Hermaphroditic White Shrimp, *Penaeus setiferus*, Parasitized by *Thelohania* sp.[1]

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ABSTRACT

Two white shrimp, *Penaeus setiferus*, with external and histological characteristics of both male and female, are considered hermaphrodites. Both were infected with protozoan microsporidial parasites, *Thelohania* sp., probably *Thelohania penaei*.

The penaeid white shrimp, *Penaeus setiferus*, is dioecious (Lindner and Cook 1970), and the sex of white shrimp is readily identified morphologically. In males, the endopod of the first pair of pleopods is modified to form the petasmata or copulatory organ. In females, the thelycum is positioned between the 3rd, 4th, and 5th pereiopods. Our paper describes two hermaphroditic white shrimp obtained from the Galveston Bay area of Texas. To our knowledge, the only previous report of hermaphroditism in the Family Penaeidae is that of Heegaard (1971).

METHODS

On June 29, 1972, a white shrimp (referred to herein as Number 1), 175 mm in total length (tip of rostrum to tip of telson), was caught in the Galveston Ship Channel. It had typical adult petasmata (Fig. 1A) and a band of grayish-yellow tissue 1 cm wide extending from the cephalothorax, along the gut line, to midway through the 6th abdominal segment (Fig. 1B). The color and locality of the tissue were similar to those of ovaries in an adult female. There was no thelycum. Another white shrimp (Number 2), 141 mm in total length, was collected on August 26, 1969 in Moses Lake near Texas City. Grossly quite similar to shrimp Number 1, it had adult petasmata and pinkish discoloration extending from the cephalothorax to the 6th abdominal segment.

A smear was made of fresh tissue from the lateral thorax of each shrimp. Tissue was removed for histological study from the lateral portion of the cephalothorax and the dorsal portion of the 2nd and 5th abdominal segments of shrimp Number 1. The shrimp were fixed in 10% formalin. Additional portions of fixed tissue were removed later from the thorax and from different abdominal segments for histological study. Fixed tissues were embedded in paraffin, sectioned, and stained with hematoxylin and eosin. Selected histological sections and the smear were stained by the Giemsa technique.

RESULTS AND DISCUSSION

Many microsporidia were present in the smear from shrimp Number 1. Large numbers of these parasites occurred in groups of eight, consistent with sporonts belonging to the genus *Thelohania* (Fig. 2). Histological examination showed that the tissue was ovarian and infiltrated with microsporidia (Fig. 3). Parasites were present in the stroma of the ovary, in the stroma around the ovary, in muscle, and sometimes in the stroma between muscle bundles. Although

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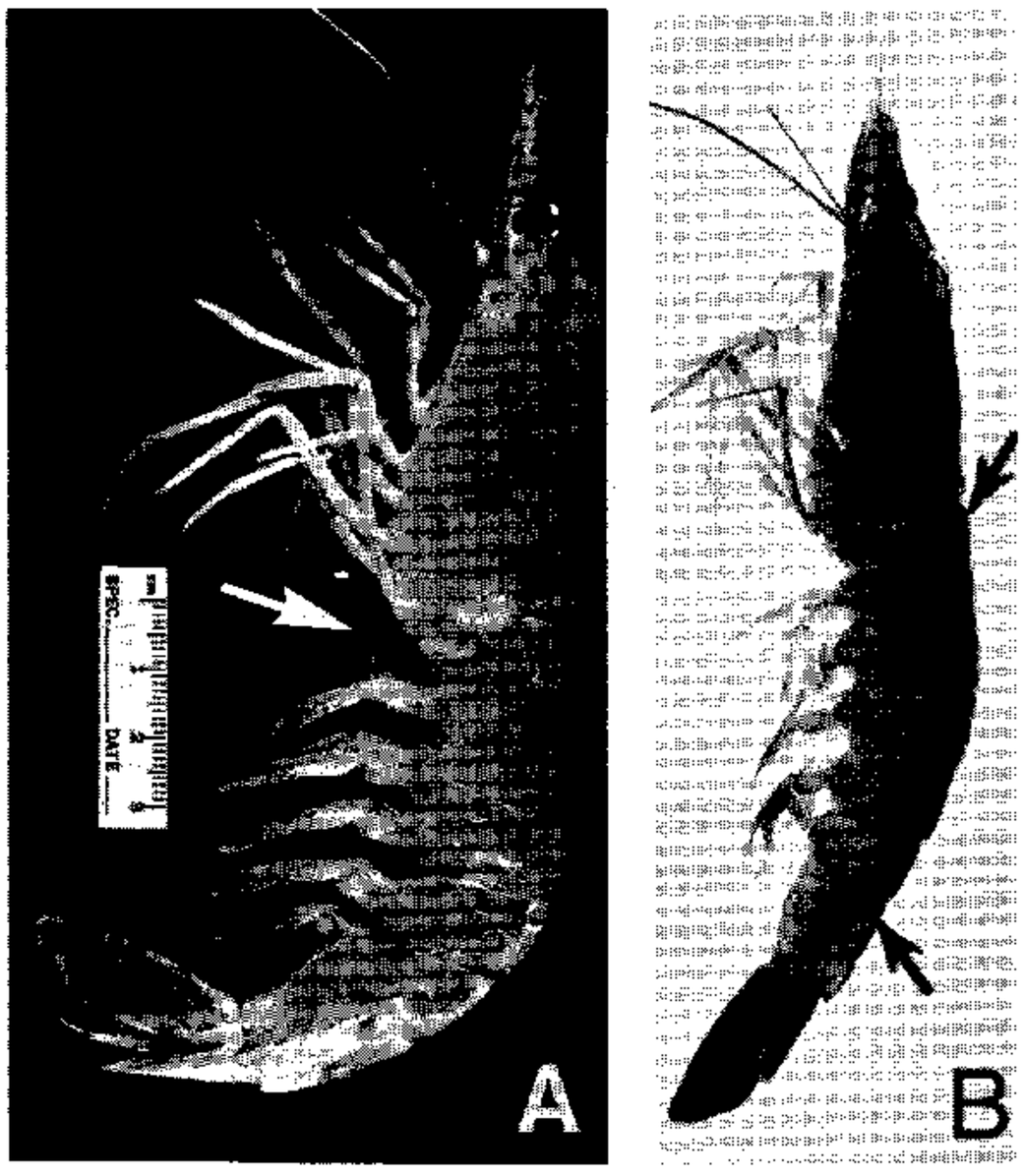

FIGURE 1.—A. Petasmata (shown by arrow) in white shrimp Number 1. B.—Discoloration (shown by arrows) in the area usually occupied by the ovary. White shrimp Number 1.

some of the parasites appeared in striated muscle, this may have been an artifact of preparation. The parasite in the two shrimp was identified as *Thelohania* sp., probably *Thelohania penaei* as discussed by Overstreet (1973). This parasite was observed originally in the reproductive organs of white shrimp collected in Louisiana and was described by Sprague (1950). Individual ova in the two white shrimp in this study were diffusely infiltrated by this parasite. The ova were enlarged and degenerated. Rarely were uninfected immature ova demonstrable. Although *Thelohania* sp. parasites were present elsewhere in these shrimp, the infection was primarily ovarian.

Ovarian tissue from the thorax of shrimp Number 1 contained seminal tubules filled with spermatogonia (Fig. 4). Numerous groups of seminal tubules were present at the periphery of the ovary, but none occurred in sections of ovary from the abdominal segments. Degeneration was evident in some of the seminal tubules. Microsporidia were observed in these necrotic areas. A majority of the seminal tubules,

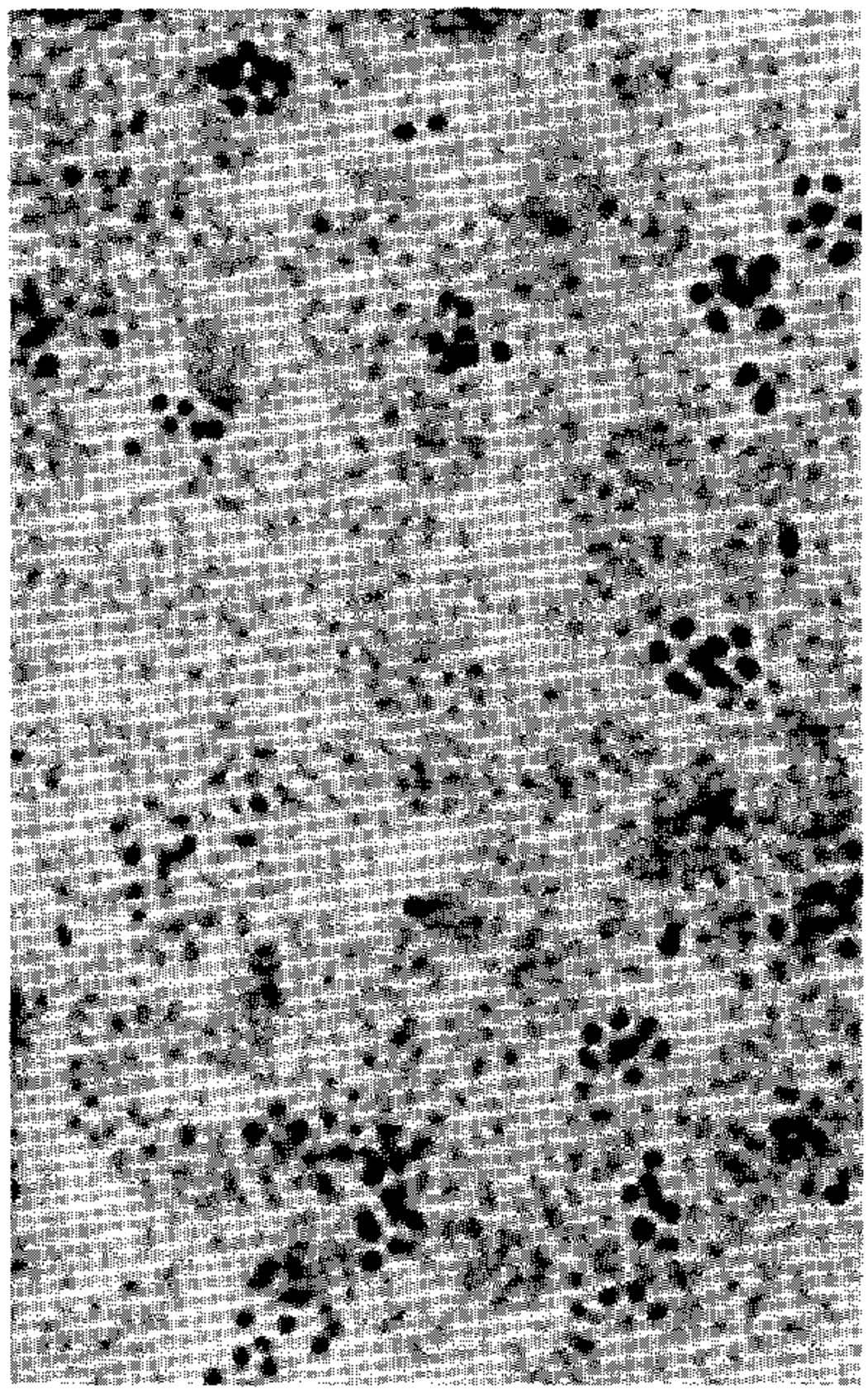

FIGURE 2.—Dab smear of ovarian tissue from white shrimp Number 1. *Thelohania* sp. "cysts" (usually with eight spores) are shown. Giemsa stain × 800.

however, was not infected. In addition to the seminal tubules in the thoracic portion of the ovary, there were large spaces filled with eosinophilic protein-like material. Columnar epithelial cells lined these spaces which were identified as male ductus efferens (Fig. 4).

Ovarian tissue in shrimp Number 2 was similar to that in shrimp Number 1. Microsporidia also were present and their distribution was the same. We did not find seminal tubules or ductus efferens in this shrimp, but samples were not examined from the cephalothoracic portion of the animal where male gonadal tissue occurs.

The gross characteristics of these shrimp were those of an hermaphrodite. Histologic examination of shrimp Number 1 confirmed this interpretation. The amount of ovarian tissue in the thorax and abdom-

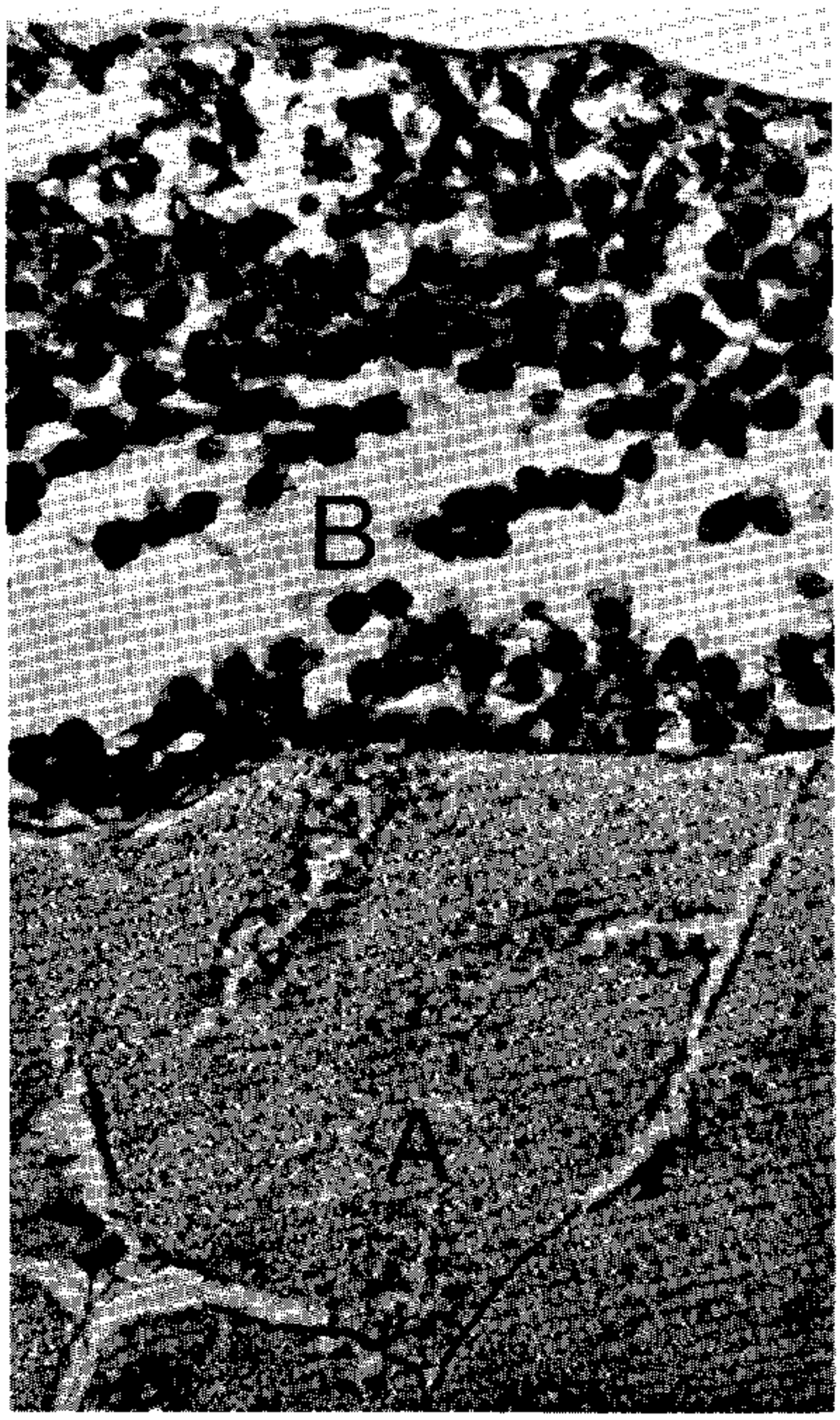

FIGURE 3.—Enlarged ova (A) diffusely infiltrated with microsporidia parasites in white shrimp Number 1. Spermatogonia fill the lumen of the seminal tubule (B). H & E stain × 350.

FIGURE 4.—Ductus efferens (A) in ovarian tissue (B) of white shrimp Number 1. It is filled with a protein-like fluid. The ductus is lined by columnar epithelial cells. H & E stain × 25.

inal segments of the two shrimp was typical of females of this size. The male gonadal tissues of shrimp Number 1 were present only in the thorax and were located within the ovarian stroma. This anatomical distribution of male and female gonadal tissue suggested a malformation.

The frequency with which hermaphrodites occur in penaeid shrimp is not known. Heegaard (1971) reported that *Penaeus kerathurus* Forskal is a protandric hermaphrodite; however, his observations are not supported by histological examination.

Numerous observations have been made on the influence of parasitism of the testes of male decapod crustaceans upon secondary sex characteristics, such as the shape of the pleopods, chelipeds, and abdomen, but parasitism of ovaries of female crustaceans, in general, is accompanied by little or no change in the general form of the body and appendages (Prosser and Brown 1962).

Our examination could not determine whether there was a cause and effect relationship between parasitism by *Thelohania* sp. and hermaphroditism in these white shrimp. *Thelohania* sp. has been shown to infect ovaries of penaeid shrimp, and it has been reported in male white shrimp (Overstreet 1973). Although only two hermaphrodites were examined in this study, ovarian tissue of both was infected with *Thelohania* sp., and both shrimp exhibited

male characteristics, but the female external sex characteristic, the thelycum, was absent. It is obvious that parasitism can occur without hermaphroditism in penaeid shrimp, but it is not known if the opposite is true.

ACKNOWLEDGMENT

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LITERATURE CITED

HEEGAARD, P. 1971. *Penaeus kerathurus* Forskal, a protandric hermaphrodite. Bull. Inst. Oceanogr. Peche, Salammbo, 2(2): 257–266.

LINDNER, M. J., AND H. L. COOK. 1970. Synopsis of biological data of the white shrimp, *Penaeus setiferus* (Linnaeus) 1776. FAO Fisheries Reports No. 57(4): 1439–1470.

OVERSTREET, R. M. 1973. Parasites of some penaeid shrimps with emphasis on reared hosts. Aquaculture 2(2): 105–140.

PROSSER, C. L., AND F. A. BROWN, JR. 1962. Comparative Animal Physiology. 2nd Ed. W. B. Saunders Co., Philadelphia, Pa. pp. 569–571.

SPRAGUE, V. 1950. Notes on three microsporidian parasites of decapod Crustacea of Louisiana coastal waters. Occas. Pap. Mar. Lab. Louisiana State Univ. 5: 1–8.