

## Ectopic Infections of *Portunium conformis* (Isopoda: Entoniscidae) in *Hemigrapsus* spp.

Ectopic infections involving Entoniscidae in shore crabs have been described. A. Veillet (*Ann. Inst. Oceanogr. (Monaco)* 22, 193-341, 1945) reported two female *Portunium maenalis* with their abdomens oriented abnormally against the region of the "fourreau." Miyashita (*Japan. J. Zool.* 9, 251-267, 1941) noted a slight asymmetry in the carapace of *Eriocheir japonicus* parasitized by *Entionella fluviatilis*, and recorded two specimens of *E. japonicus* with gross pathological changes occurring in the exoskeleton. Narrow fissures were observed between the sternal segments of these two crabs. He suggested that these fissures were products of an incompatibility of growth rate between the host and parasite, and were a result of constant internal pressure within the crab.

*Portunium conformis* is an endoparasitic isopod found in a shore crab, *Hemigrapsus* spp., on the west coast of North America. The adult female parasite is usually found on its side in the thoracic hemocoel of the host. The body of the parasite is V-shaped. The head and thorax are directed anteriorly, forming one arm; the head lying adjacent to the buccal apparatus of the host. The thoracic-abdominal junction underlies the intestine of the host. The abdomen of the parasite forms the other arm, being directed anteriorly; terminating at the anus which is appressed against a chitinized pore in the anterodorsal branchial chamber of the host (A. Veillet, *loc. cit.*, 1945; L. Muscatine, *J. Wash. Acad. Sci.* 46, 122-126, 1956; A. M. Kuris, G. O. Poinar, and R. T. Hess, *Parasitology* 80, 211-232, 1980). The body of the female parasite is entirely enclosed in a cellular sheath produced by the

host (A. M. Kuris, G. O. Poinar, and R. T. Hess, *loc. cit.*, 1980). Male parasites are found on the body surface of the female parasite or within her marsupium (A. Veillet, *loc. cit.*, 1945; A. M. Kuris, Ph.D. Thesis, Univ. California Berkeley, 1971).

Here we report on the nature and frequency of ectopic infections of *P. conformis* in *Hemigrapsus* spp. (1) In February, 1981, a male *H. nudus* (carapace width, 31 mm) was collected at Point Richmond, Contra Costa County, California. The posterolateral margin of the left branchial chamber was laterally inflated (Fig. 1). The inflated lesion was soft to the touch and had a translucent grey color. The lesion measured 22 mm long by 8 mm wide, and projected 8 mm from the unaffected surface of the carapace. When the carapace was removed, an immature female *P. conformis* was visible as a whitish mass in the anterolateral portion of the lesion. The second through fifth branchiae of the left branchial chamber were atrophied. The second branchia was displaced anteriorly, with numerous lamellae exposed through the margin of the branchial chamber. The third and fourth branchiae were indented medially and flattened anteriorly. The fourth branchia was also twisted and severely compressed. The fifth branchia was exposed ventrally underneath the lateral margin of the branchial chamber. The lamellae on the fifth branchia were markedly disrupted. Sand had infiltrated the left branchial chamber, and the branchiae were dirty greenish-grey instead of the greenish-yellow color of healthy branchiae.

The parasite was separated from the host branchiae by the thin cuticular membrane

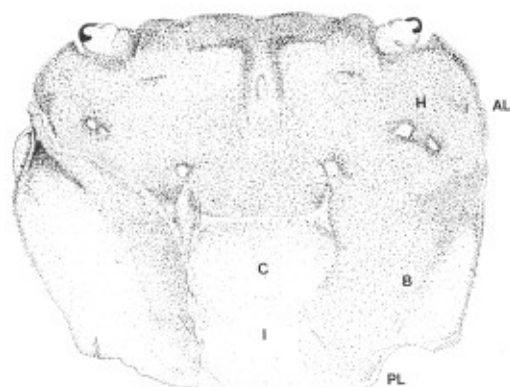


FIG. 1. Dorsal view of *Hemigrapsus nudus* from Point Richmond, California, having a female *Portunio conformis* in the left branchial hemocoelic space. The right side of the crab is unaffected by the parasite. Anatomical regions of the carapace mentioned in the text are labeled on the right side of the dorsal view: H, hepatic; C, cardiac; B, branchial; I, intestinal; AL, anterolateral; PL, posterolateral.

of the dorsal surface of the branchial chamber. The thin extension of the hemocoel (normally less than 1 mm) that lies within the branchial region of the carapace was expanded to a width of 7 mm. The parasite was slightly malformed. The isopod had attained developmental stage 8 (A. M. Kuris, G. O. Poinar, and R. T. Hess, *loc. cit.*, 1980), as indicated by its straight shape, enlarged cephalogaster, frilled gills, developing oostegites, and developing ovaries. Malformation was most notable in the shape and size of the isopod and its oostegites. The gills of the parasite were located in the anterolateral portion of the lesion, the gills being directed laterally. A male parasite was not recovered. The location of the parasite in the thin hemocoelic extension of the branchial carapace caused deformation of the dorsal carapace and displacement of the branchiae.

(2) In February 1970, a female *H. oregonensis* (carapace width 18 mm) was collected from Neah Bay, Washington. The cardiac region of the carapace was scarred, with the surface slightly indented and the posterior margin irregularly sinuous. This abnormality appeared to be the result of a traumatic injury to the crab. A reproductive

adult female *P. conformis*, bearing at least her second brood of eggs, was found within the hemocoel of the crab. The thoracic-abdominal juncture of the parasite was dorsal to the midgut of the host. All other large juvenile or adult *P. conformis* collected from other *Hemigrapsus* spp. were ventral to the midgut of the host.

(3) A female *H. oregonensis* (carapace width 22 mm) was collected from Fossil Point, Coos Bay, Oregon, in February, 1970. Externally, the host exhibited no atypical features. A reproductive female *P. conformis* carrying her first brood was present. The embryos were in an advanced stage of development. The cephalogaster of the parasite was ventral to the host midgut in the cardiac region of the thorax. The thorax and the abdomen of the parasite extended anteriorly in the left hemocoel of the crab. The anus of the parasite terminated in the anterior hepatic region of the carapace. The marsupium of the parasite was malformed. The anterior oostegites were enlarged and occupied much of the posterior portion of the hemocoel on the right side of the crab. The remaining oostegites, on the left side of the host, were very small, folded, and enclosed very few eggs. Surprisingly, the pore that connects the host-produced sheath with the thin cuticle of the anterodorsal region of the host branchial chamber was present in its typical position. Normally the anus of the parasite is appressed against this pore. Usually the cephalogaster of an adult *P. conformis* lies against the buccal apparatus of the host with the thorax extending posteriorly, the thoracic-abdominal juncture underlies the midgut of the host, and the abdomen extends anteriorly to a terminal anus in the region of the anterodorsal branchial chamber. Thus, this parasite was almost entirely confined to the space normally occupied only by the abdomen of a typical parasite.

In the first case, the unusual location of a *P. conformis* in the branchial hemocoelic space was associated with an inflated bran-

chial carapace similar in appearance to the inflations typically produced by bopyrid isopods in crab hosts (J. Bonnier, *Trav. Stat. Zool. Wimereux* 8, 1898; J. D. Shields, and A. M. Kuris, unpubl.). The present case is interesting because *Hemigrapsus* spp. on the west coast of North America are not parasitized by bopyrid isopods (over 10,000 unpublished observations). Rarely (4 observations) have *H. oregonensis* with branchial inflations similar to that reported here been examined, but only a pocket of sand and some misshapen branchiae were observed within the inflated branchial space. Thus, we suggest that an inflated branchial carapace is a host response elicited by diverse stimuli. Although typically associated with bopyrid isopod infestations, this response is not a coevolved aspect of the bopyrid-host association.

We suggest that the second case may have been caused by a traumatic injury to the cardiac region of the crab. This may have altered the position of the midgut of the host so that the developing parasite was able to grow over rather than under the midgut of the host. We are unable to offer an explanation for the unusual locations of the parasites in the first and third cases.

Ectopic infections in *Hemigrapsus* spp. are quite rare. Kuris *et al.* (*loc. cit.*, 1980) examined 3193 *H. oregonensis*, of which

1325 were parasitized by *P. conformis*, and the parasitized crabs contained 1849 parasites. For *H. nudus*, 346 crabs were examined, of which 192 were parasitized, and the parasitized crabs contained 237 parasites. Shields (unpubl.) examined 290 large (>14 mm) *H. oregonensis*, of which 60 were parasitized, and 42 large (>20 mm) *H. nudus*, of which 19 were parasitized. From these collections only three ectopic infections were found.

Ectopic infections in invertebrate definitive hosts are rare or rarely reported. Documentation of ectopic infections may provide insight into pathological mechanisms and other aspects of the host-parasite interaction despite the rarity of these events.

**KEY WORDS:** *Portunium conformis*; *Hemigrapsus* spp.; parasitic isopods; ectopic infections.

We thank Dr. Robert Trench and Dr. Elmer Noble for critical comments. Paul Sisk did the pen and ink drawing.

JEFFREY D. SHIELDS  
ARMAND M. KURIS

*Institute of Marine Science  
and  
Department of Biological Sciences  
University of California, Santa Barbara  
Santa Barbara, California 93106*

*Received May 1, 1984; accepted July 4, 1984.*

Statement of ownership, management, and circulation required by the Act of October 23, 1962, Section 4369, Title 39, United States Code of

JOURNAL OF INVERTEBRATE PATHOLOGY

Published bimonthly by Academic Press, Inc., 111 Fifth Avenue, New York, NY 10005. Number of issues published annually: 6. Editor: Dr. Thomas C. Cheng, Marine Biomedical Research Program, Medical University of South Carolina, P.O. Box 12339 (Fort Johnson), Charleston, SC 29422.

Owned by Academic Press, Inc., 111 Fifth Avenue, New York, NY 10005. Known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, and other securities: None.

Paragraph 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner. Names and addresses of individuals who are stockholders of a corporation which itself is a stockholder or holder of bonds, mortgages, or other securities of the publishing corporation have been included in paragraphs 2 and 3 when the interests of such individuals are equivalent to 1 percent or more of the total amount of the stock or securities of the publishing corporation.

Total no. copies printed: average no. copies each issue during preceding 12 months: 1222; single issue nearest to filing date: 1192. Paid circulation (a) to term subscribers by mail, carrier delivery, or by other means: average no. copies each issue during preceding 12 months: 784; single issue nearest to filing date: 804. (b) Sales through agents, news dealers, or otherwise: average no. copies each issue during preceding 12 months: 0; single issue nearest to filing date: 0. Free distribution by mail, carrier delivery, or by other means: average no. copies each issue during preceding 12 months: 44; single issue nearest to filing date: 46. Total no. of copies distributed: average no. copies each issue during preceding 12 months: 828; single issue nearest to filing date: 850.

(Signed) Rosette Corvillo, Senior Vice President