

Diel changes in embryonic maturation in two species of marine cladocerans in Guanabara Bay, Rio de Janeiro, Brazil

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ABSTRACT. Two species of marine cladocerans, *Penilia avirostris* Dana, 1852 and *Evadne tergestina* Claus, 1877 were collected in thirteen samples at a fixed station in Guanabara Bay, Rio de Janeiro (30-meter depth) by means of vertical tows with a 200 µm mesh size net at different times from September 12th to 15th, 1995. The parthenogenetic females of *Evadne tergestina* bore mature embryos (with pigmented eye) only in the samples collected at night, whereas *Penilia avirostris* at any time of day. This phenomenon was interpreted based on the greater visibility of the *Evadne tergestina* brood: one of the benefits for embryo maturing during the darkness period would be a decrease of predation on gravid females.

KEY WORDS. Cladocera, *Penilia avirostris*, *Evadne tergestina*, zooplankton, embryos, Guanabara Bay, Brazil

Only seven species of cladocerans are truly marine, which belong to the genera *Penilia* Dana, 1849 (one species *Penilia avirostris* Dana, 1849), *Evadne* Loven, 1835 and *Podon* Lilljeborg, 1853. Most of these organisms are restricted to the coastal waters, where they constitute an expressive fraction of the local zooplanktonic community. However, these animals may disappear from the plankton during certain periods of the year (ONBÉ 1999).

The females of those species retain the embryos in brood pouch located inside their carapace. This pouch is pressed with the increase in size of the embryos, and may change the shape of the animal's carapace. The embryos go on developing until they become adultlike, and then are released into the water with the maternal molting (ONBÉ 1999).

The eye of *P. avirostris* mature embryos is quite small. On the other hand, the eye of *Evadne* and *Podon* embryos become pigmented during the last hours of embryonic development. As cladocerans are transparent animals, the eye of those embryos are perceivable through the mother's brood pouch wall, a fact which renders gravid females more visible. Research has evidenced that *Evadne* young are released at night (BRYAN 1979), and it is speculated that one of the advantages of this phenomenon is the decrease in predation on gravid females.

Previous papers described the occurrence of *P. avirostris* and *E. tergestina* Claus, 1877 in Guanabara Bay (BARTH 1972). Based on this data, was established as aim to observe the time of occurrence of female bearing mature embryos in these

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species. Guanabara Bay is located in the State of Rio de Janeiro, Southeast Brazil (22°41'-23°56'S and 43°02'-43°18'W). It is classified as a coastal estuary with shallow and partially mixed waters (AMADOR 1997).

Thirteen zooplankton samples were obtained in a fixed station at a 30m-depth at different times from September 12th to 15th, 1995 (Tab. I). Samples were collected by vertical tows using a conical net (0.6 m diameter and 2 m long) with 200 μ m mesh size, and preserved according to GRIFFITHS *et al.* (1976).

Following counting, 50 individuals were removed from each sample (when in sufficient number), and placed in glycerin droplets for body clearing. After 24 hours, those animals were observed under a optical microscope to know the development stage of the embryos. Observation was made through the animal's transparent carapace. Whenever a high number of embryos became the identification difficult, the female's brood pouch was dissected with a fine needle. Embryo classification followed DELLA CROCE & BETTANIN (1965) for *P. avirostris* and ONBÉ (1974, 1977) for *E. tergestina*. Only those embryos in the last development stage were considered mature that is, those just before the release.

T-test was used for comparing percentage of mature embryos of both species at night and day. Previous ArcSinus ($x^{0.5}$) transformation was applied for normalizing data.

Cladoceran populations comprised only parthenogenetic females. *Penilia avirostris* brood pouch displayed at most 11 embryos ($\bar{X} = 2.67$), whereas *Evadne tergestina* 9 embryos ($\bar{X} = 4.40$). *P. avirostris* presented mature embryos at different times of the day, and there was no significant difference in percentage between night and day ($p = 0.32$). On the other hand, *E. tergestina* mature embryos (that is, those with pigmented eyes) were recorded only in the samples taken at darkness hours. Percentage at night was significantly higher than during the day in this species ($p < 0.001$) (Tab. I, Fig. 1).

The results suggest that the presence of mature embryos with pigmented eye in the *E. tergestina* brood pouch only during the darkness period would be an advantage. In freshwater cladocerans, the presence of visible structure inside the body (such as food-containing intestines) increases predation pressure by visual predators. The eye is the most visible part of many zooplanktonic organisms and, among freshwater cladocerans, those having greater eye become more susceptible to predation by planktivorous pelagic fish (ZARET 1972). Therefore, it may be a disadvantageous for *E. tergestina* to bear pigmented-eye embryos during daytime. As the eye of these embryos become pigmented a few moments before they are released in the water, it is probable that it is done always before dawn. Previous studies have confirmed the periodicity in the young release by *E. tergestina* (MULLIN & ONBÉ 1992).

On the other hand, *P. avirostris* may bear mature embryos independently of the available amount of light in the environment, as their small eye is not visible through the mother's brood pouch wall. However, papers have demonstrated that there is a tendency for the embryos to mature chiefly at night (MULLIN & ONBÉ 1992). In this case, the visibility of the brood would be due to the embryo size and not due to the eye.

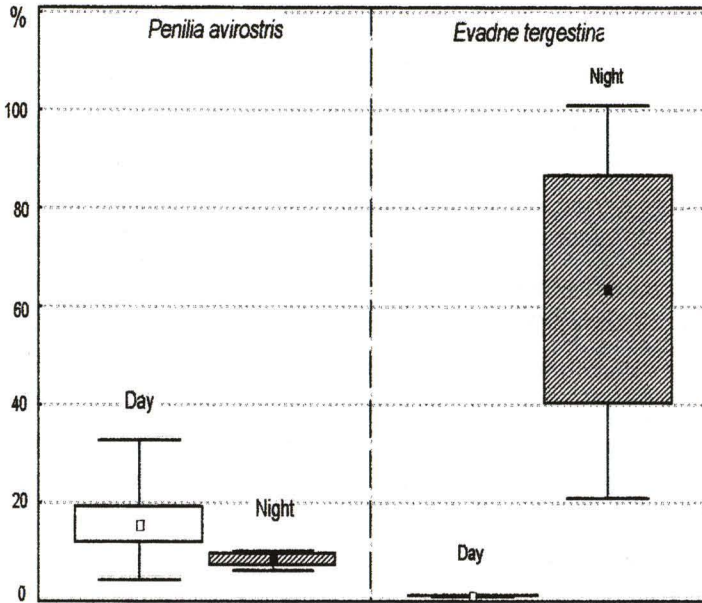


Fig. 1. Percentage of mature embryos present in the brood pouch of *Penilia avirostris* and *Evadne tergestina* at night and day (mean, standard error, minimum and maximum values).

Table I. Mean number of embryos and percentage of mature embryos (last development stage) present in the brood pouch of *Penilia avirostris* and *Evadne tergestina* during the period of 12 to 15 September, 1995.

Date September 1995	Time (h)	<i>Penilia avirostris</i>			<i>Evadne tergestina</i>		
		Number of females examined	\bar{X} embryos	% mature embryos	Number of females examined	\bar{X} embryos	% mature embryos
12	12:45	50	3.23	4.92	1	4.00	0.00
12	17:20	50	2.43	19.41	50	4.85	0.00
13	09:00	15	3.03	13.33	18	4.70	0.00
13	12:00	3	0.00	—	—	—	—
13	17:00	50	1.30	6.04	50	2.47	0.00
14	00:20	25	3.42	8.00	5	2.50	20.00
14	05:10	19	3.76	5.26	3	4.00	100.00
14	12:40	50	3.28	25.93	—	—	—
14	17:40	50	4.25	3.42	31	4.50	0.00
15	01:30	50	4.00	9.26	3	7.00	67.70
15	06:00	28	3.15	—	14	3.38	0.00
15	14:00	22	3.67	31.82	—	—	—
15	18:00	50	1.86	11.76	50	6.55	0.00
Total		462			225		
Mean			2.67			4.40	

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