

Incidence of infestation by *Bopyrina abbreviata* Richardson, 1904 (Isopoda: Bopyridae) on *Hippolyte zostericola* (Smith, 1873) (Decapoda: Hippolytidae) in Laguna de Términos, Gulf of Mexico

Román-Contreras¹, R. and Romero-Rodríguez, J.

Laboratorio de Carcino-parasitología. Unidad de Ecología. Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México (UNAM). Apartado Postal 70-305, México D. F., 04510. México.

¹E-mail: ramiror@mar.icmyl.unam.mx

Abstract

Beds of *Thalassia testudinum* were sampled in the Laguna de Términos, Gulf of México to know the prevalence of infestation of the hippolytid shrimp *Hippolyte zostericola* (Smith, 1873). A total of 30,351 specimens were collected with a Colman-Seagrove sledge net. The host species exhibited a mean of 8.09 specimens/m² and a sexual ratio of 1.1 female by male. As many as 1,231 (4.06 %) specimens of *H. zostericola* were infested by the bopyrid isopod *Bopyrina abbreviata* Richardson, 1904. Comparatively a bigger percent of infestation of females (75.99%) than males hosts (17.22%) was observed. Infested females ranged from 1.1 mm to 3.0 mm CL, and males from 0.8 mm to 2.5 mm CL. The highest percentage of *H. zostericola* infested was sized between 1.7 and 2 mm CL in both sexes. Distral or sinistral settlement of the parasites on hosts did not show statistical differences. The population structure of *B. abbreviata* was composed mainly by pairs of parasites where females usually were ovigerous. The different stages of development of *B. abbreviata* collected suggest the continuous reproduction of the species in the study area. This is the first record of *B. abbreviata* infesting *H. zostericola* in the Laguna de Términos.

Key words: Isopoda Bopyridae, *Bopyrina abbreviata*, Gulf of Mexico.

Introduction

The members of the family Bopyridae infest a great number of species of crustacean decapods. This is the family most numerous and best represented among the Epicaridea (Markham, 1986). In particular, the genus *Bopyrina* Kossmann, 1881, infests shrimps of the families Hippolytidae and Palaemonidae (Pontoniinae) (Chopra 1923; Bourdon 1968) causing changes in the sexual characters and in some cases parasitic castration (Tsukamoto, 1981).

The study of the host-parasite relationship between *B. abbreviata* and its host *H. zostericola* is important because it is a dominant component in seagrass meadows in the Caribbean Sea and other regions; as well as an important link between the primary producers and the higher trophic levels (Main, 1987; Llansó *et al.*, 1998).

Material and Methods

Samples of *B. abbreviata* were collected in the Laguna de Términos, southwestern Gulf of Mexico (18° 27' to 18° 50' N and 91° 15' to 91° 51' W) from November 1997 to November 1999, a period which included the dry season (from February to May); the rainy season (from June to September); and the "nortes" season or winter storms (from October to March) (Yáñez-

Arancibia and Day, 1982), which is characterized by strong and cold winds from the north. The samples were obtained from beds of *T. testudinum* with a Colman-Seagrove sledge net, preserved in 10% formaldehyde and later transferred to 70% ethanol. The specimens were identified and counted for each sampled period. Specimens with parasites were separated individually and the sex, cephalothorax length (CL) and the left or right infested branchial chamber of the host were recorded. In addition, for each season the sex and size of sub-samples of 5% of the unparasitized shrimps were recorded.

The stages of *B. abbreviata* were defined on the morphological criteria proposed by Masunari *et al.* (2000) which include immature and mature females, immature and mature males, and cryptonisci larvae.

Results

A total of 30,351 specimens of *H. zostericola* were collected; and the average density was 8.09 orgs./m². The maximum density was recorded during the nortes season of 1997 with 17.85 org/m² and the minimum during the rainy and nortes seasons of 1999 (1.25 and 1.42 org/m², respectively) (Figure 1). Notwithstanding the observed seasonal variations in density these values were not statistically significant ($F_0=6.94$; $P<0.05$).

Females' size of *H. zostericola* free of parasites ranged between 0.9 and 3.5 mm CL, with 701 specimens (86.44%) between 2 and 3 mm CL. Ovigerous females ranged from 1.8 to 3.5 mm CL but most were recorded between 2.8 and 3.5 mm CL. Size of males free of parasites ranged between 0.8 and 2.5 mm CL, with 500 specimens (69.25%) of this subpopulation ranging from 1.2 to 1.5 mm CL (Figure 2).

A total of 1231 (4.06%) of *H. zostericola* were infested by *B. abbreviata*. This sub-population was composed of 933 females (75.79%), 212 males (17.22%), 75 damaged specimens (6.09%) (cephalothorax only), and 11 juveniles (0.89%) (Figure 3). Differences between adult females and males were statistically significant ($\chi^2=451.42$; $P<0.05$).

Females of *H. zostericola* carrying parasites varied between 1.1 and 3 mm of cephalothorax length (CL), with 487 specimens (52.2%) between 1.7 and 2 mm CL. Males varied between 0.8 and 2.5 mm CL, and 86 of these (40.57%) ranged between 1.7 and 1.9 mm CL. No statistically significant differences were found between the numbers of parasites on the right or the left branchial chamber of the hosts ($\chi^2=1.24$; $P>0.05$).

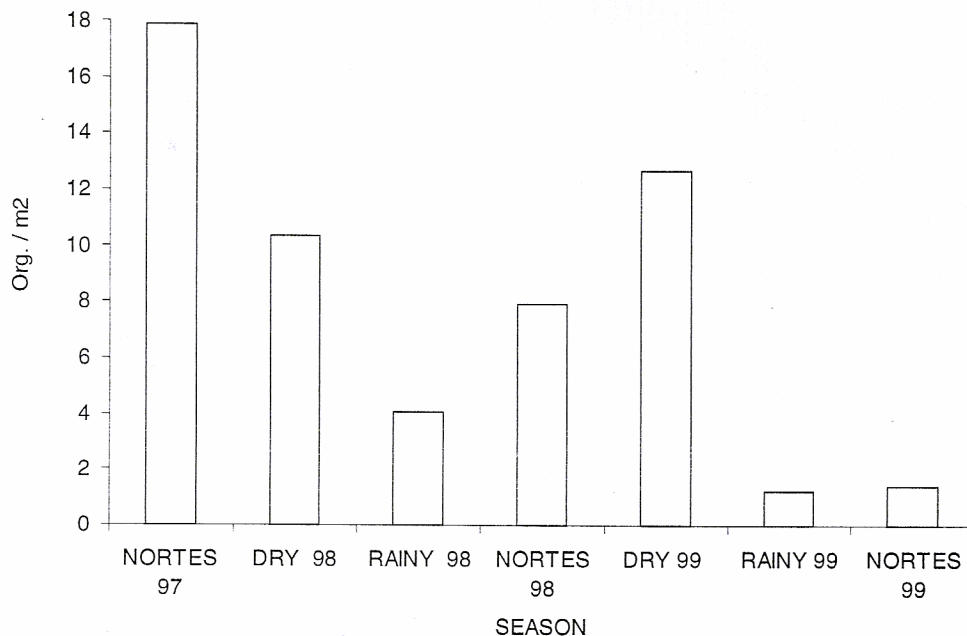


Figure 1: Density of the population of *Hippolyte zostericola* by season in the Laguna de Términos, southwestern Gulf of Mexico. "Nortes" = winter storms.

The population of *B. abbreviata* was composed of 969 couples sexually mature of which 816 (84.21%) females were ovigerous, and 36 couples that were sexually immature. As many as 198 shrimps did not exhibit physically the parasite but presented evidence of had been previously infested.

The population' structure of *B. abbreviata* ($F_0=2.95$; $P<0.05$) showed no statistically significant differences from one season to another ($F_0=2.95$; $P>0.05$).

Other ovigerous females of *H. zostericola* were collected during the nortes season of 1997 and the dry season of 1999, evincing to have been recently infested. Additional specimens separated from their hosts were collected and other associations of parasites in different stages were recorded (Table I).

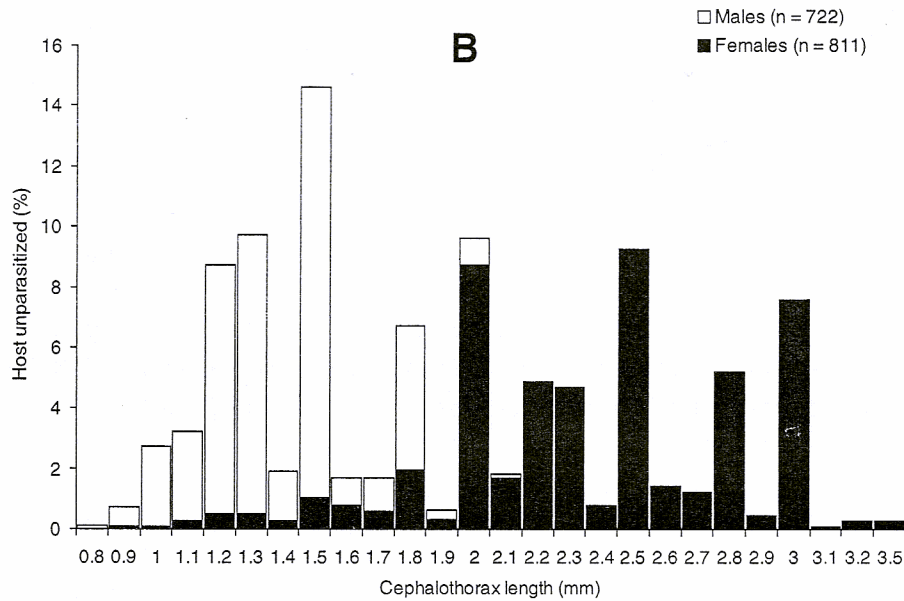


Figure 2: Size composition of the subsamples of *H. zostericola* unparasitized in the Laguna de Términos, southwestern Gulf of Mexico.

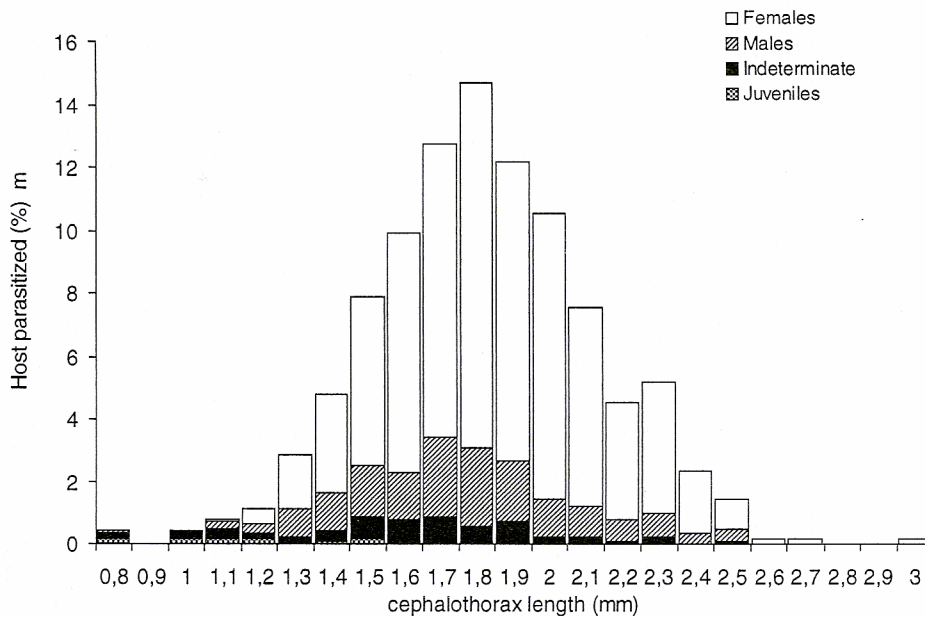


Figure 3: Composition of the subpopulation of *H. zostericola* parasitized in the Laguna de Términos, southwestern Gulf of Mexico.

Table I: Other types of association of *B. abbreviata* on *H. zostericola*. "Nortes" = winter storms.

Associations	"Nortes" 97	Dry 98	Rainy 98	"Nortes" 98	Dry 99	Rainy 99	"Nortes" 99
♀ Inmature single	1	1			1		
♀ Mature single	4	2	2		1		1
♀ Mature with 1 larvae	8						
♀ Mature with 2 larvae	1						
♀ Mature with 3 larvae	1						
Mature couple with additional larvae	1						
♀ Mature with 2 males	1						
♂ Mature single			1				

Discussion

The shrimp *H. zostericola* is a conspicuous species in the seagrass beds of *T. testudinum* where it has been recorded as a dominant species among the 15 species of carideans present in the Laguna de Términos (Ledoyer 1986; Negreiros-Fransozo *et al.*, 1996).

The average of infestation of *H. zostericola* by *B. abbreviata* was 4.06% ranging from 6.98% during the nortes season of 1997, to 0.94% during the nortes season of 1998. The closest percentages of infestation by one species of *Bopyrina* compared to the present study, was recorded by Tsukamoto (1981) between *Bopyrina ocellata* (Czerniavski, 1868), and *Hippolyte curacaoensis* Schmitt, 1924, where the infestation ranged from 0.1 to 4.6%. Comparatively, infection levels by *Probopyrus pandalicola* (Packard, 1879), varied from less than 1% in *Palaemonetes vulgaris* (Say, 1818), (see Morris 1948) to 100% in *Palaemonetes paludosus* (Gibbes, 1850), infested by the same species of bopyrid (see Beck 1979). In *Macrobrachium tenellum* (Smith, 1871), the females were more frequently infested than males (23.3: 2.6) by *Probopyrus pacificensis* Román-Contreras, 1993, which was dependent of the month of collection.

The wide variability recorded by several authors on the percentages of infestation in other species of bopyrids suggests that there is not any infestation pattern and that the frequency of infestation can vary according to the host species, size of samples and studied area (Cole 1949).

In the present study females of *H. zostericola* infested by *B. abbreviata* were more frequently collected than males (4 females: 1 male); female hosts, both parasitized and unparasitized, have greater sizes in the present study. Beck and Cowell (1976) and Beck (1979) have suggested that the parasite could to have advantage for infesting female hosts, since they are frequently bigger than males in larger size classes and sometimes they have longer life-span than males.

Lewis and Windsor (1979) recorded that the incidence of infestation in males of *Munida iris* A. Milne-Edwards, 1880, by *Anuropodione carolinensis* Markham, 1973, was significantly greater than in females. Likely Kunju (1955) found higher percentages of male hosts parasitized although the females had larger sizes. Bourdon (1968) stated that when the males hosts are larger, greater percentages of specimens are infested. However this is not necessarily an indication of preference of the parasites to infest males or females host since Lewis and Windsor's (1979) samples of males were significantly more numerous than females for each sampled month. Beck (1979) has suggested that further research is needed to clarify the relationship between the bopyrid infection' levels and the sex and size of the hosts infested.

The location on the right or left side of the parasite on *H. zostericola* did not show statistically significant differences and we are unable to affirm that *B. abbreviata* has preference for either

left or right branchial chamber of its host. Our results agree with reports for *Probopyrus bithynis* Richardson, 1904, on *Macrobrachium obione* (Smith, 1874), (see Truesdale and Mermilliod 1977), *P. pandalicola* on *Palaemonetes paludosus* (see Beck, 1980); *Probopyrus* “*pandalicola*” infesting *Palaemon ritteri* Holmes, 1895, (see Campos and Campos 1989); and *P. pacificensis* infesting *Macrobrachium tenellum* (Smith, 1871), (see Román-Contreras 1993). In addition, Masunari *et al.* (2000) did not observe preferences by *Macrobrachium potiuna* (Müller, 1880) to be located neither on the right nor in the left branchial chamber of *Probopyrus floridensis* Richardson, 1904. Exception to this rule are species in the genera *Asymmetrione* Codreanu, Codreanu and Pike, 1965, and *Bopyrissa* Nierstrasz and Brender à Brândis, 1931, which for reasons unknown have only dextral or sinistral forms (Markham 1986).

The population structure of *B. abbreviata* during the sampled seasons in the present work was mainly composed by couples of parasites sexually mature that in most of the cases included ovigerous females. This is the probable cause because the larvae of *B. abbreviata* were collected throughout the sampled seasons as well as was observed by Allen (1966) and Tsukamoto (1981) between the host-parasite relationships *Pandalus montagui* Leach, 1814-*Hemiarthrus abdominalis* (Kroyer, 1840); and *Hippolyte curacaoensis*-*Bopyrina ocellata*, respectively.

Conclusions

In the present study the density of *H. zostericola* did not show a defined seasonal pattern in the study area.

The minimum size recorded in *H. zostericola* was 0.8 mm CL and the maximum 3 mm CL.

The percentage of infection in the population of *H. zostericola* was 4.06%, which is similar to values recorded in other bopyrid species.

The highest frequency of infestation of *H. zostericola* by *B. abbreviata* was found in sizes between 1.7 and 2 mm CL.

The frequency of infestation by *B. abbreviata* was greater in females than in males (4.4:1).

Bopyrina abbreviata didn't exhibit preference neither for the right nor for the left branchial side of their hosts.

The stages of development of *B. abbreviata* recorded in the sampled seasons suggest that the species have a continuous reproduction in the study area.

This is the first record of *B. abbreviata* infesting *H. zostericola* in the Laguna de Términos, Gulf of Mexico.

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References

- Allen, J. A. 1966. Notes on the relationship of the bopyrid parasite *Hemiarthrus abdominalis* (Kroyer) with its hosts. *Crustaceana* 10: 1-6.
- Beck, J. T. 1979. Population structure interactions between a parasitic castrator, *Probopyrus pandalicola* (Isopoda: Bopyridae), and one of its freshwater shrimps hosts, *Palaemonetes paludosus* (Decapoda: Caridea). *Parasitology* 79: 431-449.
- Beck, J. T. 1980. Life history relationship between the bopyrid isopod *Probopyrus pandalicola* and one of its freshwater shrimp hosts *Palaemonetes paludosus*. *The American Midland Naturalist* 104 (1): 135-154.
- Beck, J. T. and Cowell, B. C. 1976. Life history and ecology of the freshwater caridean shrimp *Palaemonetes paludosus* (Gibbes). *The American Midland Naturalist* 96: 52-65.

- Bourdon, R. 1968. Les Bopyrides des Mers Européennes. Mémoires du Muséum National D'Histoire Naturelle. Paris. Série A, Zoologie: 77-424.
- Campos, E. and de Campos, A. R. 1989. Epicarideos de Baja California: distribución y notas ecológicas de *Probopyrus pandalicola* (Packard, 1879) en el Pacífico oriental. Revista de Biología Tropical 37 (1): 29-36.
- Cole, L. C. 1949. A theory for analyzing contagiously distributed populations. Ecology 27 (4): 329-341.
- Chopra, B. 1923. Bopyrid isopods parasitic on Indian Decapoda Macrura. Records of the Indian Museum 25: 411-550.
- Kunju, M. M. 1955. Preliminary studies on the biology of the palaemonid prawn, *Leander styliiferus* Milne-Edwards in West Bengal, India. Proceedings Indo-Pacific Fisheries Council 6: 404-418.
- Ledoyer, M. 1986. Faune mobile des herbiers de phanérogames marines (*Halodule* et *Thalassia*) de la Laguna de Términos (Mexique, Campeche). II Les Gammariens (Crustacea). Anales del Instituto de Ciencias del Mar y Limnología, Universidad Nacional Autónoma de México 13 (3): 171-200.
- Lewis, E. L. and Windsor, N. T. 1979. Parasitism of galatheid crustaceans from the Norfolk Canyon and Middle Atlantic Bight by bopyrid isopods. Crustaceana 37 (3): 293-303.
- LLansó, R. J.; Bell, S. S. and Vose, F. E. 1998. Food habits of red drum and spotted sea trout in a restored mangrove impoundment. Estuaries 21 (2): 294-306.
- Main, K.L. 1987. Predator avoidance in seagrass meadows: prey behaviour, microhabitat selection, and cryptic coloration. Ecology 68: 170-180.
- Markham, J. C. 1986. Evolution and zoogeography of the Isopoda Bopyridae, parasites of Crustacea Decapoda. Pp. 143-164. Gore R. H. and Heck K. L. eds. Crustacean Biogeography. A. A. Balkema/Rotterdam/Boston.
- Masunari, S., Da Silva Castagini A. and Oliveira, E. 2000. The population structure of *Probopyrus floridensis* (Isopoda, Bopyridae), a parasite of *Macrobrachium potiuna* (Decapoda, Palaemonidae) from the Perequê River, Paranaguá Basin, Southern Brazil. Crustaceana 73 (9): 1095-1108.
- Morris, J. A. 1948. Studies on the host-parasite relationship of *Probopyrus pandalicola* (Packard). 20p. Ph. D. Dissertation. The Catholic University of America. Biological Studies 8.
- Negreiros-Fransozo M. L.; Barba, E.; Sánchez, A. J.; Fransozo, A. and Ráz-Guzmán, A. 1996. The species of *Hippolyte* Leach (Crustacea, Caridea, Hippolytidae) from Términos Lagoon, southwestern Gulf of Mexico. Revista Brasileira de Zoologia 13 (3): 539-551.
- Román-Contreras, R. 1993. Aspectos biológicos de *Probopyrus pacificensis* Román-Contreras, 1993, parásito del langostino *Macrobrachium tenellum* (Smith, 1871) en la Laguna de Coyuca, Guerrero, México. 86p. Tesis Doctoral. Facultad de Ciencias. Universidad Nacional Autónoma de México (UNAM). México, D. F.
- Truesdale, F. M. and Mermilliod, W. J. 1977. Some observations on the host-parasite relationship of *Macrobrachium obione* (Smith) (Decapoda, Palaemonidae) and *Probopyrus bithynis* Richardson (Isopoda, Bopyridae). Crustaceana 32 (2): 216-220.
- Tsukamoto, R. Y. 1981. *Bopyrina ocellata* (Czerniavsky, 1868), Isópode parasita assinalada pela primeira vez no Atlântico Sul. (Epicaridea, Bopyridae). Morfología, desenvolvimento e distribuição geográfica. Ciência e Cultura 33 (3):394-401.
- Yáñez-Arancibia, A. and Day, Jr, J. W. 1982. Ecological characterization of Términos Lagoon, a tropical lagoon-estuarine system in the southern Gulf of Mexico. Oceanologica Acta, Suppl. 5 (4): 431-440.

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