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CARETTACOLA HAWAIIENSIS N. SP. (TREMATODA: SPIRORCHIDAE) FROM THE GREEN TURTLE, *CHELONIA MYDAS*, IN HAWAII

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ABSTRACT: *Carettacola hawaiiensis* n. sp. (Trematoda: Spirorchidae) is described from the hepatic vessels of the green turtle, *Chelonia mydas* (L.), in Hawaii. The new species differs from any previously described species of *Carettacola* in size, placement of vitellaria, and shape and placement of Laurer's canal. The genus *Haemoxenicon* Martin and Bamberger, 1952, becomes a synonym of *Carettacola* Manter and Larson, 1950. *Haemoxenicon stunkardi* Martin and Bamberger, 1952, is transferred to the genus *Carettacola* Manter and Larson, 1950, and becomes *Carettacola stunkardi* n. comb. An emended generic diagnosis for *Carettacola* is given along with a key to the species.

From 1986 to 1988, 10 green sea turtles (*Chelonia mydas* (L.)) were found stranded on the islands of Lanai, Maui, and Oahu in Hawaii. The turtles were covered with neoplasms identified as fibropapillomas. These growths on turtles can result in reduced vision, disorientation, blindness, and physical obstruction to normal swimming and feeding. Upon determination that the turtles would not survive, they were killed and examined for parasites. Two turtles, 1 from Kaneohe Bay, Oahu, and 1 from Kahului Bay, Maui, were infected with an undescribed species of the genus *Carettacola* Manter and Larson, 1950.

MATERIALS AND METHODS

A thorough examination for parasites was carried out on the lungs, liver, heart, major vessels, stomach, intestine, and bladder. Worms were placed in tap water and refrigerated overnight for egg expulsion, fixed in alcohol–formalin–acetic acid (AFA) for 2 days, and then transferred to 70% ethyl alcohol for storage. Whole mounts were stained in Semichon's acetocarmine, dehydrated in a graded ethanol series, and mounted in Canada balsam. Drawings were made with the aid of a drawing tube. Measurements are in micrometers unless otherwise indicated, with range followed by mean in parentheses. Representative specimens have been deposited in the United States National Museum (USNM) Helminthological Collection, Beltsville, Maryland, and the Harold W. Manter Laboratory (HWML), Division of Parasitology, University of Nebraska State Museum, Lincoln, Nebraska. The balance of the specimens are deposited in the Institute of Parasitology, California State University, Long Beach, California.

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DESCRIPTION

Carettacola hawaiiensis n. sp.

(Figs. 1–4)

Diagnosis (based upon measurements of 8 whole specimens): Spirorchidae Stunkard, 1921; Carettacolinae Yamaguti, 1958. Body elongate, 5.0–7.7 mm (6.5) long, maximum width 0.210–0.380 mm (0.310) at midbody. Oral sucker terminal, 105–178 (160) long by 84–131 (112) wide with short spines around perimeter. Esophagus tubular, 0.92–1.16 mm (1.01) long, posterior third becoming flask-shaped at cecal bifurcation. Gland cells occur along esophagus particularly at narrow anterior portion of flask-shaped enlargement. Intestinal ceca slightly sinuous, terminating near anterior ends of forks of Y-shaped excretory vesicle. Acetabulum approximately 22% of body length from anterior end, 200–280 (230) in diameter, immediately posterior to intestinal bifurcation, weakly muscular, protrusible, and ringed with small spines. Testes number 34–48 (40), 156–278 (205) by 94–134 (121) wide, in irregular linear series filling most of posterior intercecal field. Genital pore ventrosinistral, approximately 32% of body length from anterior end. External seminal vesicle saccate, 101–161 (125) long by 88–131 (103) wide, anterior to cirrus sac, filling intercecal area between acetabulum and cirrus sac. Cirrus sac large, 287–337 (307) long by 104–125 (121) wide, partly an-

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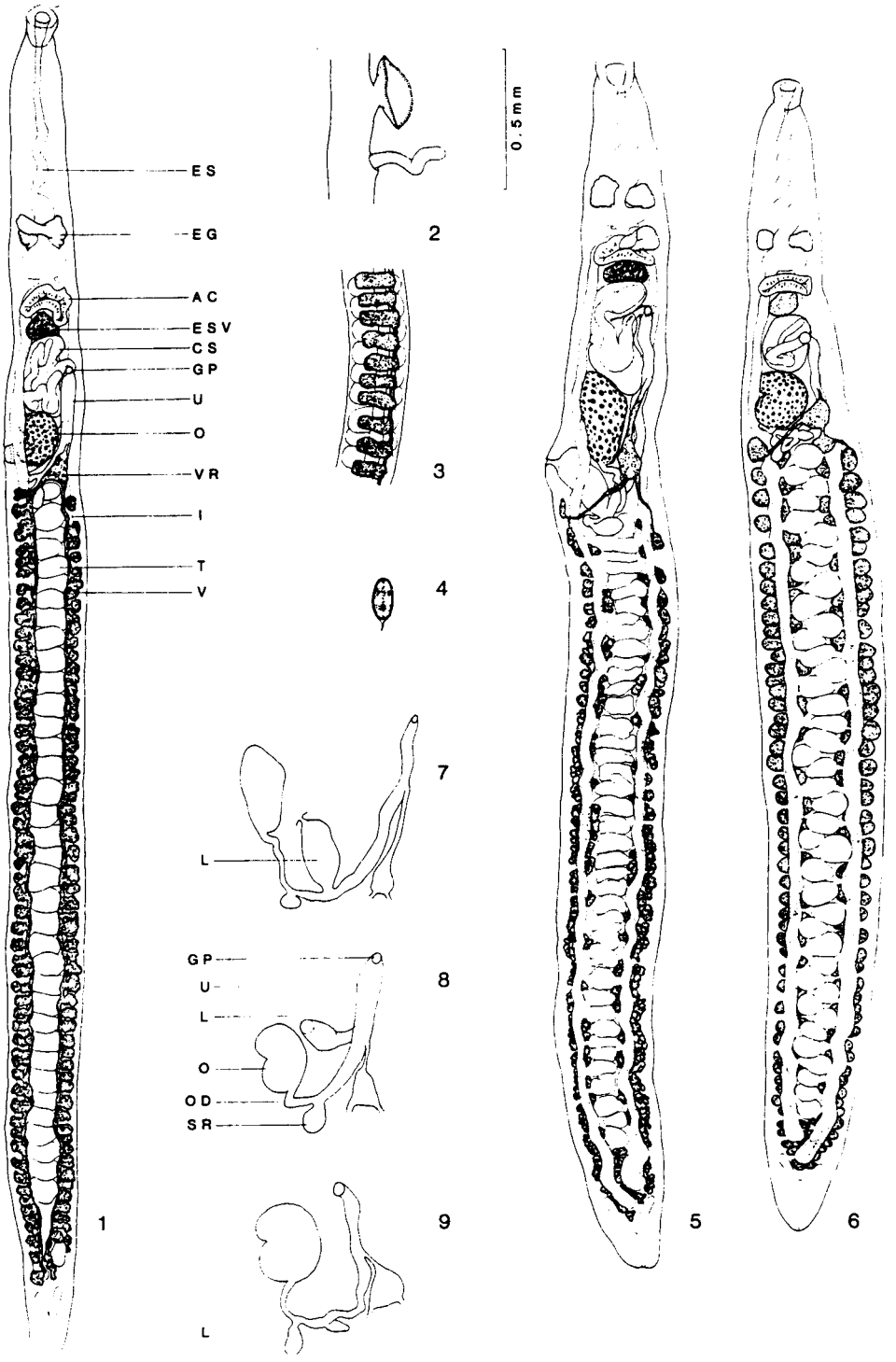
FIGURES 1–9. *Carettacola hawaiiensis* n. sp. from the green turtle in Hawaii, *Carettacola bipora*, and *Carettacola stunkardi* n. comb. with diagrams of female reproductive organs from each. **1–4.** *Carettacola hawaiiensis* n. sp. 1. Entire worm (ventral view). 2. Lateral view of acetabulum and cirrus. 3. Vitellaria formed around ventral surface of ceca. 4. Egg. **5.** *Carettacola bipora* (ventral view). **6.** *Carettacola stunkardi* n. comb. (ventral view). **7–9.** Female reproductive organs of *Carettacola bipora*, *Carettacola hawaiiensis*, and *Carettacola stunkardi*. 7. *Carettacola bipora*. 8. *Carettacola hawaiiensis*. 9. *Carettacola stunkardi*. Scale used for all figures except reproductive organs (7, 8, 9). ES, esophagus; EG, esophageal gland; AC, acetabulum; ESV, external seminal vesicle; CS, cirrus sac; GP, genital pore; U, uterus; O, ovary; OD, oviduct; VR, vitelline reservoir; I, intestinal cecum; L, Laurer's canal; SR, seminal receptacle; T, testis; V, vitellaria.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terior but mostly posterior to common genital pore, partly overlapping ovary, containing tubular seminal vesicle, numerous large prostatic cells, and long aspinous cirrus.

Ovary reniform, 220–280 (250) long by 150–220 (190) wide, intercecal, about ⅓ body length from anterior end; oviduct extends posteriorly then turns sinistral and is joined by small, spherical seminal receptacle. Oviduct extends to edge of cecum, bends anteriad, and enters uterus near common vitelline duct. The uterus extends anteriorly where it is joined by Laurer's canal. Laurer's canal opens dorsolaterally through marginal pore, opposite posterior end of ovary. Vitelline follicles large, primarily extracecal, roughly C-shaped, ventral to ceca; measuring 173–236 (203) long by 89–131 (106) wide; extending from level of anterior testis to ends of ceca. Uterus short, in several specimens contained large single egg. Egg, 174–184 (179) long by 63–84 (74) wide, with posterior spine (21–36 long). Mehlis' gland not observed.

Taxonomic summary

Type host: *Chelonia mydas* (L.).
Type locality: Kaneohe Bay, Oahu, Hawaii.
Additional localilty: Kahului Bay, Maui, Hawaii.
Site: Hepatic vessels.
Specimens deposited: Holotype USNM Helminthological Collection no. 81897, paratypes, USNM Helminthological Collection no. 81897 and HWML 33435.
Etymology: The species is named after state in which it was found.

Remarks

Carettacola hawaiiensis closely resembles both *Carettacola bipora* Manter and Larson, 1950, from the loggerhead turtle *Caretta caretta* (L.) collected at Tortugas, Florida, and *Haemoxenicon stunkardi* Martin and Bamberger, 1952, from the green turtle (*C. mydas*) collected off Baja, California. However, in addition to differing from both in total length and width, *C. hawaiiensis* also differs by having vitelline follicles encircling the ceca ventrally, large vaginalike Laurer's canal, and Laurer's canal joining to the uterus rather than oviduct. The acetabulum of *C. hawaiiensis* does not have a center membranous flap as does *C. bipora* and the Laurer's canal "vaginal walls" of *C. hawaiiensis* are not thick and muscular as found in *C. bipora*. The egg of *C. hawaiiensis* is larger than that of either *C. bipora* or *H. stunkardi*.

During this study the holotypes of *C. bipora* (USNM Helm. Coll. no. 37177) and *H. stunkardi* (Hancock Parasit. Coll. no. 499) were examined. *Haemoxenicon stunkardi* could not be separated from the genus *Carettacola* by criteria given in the original description. *Carettacola bipora* has a common genital pore and not separate male and female pores as originally described. Also, *H. stunkardi* has a flask-shaped "stomach" area just anterior to the cecal bifurcation as does *C. bipora* and *C. hawaiiensis*. The "minute dorsal Laurer's pore" described for *Haemoxenicon* by Martin and Bamberger (1952) appears to be a reduced version of the same structure found in both *C. bipora* and *C. hawaiiensis*. These findings indicate that *H. stunkardi* should be placed in the genus *Carettacola* and the generic diagnosis emended to include *Haemoxenicon* Martin and Bamberger, 1952. *Haemoxenicon stunkardi* is transferred to *Carettacola* and becomes *Carettacola stunkardi* n. comb. *Haemoxenicon* is reduced to a junior synonym of *Carettacola*. An emended generic diagnosis of *Carettacola* follows.

Carettacola Manter and Larson, 1950

Emended generic diagnosis: Spirorchidae, Carettacolinae. Body slender, almost uniform in width. Oral sucker terminal, esophagus long, ceca terminating near posterior extremity. Acetabulum located immediately posterior to intestinal bifurcation, membranous, variable shape. Testes numerous, arranged in linear series, filling most of posterior intercecal field; external seminal vesicle, filling intercecal area between acetabulum and cirrus pouch. Cirrus pouch large, postacetabular, containing tubular seminal vesicle, numerous prostate cells. Cirrus armed or unarmed. Genital pore ventrosinistral to cirrus pouch, posterior to acetabulum, preovarian. Ovary oval to reniform, intercecal, immediately behind cirrus pouch. Receptaculum seminis small. Laurer's canal present behind or overlapping ovary, may or may not be expanded behind pore with muscular walls. Vitelline follicles extending around ceca from level of anterior testis to cecal ends. Uterus short, containing a single egg with polar filament. Excretory vesicle Y-shaped, with terminal pore. Parasites of marine turtles.

Type species: *Carettacola bipora* Manter and Larson, 1950.

KEY TO SPECIES OF *CARETTACOLA*

1a. Vitellaria formed around ventral surface of cecal branches ..... *C. hawaiiensis*
1b. Vitellaria formed around dorsal surface of cecal branches 2
2a. Laurer's canal expanded behind lateral pore-forming muscular sac ..... *C. bipora*
2b. Laurer's canal with only minute pore opening on dorsal surface without muscular sac .. .. *C. stunkardi*

DISCUSSION

Glazebrook et al. (1989) listed the most common sites for cardiovascular flukes in marine turtles as the heart, followed by visceral vessels. *Carettacola bipora* was found in intestinal washings of the loggerhead turtle, but the worms were believed to have originated from a nearby blood vessel (Manter and Larson, 1950). Glazebrook et al. (1989) listed *C. bipora* from "abdominal blood vessel." *Haemoxenicon stunkardi* and *Haemoxenicon chelonenecon* Martin and Bamberger, 1952, were found in mesenteric veins of *C. mydas*. *Haemoxenicon chelonenecon* subsequently has been synonymized with *H. stunkardi* by Caballero et al. (1955). *Carettacola hawaiiensis* is the first trematode found in the hepatic vessels of a marine turtle. The occurrence of these 3 worms in the vascular system of organs other than the heart and associated major vessels sets them apart from other sea turtle spirorchids.

When the 3 species are compared the configuration of the arrangement of internal structures is nearly identical (Figs. 1, 5, 6). The occurrence of a well developed Laurer's canal in all 3 worms (Figs. 7–9) also differentiates these parasites from other known spirorchids infecting marine turtles. The true uterus is very short in all 3 species, with the Laurer's canal being an offshoot of the uterine region in *C. hawaiiensis* rather than the ootype region (near the seminal receptacle) as in *C. bipora* and *C. stunkardi*. Another unique feature shared by only these 3 spirorchid worms is the C-shaped vitelline follicles that encircle the cecal branches, *C. hawaiiensis* ventrally (Fig. 3) and *C. bipora* and *C. stunkardi* dorsally (Figs. 5, 6).

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