Comparing the efficiency of two sampling devices for collecting resting eggs of marine cladocerans.

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Abstract

The aim of this study was to compare the efficiency of two kinds of apparatus used to collect sea-bottom samples to estimate the density of resting eggs of marine cladocerans. Short period samples were taken from the sediment of the Guanabara bay, by means of an Ekman grab and a 2 inch diameter corer. The present investigation demonstrated that the Ekman grab yielded more resting eggs than did the corer, thus being the more useful method for collecting resting eggs. The significant difference between the methods (confirmed by paired t-test) indicates that although both the Ekman grab and the gravity corer are useful for collecting resting eggs, the objective of the research will determine the more suitable method.

Key words: resting eggs, marine cladocerans, *Penilia avirostris*, *Pleopis polyphemoides*, Ekman grab, gravity corer.

Introduction

Cladocerans are small crustaceans that almost exclusively inhabit fresh water. Of the approximately 700 species described, only eight are truly marine, in five genera: *Penilia*, *Evadne*, *Pseudevadne*, *Pleopis* and *Podon*, according to Onbé (1999).

Although marine cladocerans are quite abundant among mesozooplanktonic community, their resting eggs have received little attention. The distribution of resting eggs of marine cladocerans in the sea bottom was first studied by Purasjoki (1945). Important contributions have been made by Dr. Takashi Onbé in Japan (see review in Egloff *et al.* 1997). Other important contributors have been Viitasalo and Katajisto (1994) and Egloff (1997).

The few studies of the biology and ecology of marine cladocerans in Brazil, have focused only on their planktonic life phases (reviewed by Barros, 2000), and there is little information on the benthic phase in any tropical environment. For this reason, researches on resting eggs of marine cladocerans in Guanabara bay (Rio de Janeiro) were initiated in 1999. These studies (Barros, 2000) demonstrated the occurrence of wide differences in the estimation of density of resting eggs (about 340.10^3 eggs), obtained using different sampling devices: an Ekman grab and a gravity-corer sampler. These results raised the question of which might be the best method to obtain quantitative samples of resting eggs. Both the Ekman grab and the gravity corer are commonly used to collect resting eggs of cladocerans and copepods from the sea bottom (Onbé, 1978, 1985; Madhupratap *et al.* 1996; Viitasalo and Katajisto, 1994). This study aimed to compare the efficiency of these devices for sampling resting eggs of cladocerans from the sea bottom of Guanabara bay.

Material and Methods

The study area was Guanabara bay (Fig. 1), in the state of Rio de Janeiro (22°41' - 22°56'S and 43°02' - 43°18'W). The mean depth of the bay is about 7.6 m, deeper in the outer part. Several 5-10 m deep channels merge with a large central channel, parts of which are more than 50 m deep. Guanabara

bay is considered one of the most ecologicaly vulnerable Brazilian bays. It is undergoing rapid eutrophication, mainly because of the large quantities of organic wastes released daily (Kjerfve, 1997).

Sediment samples were collected in three replicates, each taken over a 3 to 4-day-period, from March through May 2001. Resting eggs were found in highest densities during the same season of the previous year (Barros, 2000). The sampling equipment consisted of an Ekman grab (15 cm height x 15 cm width), which is able to sample 1 to 2 liters each time on average; and a gravity corer, 5 cm in diameter and 50 cm in length, made of stainless steel and weighing about 15 kg.

The sampling station (Fig. 1) was located near the central channel of the bay. The water was about 15 m in deep, and the sediment was mud. This site is appropriate for the study of resting eggs of cladocerans, since the presence of fine sediment particles (smaller than 50 µm) indicates hydrodynamical conditions that favors resting eggs to settle into the sea bottom, leading to high densities (Onbé, 1985). This was observed in earlier studies on resting eggs in Guanabara Bay (Barros, 2000).

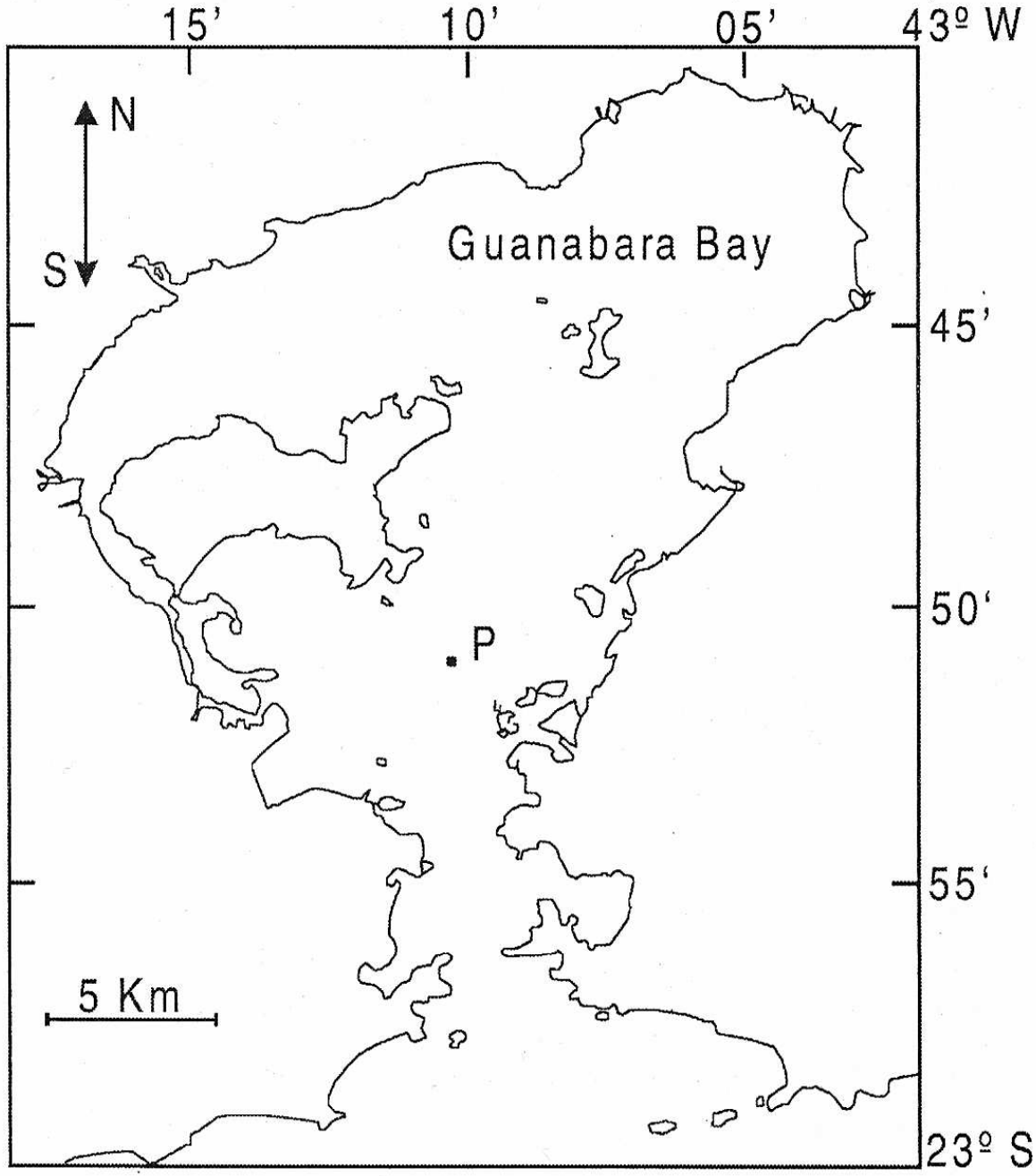

Figure 1: Location of the sampling station (P) in Guanabara Bay, State of Rio de Janeiro.

The volume of samples taken with the Ekman grab was determined by means of a graduated recipient. The samples in the corer tubes were divided into three 5-cm layers of sediment, which corresponds to the maximum depth (15 cm) that can be sampled by the Ekman grab. Samples were preserved in 10% formaldehyde. The sorting of resting eggs from sediment samples was estimated by sieving sediment samples through a 100-µm mesh. The sieved residue was transferred to a centrifuge tube containing a dense sugar solution (1 kg sucrose in 1 liter water), and centrifuged three times at 3,500 rpm for 4 minutes. After each centrifugation, the supernatant was collected to quantify resting eggs. The eggs were identified according to descriptions by Onbé (1985). Densities were expressed as number of resting eggs x m^{-3}. For both species of cladocerans present in the bay, sampling efficiency was compared in terms of the absolute density and of the temporal distribution of resting eggs. Density data for resting eggs of each species were compared between both samples, using a paired t-test. Pairs were formed by values corresponding to the mean of three replicates (n = 17).

Results

Resting eggs belonging to two genera and species of marine cladocerans were found at Guanabara Bay: *Penilia avirostris* Dana and *Pleopis polyphemoides* (Leuckart). The numbers of resting eggs actually found in samples collected with the Ekman grab were higher than in the samples taken with the gravity corer. However, densities of resting eggs estimated from the gravity-corer samples were higher (8-10 times on average) than the densities estimated from the Ekman grab samples. A comparison between the Ekman grab and the corer samples showed marked differences in the average density of resting eggs (over 40 x 10^3 resting eggs x m^{-3} for *P. avirostris* and about 10 x 10^3 resting eggs x m^{-3} for *P. polyphemoides*), as well as in terms of temporal distribution.

Resting eggs of *P. avirostris* were more abundant during the study period, with maximum densities over 200 x 10^3 resting eggs x m^{-3} (mean = 85 x 10^3 resting eggs x m^{-3}) in corer samples, and maximum densities of 39 x 10^3 resting eggs x m^{-3} (mean = 8 x 10^3 resting eggs x m^{-3}) in the Ekman grab samples. Densities for *P. polyphemoides* reached maxima of 16 x 10^3 resting eggs x m^{-3} (mean = 5.10^3 resting eggs x m^{-3}) in corer samples, and maxima of 3 x 10^3 resting eggs x m^{-3} (mean = 0.6 x 10^3 resting eggs x m^{-3}) in the Ekman grab samples (Fig. 2). Highly significant differences ($n = 17$, $p < 0.01$) between the density of resting eggs collected with both samplers were confirmed by paired t-test for *P. avirostris* ($t = 5.95$) and *P. polyphemoides* ($t = 18.88$).

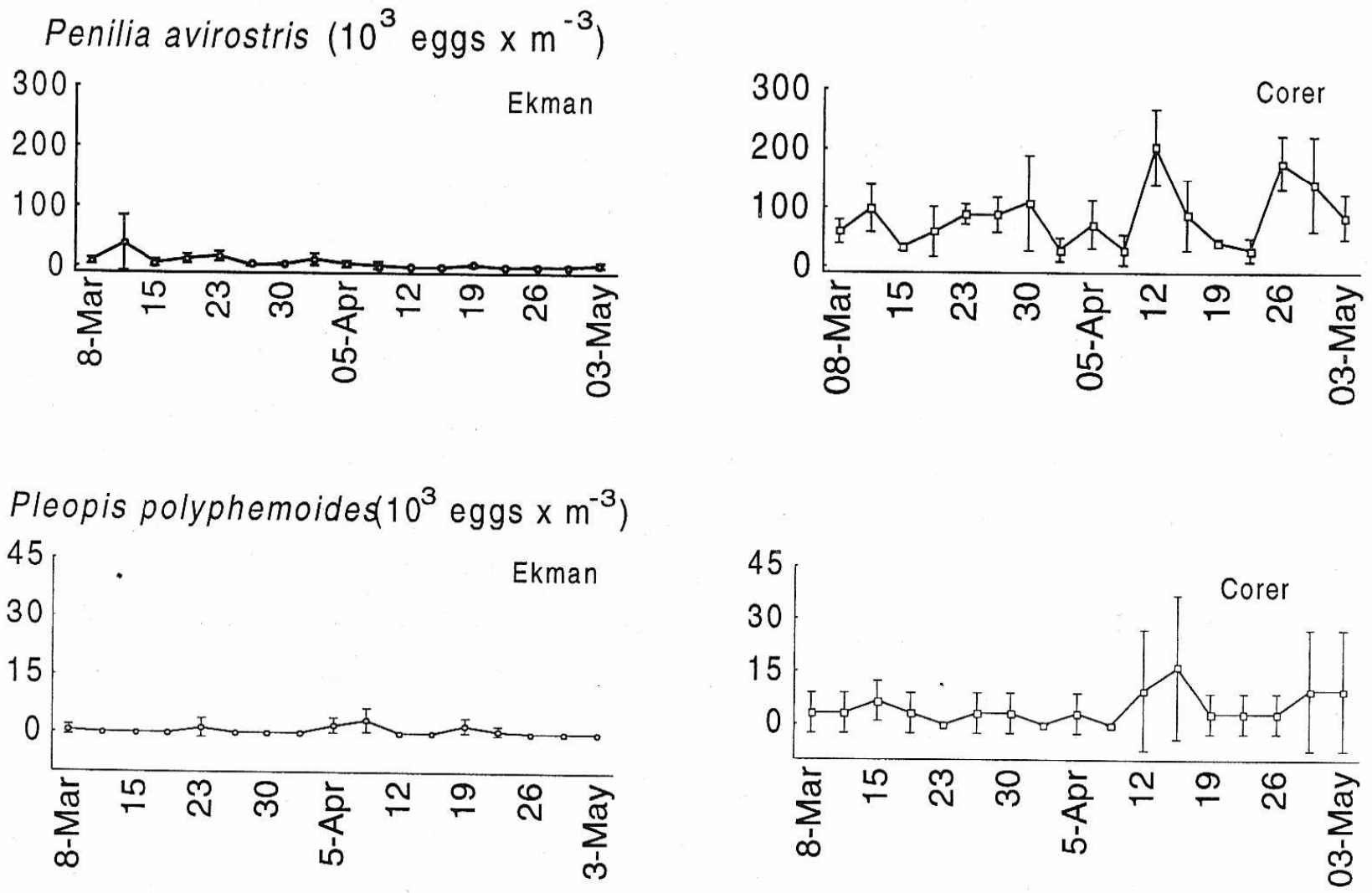

Figure 2: Densities of resting eggs of *Penilia avirostris* and *Pleopis polyphemoides* obtained with an Ekman grab (left) and a corer sampler (right) at a fixed station in Guanabara Bay, from 8 March to 3 May, 2001. Vertical line = standard deviation; point = mean.

The temporal distribution of resting eggs showed different patterns between the two types of sample. These differences were especially clear in the case of resting eggs of *P. avirostris*, which showed successive peaks of density in the corer samples; such peaks were not observed in grab samples. In the case of *P. polyphemoides*, the peaks occurred on different dates.

Discussion

Resting eggs of *P. avirostris* were more abundant than those of *P. polyphemoides* in the sediment of Guanabara Bay, in accordance with earlier studies (Barros, 2000). This difference in abundance accounts for the dominance of *P. avirostris* in the plankton, whereas *P. polyphemoides* occurs in lower densities.

The corer and the grab samplers have similar functions, but each has disadvantages. Although the Ekman grab can collect sediment in large quantities, it does not maintain the sample integrity; part of the sediment is lost because of contact with the water while the grab is being raised to the surface. This may explain the lower densities of eggs sorted from an Ekman grab sample. On the other hand, the gravity corer keeps the sediment intact inside the tube, thus avoiding high loss of material because of contact with the water. However, the small diameter of the tube, necessary to allow it to penetrate into the sediment, does not allow collection of a large volume of sediment. The small volume of sediment makes detection of resting eggs difficult if they are present in low densities, and increases sampling error (points dispertion). In our triplicate samples, coefficient of variation reached 88% for *P. avirostris* and 173% for *P. polyphemoides*. In such a situation, additional replicates would be advisable.

The progress of knowledge of the biology and ecology of marine cladocerans, especially in little-studied tropical coastal environments such as Guanabara Bay, needs investigation of the role of resting eggs in the recruitment of planktonic populations of cladocerans, as well as its consequences for the marine trophic chain. Consequently, large quantities of resting eggs are necessary for laboratory experiments, and an adequate sampling method must be employed. The present investigation demonstrated that the Ekman grab yielded more resting eggs than did the corer, thus being the more useful method for collecting resting eggs in this case. However, for studies involving the estimation of density levels, the gravity corer with an adequate diameter and number of replicates is more appropriate. The significant difference between the methods indicates that although both the Ekman grab and the gravity corer are useful for collecting resting eggs, the objective of the research will determine the more suitable method.

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