks: *Pristonchocotyle* differs from all known genera of the family Hexabothriidae by having vaginae that fuse and then divide again. In *Hexabothrium* Nordmann, 1840, *Eripocotyle* van Beneden and Hesse, 1863 and *Heteronchocotyle* Brooks, 1934, the vaginae remain parallel tubes entering the transverse yolk ducts separately. In *Pseudohexabothrium* Brinkmann, 1952, the vaginae fuse posteriorly just before entering the yolk reservoir. *Rhinobatonchocotyle* Doran, 1953 has the vaginae fusing twice before entering the yolk reservoir. The vaginae fuse and have a long median tube which enters the yolk reservoir in *Rajonchocotyle* Cerfontaine, 1899 and *Dasyonchocotyle* Hargis, 1955. An abnormal specimen was selected as the holotype as the vaginae are best seen in this specimen.

The name *Pristonchocotyle* is after the host and *intermedia* indicates the intermediate condition of the vaginae.

CESTODA

Order Tetraphyllidea Carus, 1863
Family Phyllobothriidae Braun, 1900

Phyllobothrium lactuca van Beneden, 1850

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Locality: Río San Juan, El Castillo, Nicaragua.

Specimen deposited: USNM Helm. Col. No. 61338.

Remarks: Van Beneden (1850) briefly described the species. He stated that the nearly gravid proglottids break free from the strobila. Southwell (1925, 1930), describing what he believed to be *P. lactuca*, also stated that the nearly gravid proglottids are apolytic. Yoshida (1917), Woodland (1927), Euzet (1959), Robinson (1959) and Williams (1968) maintained that the species is anapolytic. In addition to strobilate worms, we found both mature and gravid apolytic proglottids. Whether this was normal or a response by the cestode to an environmental change by the host is not known. The free proglottids were, however, always single and not in chains.

Williams (1968) questions the occurrence of *P. lactuca* in a variety of hosts throughout the world because in British waters it is found only in *Mustelus*. He suggests that the species probably is a complex of species.

We place our specimens here tentatively awaiting clarification of *P. lactuca*.

Phyllobothrium leuci n. sp.

(Figures 22–24)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

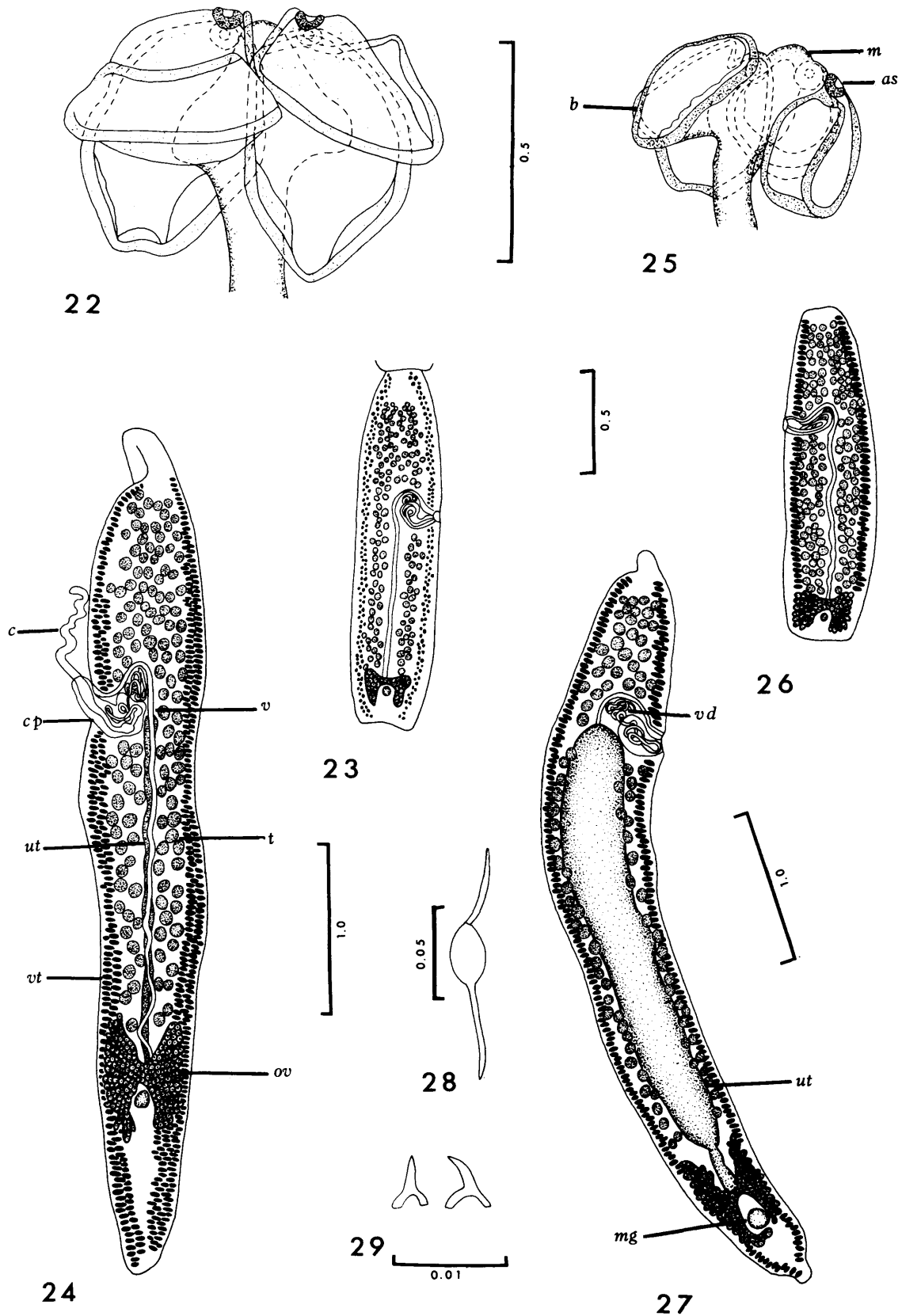
Localities: Río San Juan, San Juan del Norte, Nicaragua; Río San Juan, El Castillo, Nicaragua; Lake Nicaragua, Los Cocos, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.

Holotype: USNM Helm. Col. No. 61339.

Description (measurements on 11 worms unless otherwise noted): Acraspidote, apolytic. Length 10.1 to 42.0 mm (17.7) with 30 to 68 proglottids. Scolex 300 to 615 (458) long by 420 to 825 (584) wide, with small hump-like myzorrhynchus. Bothridia thin, edges thickened, sometimes folded to form boat-shaped structure; length 225 to 615 (436), width 195 to 405 (301). Accessory sucker from 45 to 82 wide, usually 68 to 82 (74). Neck 4.5 to 8.5 mm (6.2) long by 90 to 135 (117) wide immediately behind scolex. Immature and mature proglottids longer than wide. Mature proglottids 1.13 to 5.27 mm (1.87) long by 185 to 750 (423) wide. Testes numbering 83 to 151 (122) with 32 to 68 (45) anterior to cirrus sac, 43 to 104 (85) in diameter, not crowded together. Genital pore unilateral, one-fourth to one-third back from anterior end of proglottid. Cirrus sac 157 to 750 (239) long by 75 to 180 (97) wide, first directed posterior-medially, then bending antero-medially. Cirrus spined. Vas deferens coiled. Vagina with sphincter near poral end, poral end surrounded by gland cells. Uterus reaching level of genital pore. Ovary symmetrical, bilobed, 164 to 810 (246) long by 185 to 525 (266) wide. Mehlis' gland 43 to 120 (53) in diameter, between posterior halves of ovary. Vitellaria follicular, in two lateral bands, extending posterior to ovary. Two gravid apolytic proglottids 5.0 and 7.43 mm long by 710 and 840 wide. Genital pore one-fourth to one-third the distance from anterior end of segment. Testes number 120 in smaller proglottid, 90 to 150 (130) in diameter, and 103 in larger specimen, 71 to 96 (86) in diameter. Cirrus sac in smaller proglottid 180 long, partially extruded; in larger 390 long by 225 wide. Cirrus covered by small spines. Vas deferens confined between cirrus sac and bend in vagina. Ovary 825 and 975 long by 450 and 480 wide, anterior horns longer than posterior. Mehlis' gland 107 and 144 long. Eggs thin-shelled, with or without a small knob on one or both ends, 25 to 29 (27) long by 21 to 27 (24) wide.

Remarks: Only four species of *Phyllobothrium* having unilateral genital pores have been reported. These are *P. minutum* Shipley and Hornell, 1906; *P. unilaterale* Southwell, 1925; *P. dasybati* Yamaguti, 1934 and *P. chiloscyllyi* Subhadrpradha, 1957. The bothridia of *P. leuci* differ from those of *P. minutum* in lacking a large accessory sucker near the center of the bothridium and in not having "crumpled" edges. Woodland (1927) described *P. unilaterale* as lacking accessory suckers, but Southwell (1925) reported it as having small marginal ones. Southwell's diagram (p. 155) shows the bothridia with highly irregular, almost lobed, edges. This condition is in marked contrast to the smooth bothridia of *P. leuci*, but *P. unilaterale* is too poorly described to permit a complete comparison. *Phyllobothrium dasybati* differs in having twice as many testes as *P. leuci* and in being longer with fewer proglottids. Yamaguti's specimen is 57 mm long with "some 60 segments," whereas the longest worm in our collection is 42 mm long with 68 segments. Yamaguti apparently did not find gravid proglottids as he described no eggs. *Phyllobothrium leuci* differs from *P. chiloscyllyi* in having a spined cirrus, in being much larger, in having more testes and in having a much longer neck (1 to 2 mm in *P. chiloscyllyi* and 4.5 to 8.5 mm in *P. leuci*).

The name *leuci* refers to the host species.



FIGURES 22-24. *Phyllobothrium leuci*. FIG. 22. Scolex. FIG. 23. Mature proglottid. FIG. 24. Apolytic proglottid. FIGURES 25-29. *Phyllobothrium nicaraguensis*. FIG. 25. Scolex. FIG. 26. Mature proglottid. FIG. 27. Gravid apolytic proglottid. FIG. 28. Egg. FIG. 29. Cirrus spines. As, Accessory sucker; B, Bothridium; Cp, Cirrus pouch; M, Myzorhynchus; Mg, Mehlis' gland; O, Ovum; Vd, Vas deferens. Other abbreviations as before.

Phyllobothrium nicaraguensis n. sp.

(Figures 25–29)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).*Location:* Spiral valve.*Localities:* Río San Juan, San Juan del Norte, Nicaragua; Río San Juan, San Carlos, Nicaragua; Lake Nicaragua, Los Cocos, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.*Holotype:* USNM Helm. Col. No. 61340.

Description (measurements on 10 worms unless otherwise noted): Acraspidote, apolytic. Length 9.5 to 22.0 mm (13.5) with 24 to 25 proglottids in larger specimens. Scolex 285 to 450 (391) long by 374 to 630 (469) wide, with small hump-like myzorhynchus. Bothridia thin, with thickened, folded edges, 225 to 435 (335) long by 203 to 330 (274) wide. Accessory suckers 43 to 68 (54) in diameter at anterior edge of each bothridium. Neck 3.5 to 5.3 mm (4.9) long by 60 to 120 (106) wide just behind scolex. First few proglottids nearly square in outline. Immature proglottids soon longer than wide. Genital pore unilateral, at junction of anterior and middle thirds of segment. Cirrus sac with shape of shallow "S." About 115 closely-crowded testes, largest measuring 29 long by 43 wide. Mature proglottids 0.6 to 2.37 mm (1.41) long by 270 to 465 (372) wide. Genital pore as above. Poral portion of cirrus sac narrow, becoming enlarged medially; 180 to 340 (220) long by 71 to 136 (94) wide. Cirrus spined. Testes number 70 to 132 (107) with about 45 anterior to cirrus sac; large spherical bodies, closely-crowded together, anterior and posterior margins flattened; 21 to 54 (32) long by 36 to 75 (46) wide. Vas deferens tightly coiled. Ovary bilaterally symmetrical, consisting of lobules radiating laterally, 144 to 390 (212) long by 179 to 330 (264) wide, near posterior end of proglottid. Poral portion of vagina surrounded by gland cells. Mehlis' gland between posterior halves of ovary, 51 to 79 (68) in diameter. Vitellaria follicular, in two lateral bands. Gravid apolytic proglottids (two measured) 3.15 and 5.21 mm long by 510 and 750 wide. Testes 88 and 85 respectively; pushed laterally by bulging uterus posterior to cirrus sac. Genital pore at junction of first and second fourths of segment. Cirrus sac 270 and 375 long by 128 and 188 wide, pushed forward by packed uterus. Spines on cirrus 5 long. Ovary 525 and 825 long by 375 and 465 wide, appearance as before. Mehlis' gland 121 and 161 long. Bulging uterus in larger specimen 3.23 mm long by 428 at widest point. Eggs somewhat collapsed, spindle-shaped with long filaments at each end. Favorable egg (including filaments) 141 long by 13 wide; one filament 61 long, other folded. Egg without filament 54 long. Vitellaria as above.

Remarks: We obtained many specimens from the first listed locality but only a few from each of the other sites. The spindle-shaped eggs are similar to those in *P. gracile* Wedl, 1855 except they are smaller. In addition, *P. nicaraguensis* differs from this species in having unilateral genital pores located in the anterior half of the proglottid and in lacking neck spines.

Specimens of both *P. nicaraguensis* and *P. leuci* obtained from two sharks near Los Cocos, Nicaragua, approximately 345 km from the ocean, compared to those from other collection sites, were shorter and in poorer condition although the sharks were taken alive. Proglottids were mainly immature with only a few moderately mature and no gravid proglottids.

The name *nicaraguensis* refers to the original locality.

Phyllobothrium pristis n. sp.

(Figures 30–31)

Host: *Pristis perotteti* Müller and Henle, 1841.*Location:* Spiral valve.*Localities:* Río San Juan, San Carlos, Nicaragua; Río Tipitapa, Los Cocos, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.*Holotype:* USNM Helm. Col. No. 61337.

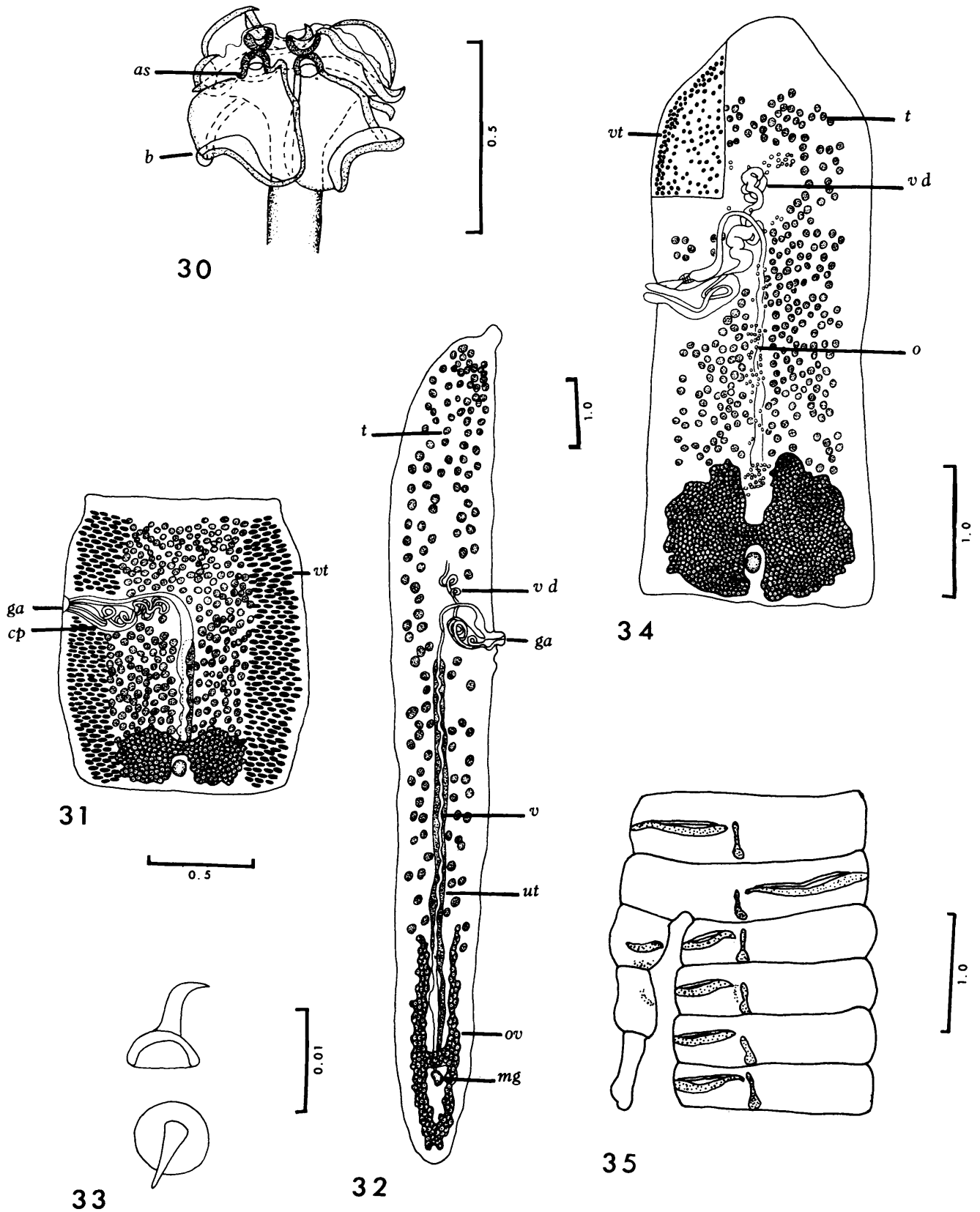
Description (measurements on seven worms): Craspidote, apolytic. Length 145 to 265 mm (196). Scolex 375 to 555 (463) long by 525 to 810 (667) wide. Bothridia with thickened edges, folded in various shapes, 345 to 525 (405) long by 225 to 435 (356) wide. Accessory sucker 82 to 114 (97) in diameter. Neck 25 to 32 mm (30) long by 100 to 180 (126) wide just behind scolex. Immature proglottids 405 to 420 (409) long by 0.885 to 1.23 mm (1.01) wide, velum length 30 to 68 (41). Cirrus sac 225 to 360 (287) long by 30 to 45 (38) wide. Genital pore at about middle of lateral margin, irregularly alternating. Testes numbering 250 to 335 (304); 23 to 75 (51) long. Mature proglottids 0.96 to 1.43 mm (1.27) long by 0.98 to 1.17 mm (1.08) wide, velum length 53 to 120 (65). Testes numbering 230 to 344 (297); 43 to 82 (68) in diameter. Genital pore about one-third back from anterior end of segment. Cirrus sac thin-walled, perpendicular to lateral margin or nearly so, extending medially about two-thirds distance to midline. Cirrus spined and coiled within sac, spines 3 to 4, easily lost. Vas deferens tightly coiled. Transverse portion of vagina somewhat sigmoid then turning posteriorly along midline to ovary. Ovary 210 to 335 (261) long by 640 to 885 (738) wide, bilobed, symmetrical, at posterior end of segment. Mehlis' gland 95 to 125 (108) long, between posterior halves of ovary. Vitellaria follicular, forming two wide dense lateral bands. Eggs, from a single attached gravid proglottid, thin-walled, light brown in color, 21 to 23 long by 14 to 18 wide.

Remarks: This species is most similar to *P. dasybati* Yamaguti, 1934 from which it differs by possessing irregularly alternating genital pores, by being much larger and by having minute spines on the cirrus. It resembles *P. thridax* van Beneden, 1850 in size and in the possession of a long neck. It differs, however, in the number of testes, 40 in *P. thridax* and 230 to 344 in *P. pristis*.

The name *pristis* is for the host.

Anthobothrium cornucopia van Beneden, 1850*Host:* *Carcharhinus leucas* (Müller and Henle, 1841).*Location:* Spiral valve.*Locality:* Río Dulce, Guatemala.*Specimen deposited:* USNM Helm. Col. No. 71471.*Anthobothrium laciniatum* Linton, 1890*Host:* *Carcharhinus leucas* (Müller and Henle, 1841).*Location:* Spiral valve.*Localities:* Río San Juan, El Castillo, Nicaragua; Río San Juan, San Juan del Norte, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.*Specimen deposited:* USNM Helm. Col. No. 61335.

Remarks: Southwell (1925) and Joyeux and Baer (1936) considered *Anthobothrium laciniatum* to be synonymous with *A. cornucopia*. However, Zschokke (1888) completely described *A. cornucopia* verifying the presence of an unsegmented neck, as previously described by van Beneden, and recording the number of testes as 350. Riser (1955) stated



FIGURES 30-31. *Phyllobothrium pristis*. FIG. 30. Scolex. FIG. 31. Mature proglottid. FIGURES 32-33. *Platybothrium hypoprioni*. FIG. 32. Apolytic proglottid. FIG. 33. Cirrus spines. FIGURES 34-35. *Cathetocephalus thatcheri*. FIG. 34. Gravid apolytic proglottid. FIG. 35. Budding proglottid. Ga, Genital atrium. Other abbreviations as before.

that *A. laciniatum* differs from *A. cornucopia* in smaller size, absence of an unsegmented neck and fewer testes. The specimens we consider to be *A. cornucopia* consist of six worms up to 9.4 mm long. They are in poor condition, the shark being dead when obtained. The scoleces are not clear but appear to be without accessory suckers and all are provided with an unsegmented neck, up to 213 long. The proglottids following the neck are all lacinated. All specimens considered to be *A. laciniatum* have a distinctly segmented neck and are lacinated but longer, ranging from 12.7 to 27.8 mm.

Anthobothrium pristi Woodland, 1934

Host: *Pristis perotteti* Müller and Henle, 1841.

Location: Spiral valve.

Localities: Río Tipitapa, Los Cocos, Nicaragua; Río San Juan, San Carlos, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 61336.

Remarks: Woodland (1934) described this species from the same host in the Amazon River. He is correct in considering four bothridia to be present and that accessory suckers are absent. His longest specimens were about 110 mm long with the posterior proglottids broader than long, and descriptions of the mature and gravid proglottids are lacking. Specimens in the present collection measure up to 178 mm long and a description of the mature, but not the gravid, proglottid can be given.

Woodland (1934) reported an unspined cirrus. We found this condition in immature proglottids, such as he had, but in proglottids which are square or longer than wide, spines can be observed.

Description of mature proglottid (five measured): 1.13 to 2.33 mm (1.84) long, 0.71 to 1.43 mm (1.06) at widest point. Genital pore about one-third from anterior end. Cirrus sac extending medially approximately one-third width of proglottid, 255 to 420 (321) long by 113 to 225 (131) wide, elongate, tear-drop in shape, narrowest at pore; perpendicular to margin or nearly so. Cirrus spined. Vas deferens strongly coiled. Testes numbering 220 to 300 (249), 36 to 79 (55) long. Vitellaria follicular, in two lateral bands. Ovary symmetrical 225 to 480 (269) long by 405 to 750 (563) wide. Mehlis' gland at posterior end of proglottid, between right and left halves of ovary; 82 to 144 (104) long.

Family Onchobothriidae Braun, 1900

Platybothrium hypoprioni Potter, 1937

(Figures 32–33)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Localities: Río San Juan, San Juan del Norte, Nicaragua; Río San Juan, El Castillo, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 61341.

Remarks: Potter (1937) based the description of this species on specimens collected by Dr. H. W. Manter from *Negaprion brevirostris* from Dry Tortugas, Florida. She failed to mention the vitellaria in her description but her drawing of a mature proglottid perhaps indicates two lateral bands. In our specimens, the vitellaria form a distinct sleeve surrounding all the reproductive organs. Potter (1937:71) also stated, "No indication of a protrusible cirrus was seen, and if present, it is not armed." More mature proglottids in our specimens show the presence of strong spines on the cirrus,

and even shorter worms show indications of spines. Study of specimens from the original collection shows cirrus spines in a few proglottids.

Emended diagnosis of P. hypoprioni: Scolex cuboidal, provided with four bothridia. Each bothridium possessing anterior sucker, posterior sucker-like loculus with single transverse septum; two large hooks, one with three prongs and one with two prongs, without connecting bar between them. Scolex with minute spines on bothridial surface. Neck and anterior proglottids provided with spines. Both scolex and body spines with bifurcated bases. Genital pore between middle and anterior one-third of proglottid, irregularly alternating. Mature proglottids longer than wide, provided with about 95 to 140 testes; large, broad, thin-walled cirrus sac extending to near midline. Seminal vesicle extending in loose coils anterior to vagina. Cirrus provided with large spines. Vitellaria forming sleeve surrounding reproductive organs. Ovary in apolytic proglottids, inverted "A" shape; eggs released in small packets.

Phoreiobothrium triloculatum Linton, 1901

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Localities: Río Dulce, San Felipe, Guatemala and Río Colorado, Barro del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 71472.

Family Cathetocephalidae Dailey and Overstreet, 1973

Cathetocephalus thatcheri Dailey and Overstreet, 1973

(Figures 34–35)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Localities: Río San Juan, El Castillo, Nicaragua; Río San Juan, San Carlos, Nicaragua; Río Colorado, Barra del Colorado, Costa Rica; and Río Dulce, San Felipe, Guatemala.

Specimen deposited: USNM Helm. Col. No. 61342.

Remarks: Our specimens agree in general morphology with those reported by Dailey and Overstreet (1973) but differ in some particulars. Length 75 to 347 mm (212) with up to 244 proglottids. Scolex 0.75 to 8.58 mm (3.56) long by 0.315 to 1.245 mm (0.744) wide. Neck 285 to 300 (295) wide at scolex. Mature proglottids 1.13 to 4.02 mm (1.91) long by 1.10 to 2.81 mm (1.63) wide; cirrus sac 500 to 1065 (691) long by 169 to 255 (191) wide; testes numbering 303 to 405 (376), 71 to 89 in diameter; vagina having sphincter near lateral margin of proglottid; ovary 216 to 954 (515) long by 862 to 1278 (1210) wide. Apolytic gravid proglottids (two) 5.21 mm and 5.24 mm long by 1.95 mm and 2.01 mm wide; cirrus sac 720 and 825 long by 300 wide; testes numbering 385 and 400, 64 to 118 (86) in diameter; ovary 1.28 mm long by 1.67 mm and 1.73 mm wide; eggs 42 to 46 (44) long by 32 to 36 (35) wide.

Family Dasyrhynchidae Dollfus, 1935

Dasyrhynchus variounicinnatus (Linton, 1924)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Localities: Río San Juan, El Castillo, Nicaragua; and Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 61334.

Remarks: Only two scoleces were obtained from El Castillo. Numerous specimens were obtained from Barra del Colorado.

Callitetrarhynchus gracilis (Rudolphi, 1819)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Locality: Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 71474.

Family Tentaculariidae Poche, 1926

Nybelinia bisulcata (Linton, 1889)

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Localities: Río Dulce, San Felipe, Guatemala and Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 71475.

Remarks: A total of three specimens was obtained from two sharks, one at each locality.

Family Obothriidae Dollfus, 1942

Obothrium penetrans Linton, 1907

Host: *Carcharhinus leucas* (Müller and Henle, 1841).

Location: Spiral valve.

Locality: Río Colorado, Barra del Colorado, Costa Rica.

Specimen deposited: USNM Helm. Col. No. 71476.

Remarks: Only a single specimen was obtained.

DISCUSSION

Thorson (1971) firmly established that the bull shark, *Carcharhinus leucas*, migrates throughout the Lake Nicaragua-Río San Juan System. The same appears to be true for the sawfish, *Pristis perotteti* (Thorson, 1976). Thus it is not surprising that the helminths we found in these two species are of marine origin or have strong marine affinities. Although *Anthobothrium pristis* was described originally from the same sawfish host in the Amazon River approximately 960 km. from the sea, the sawfish in the Amazon also probably come in from the sea, and all of the previously known members of the genus *Anthobothrium* are marine. It seems probable that, at least for the shark, the parasites were picked up in either marine or estuarine waters. This idea is supported by the fact that the lake bony fishes (179 examined: Cichlidae 93, Characidae 44, Pimelodidae 17, Eleotridae 15, Poeciliidae 5, Pomadasyidae 3 and Lepisosteidae 2) did not harbor larval tetraphyllideans or trypanorhynchids (Watson, 1976).

Varying degrees of euryhalinity, as indicated by survival in fresh water, are shown by the monogeneans. *Erpocotyle carcharhini* apparently has little or no ability to tolerate fresh water, as we did not find it in sharks more than 100 m upriver from the mouth. *Dermophthirius maccallumi* shows some degree of tolerance. It occurred on 100% of the adult sharks examined at or near the river mouths but at San Carlos the percentage infested dropped to 21. We did not find it at the northwest end of the lake. We found *Heteronchocotyle leucas* on sharks examined at all localities, indicating a wide range of salinity tolerance. We collected *Erpocotyle caribbensis* and *Pristionchocotyle intermedia* from sawfish in the lake, at San Carlos and near Los Cocos, but did not collect monogeneans from sawfish at the mouths of the rivers. Considering their marine affinities, it is possible that these two helminths are also highly euryhaline.

As the sharks were found further and further away from the river mouths, there were changes in their cestode fauna. This was not true for the sawfish, in which both *Anthobothrium pristis* and *Phyllobothrium pristis* occurred at the

river mouth (Barra del Colorado), at San Carlos and at Los Cocos. All shark cestodes, with the exception of *P. lactuca* which was collected only at El Castillo, were found either at the river mouths or within a short distance (up to about 30 km) from the river mouths. The trypanorhynchids rapidly dropped out and we found only two scoleces of *D. varioun-cinnatus* at El Castillo. Tetraphyllideans showed a reduction in the number of species but not so rapidly and specimens of two species, *P. leuci* and *P. nicaraguensis*, were found at the northwest end of the lake as well as at the river mouth. These two species were in good condition at the river mouth but in rather poor condition at Los Cocos where their strobilae consisted of immature proglottids with only a few moderately mature and no gravid proglottids. This situation is similar to that obtaining in salmonids in Wales and in the USSR (Kennedy, 1969; Dogiel and Petrushevski, as reported in Dogiel, 1962) where the further upstream the salmonids migrated or the longer they remained in fresh water, the more reduced became the marine helminth fauna. The first to go, as would be expected, were the Monogenea followed by a gradual loss of the intestinal forms. In the case of the cestode *Eubothrium crassum* (Bloch), the number of scoleces remained basically the same, but the strobilae were much shorter in salmonids which had remained in fresh water for extended periods than in the recent arrivals. Kennedy (*loc. cit.*) found the size reduction to be due to the loss of mature worms *en toto*. Dogiel and Petrushevski (*loc. cit.*) reported the reduction to be by a loss of the posterior proglottids. The Los Cocos tetraphyllideans and the El Castillo trypanorhynchids tend to support the latter view. However, we must emphasize that the migratory history of the individual sharks examined is unknown.

ACKNOWLEDGMENTS

We are indebted to the following persons for a variety of courtesies and services: the late Dr. Harold W. Manter and Mrs. Mary Lou Pritchard, University of Nebraska; Father José Maria Gondra, at that time Rector, and Father Ignacio Astorqui, Ichthyologist and later Rector, Colegio Centro America; and Mrs. Hope D. Watson, University of Lagos. We gratefully acknowledge financial support from the National Science Foundation (grant number G-23574) and the U.S.P.H.S., National Institutes of Health (grant number HE-09075).

SUMMARY

Five species of monogeneans and 14 species of cestodes are reported from two elasmobranch species in fresh waters of Guatemala, Nicaragua and Costa Rica. Monogeneans from the bull shark, *Carcharhinus leucas* (Müller and Henle, 1841), are: *Dermophthirius maccallumi* n. sp. (Microbothriidae); *Heteronchocotyle leucas* Hargis, 1955 and *Erpocotyle carcharhini* n. sp. (Hexabothriidae). Cestodes from the bull shark are: *Phyllobothrium lactuca* van Beneden, 1850, *P. leuci* n. sp., *P. nicaraguensis* n. sp., *Anthobothrium cornucopia* van Beneden, 1850, *A. laciniatum* Linton, 1890 (Phyllobothriidae); *Platybothrium hypoprioni* Potter, 1937, *Phoreiobothrium triloculatum* Linton, 1901 (Onchobothriidae); *Cathetocephalus thatcheri* Dailey and Overstreet, 1973 (Cathetocephalidae); *Dasyrhyinchus varioun-cinnatus* (Linton, 1924) and *Callitetrarhynchus gracilis* (Rudolphi, 1819) (Dasyrhyinchidae); *Nybelinia bisulcata* (Linton, 1889) (Tentaculariidae); and *Obothrium penetrans* Linton, 1907

(Otobothriidae). From the sawfish, *Pristis perotteti* Müller and Henle, 1841, are two monogeneans, *Erpocotyle caribbensis* n. sp. and *Pristionchocotyle intermedia* n. g., n. sp. (Hexabothriidae); and two cestodes, *Phyllobothrium pristis* n. sp. and *Anthobothrium pristis* Woodland, 1934 (Phyllobothriidae). The helminths found in these two species of euryhaline elasmobranchs are of marine origin or have strong marine affinities.

RESUMEN

Se señalan cinco especies de monogéneos y 14 especies de céstodos encontrados en dos especies de elasmobranquios colectados en aguas dulces de Guatemala, Nicaragua y Costa Rica. Los monogéneos del tiburón, *Carcharhinus leucas* (Müller y Henle, 1841) son: *Dermophthirus maccallumi*, n. sp. (Microbothriidae); *Heteronchocotyle leucas* Hargis, 1955 y *Erpocotyle carcharhini*, n. sp. (Hexabothriidae). Los céstodos del tiburón son: *Phyllobothrium lactuca* van Beneden, 1850, *P. leuci* n. sp., *P. nicaraguensis* n. sp., *Anthobothrium cornucopia* van Beneden, 1850, *A. laciniatum* Linton, 1890 (Phyllobothriidae); *Platybothrium hypoprioni* Potter, 1937, *Phoreiobothrium triloculatum* Linton, 1901 (Onchobothriidae); *Cathetocephalus thatcheri* Dailey and Overstreet, 1973 (Cathetocephalidae); *Dasyrhynchus variounicinnatus* (Linton, 1924) y *Callitetrarhynchus gracilis* (Rudolphi, 1819) (Dasyrhynchidae); *Nybelinia bisulcata* (Linton, 1889) (Tentaculariidae); y *Otobothrium penetrans* Linton, 1907 (Otobothriidae). En el pez sierra, *Pristis perotteti* Müller y Henle, 1841, se encontraron dos monogéneos: *Erpocotyle caribbensis*, n. sp. y *Pristionchocotyle intermedia*, n. gen., n. sp. (Hexabothriidae); y dos céstodos: *Phyllobothrium pristis*, n. sp. y *Anthobothrium pristis* Woodland, 1934 (Phyllobothriidae). Los helmintos encontrados en estas dos especies de elasmobranquios eurihalinos son de origen marino o están relacionados con formas marinas.

LITERATURE CITED

- BENEDEN, P. J. VAN. 1850. Recherches sur la faune littorale de Belgique (Cestoides). Mém. Acad. Roy. Sci. Belgique 25:1-200.
- DAILEY, M. D. and R. M. OVERSTREET. 1973. *Cathetocephalus thatcheri* gen. et sp. n. (Tetracanthocephala: Cathetocephalidae fam. n.) from the bull shark: a species demonstrating multistrobilization. J. Parasitol. 50:469-473.
- DOGIEL, V. A. 1962. General Parasitology. Trans. by Z. Kabata (1964). Oliver and Boyd, Edinburgh.
- EUZET, L. 1959. Recherches sur les cestodes Tetracanthocephales des sélaciens des Côtes de France. Causse, Graille and Castelneau, Montpellier.
- EUZET, L. and C. MAILLARD. 1967. Parasites de poissons de mer ouest-africains, récoltés par J. Cadenat. VI. Monogènes de Sélaciens. Bull. l'Inst. Fond. d'Afrique Noire. 29, Série A, no. 4:1435-1493.
- HARGIS, W. J., JR., 1955. Monogenetic trematodes of Gulf of Mexico fishes. Part VI. The superfamilies Polystomatoidea Price, 1936 and Dididophoroidea Price, 1936. Trans. Amer. Micro. Soc. 74:361-377.
- JOYEUX, C. and J. G. BAER. 1936. Faune de France. 30. Cestodes. Lechevalier, Paris.
- KENNEDY, C. R. 1969. The occurrence of *Eubothrium crassum* (Cestoda: Pseudophyllidae) in salmon *Salmo salar* and trout *S. trutta* of the River Exe. J. Zool. London 157:1-9.
- POTTER, C. C. 1937. A new cestode from a shark (*Hypoprion brevirostris* Poey). Proc. Helm. Soc. Wash. 4:70-72.
- RISER, N. W. 1955. Studies on cestode parasites of sharks and skates. J. Tenn. Acad. Sci. 30:265-311.
- ROBINSON, E. S. 1959. Records of cestodes from marine fishes of New Zealand. Trans. Roy. Soc. N. Z. 86:143-153.
- SOUTHWELL, T. 1925. A monograph on the Tetracanthocephala with notes on related cestodes. Univ. of Liverpool Press. Memoirs, New Series No. 2.
- SOUTHWELL, T. 1930. The fauna of British India, including Ceylon and Burma. Cestoda. Vol. I. Taylor and Francis, London.
- THORSON, T. B. 1971. Movement of bull sharks, *Carcharhinus leucas*, between Caribbean Sea and Lake Nicaragua demonstrated by tagging. Copeia 1971:336-338.
- THORSON, T. B. 1976. The status of the Lake Nicaragua shark: An updated appraisal. In: Investigations of the Ichthyofauna of Nicaraguan Lakes. T. B. Thorson, ed. School of Life Sciences, University of Nebraska-Lincoln.
- WATSON, D. E. 1976. Digenea of fishes from Lake Nicaragua. *Ibid.*
- WILLIAMS, H. H. 1968. The taxonomy, ecology and host-specificity of some Phyllobothriidae (Cestoda: Tetracanthocephala), a critical revision of *Phyllobothrium* Beneden, 1849 and comments on some allied genera. Phil. Trans. Roy. Soc. London, Series B. No. 786. 253:231-307.
- WOODLAND, W. N. F. 1927. A revised classification of tetracanthocephalan Cestoda, with description of some Phyllobothriidae from Plymouth. Proc. Zool. Soc. London (3):519-548.
- WOODLAND, W. N. F. 1934. On six new cestodes from Amazon fishes. Proc. Zool. Soc. London (1):33-44.
- YOSHIDA, S. 1917. Some cestodes from Japanese selachians, including five new species. Parasitology 9:560-592.
- ZSCHOKKE, F. 1888. Recherches sur la structure anatomique et histologique des cestodes. Mém. Inst. Nat. Genevois 17:1-396.