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STUDY OF SPATIAL DISTRIBUTION OF MARINE ORGANISMS. WHAT HINTS COULD SUPPLY? TWO EXAMPLES

STUDIO DELLA DISTRIBUZIONE DI ORGANISMI MARINI. QUALI INFORMAZIONI PUÒ FORNIRE? DUE ESEMPI

Abstract *– The spatial distribution pattern of 2 different kind of benthic organisms (interstitial protists and red coral recruits) were studied by means of Nested ANOVA and Nearest-Neighbour Distances analysis, respectively. Our results highlight the different scales at which different protists spread over the sandy bottom. Red coral recruits tend to cluster on natural substrates while spread at random on artificial, homogeneous substrates.*

Key-words: *benthos, Eastern Ligurian Sea, larval settlement, spatial distribution, red coral.*

Introduction - The study of spatial distribution patterns can increase our understanding of the scale at which ecological processes, namely biological interactions, operate (Underwood, 1997). In this short note we examine the distribution of two different kinds of marine organisms in their environment. The first case examined deals with the scale at which some intersititial protists (ciliates and unicellular fungi-thraustochytrids) spread on the sandy-shore bottom. This research was carried out examining protist density on samples collected following a Multifactorial Nested ANOVA model with different spatial scales. The second deals with the spatial distribution pattern of red coral recruits on natural and artificial substrates. This research was set out examining Nearest Neighbour Distances (Pielou, 1984) between red coral recruits on natural and artificial substartes.

Materials and methods – One-hundred twenty-eight 1 ml sand samples were collected at Marina di Pisa (Italy, Eastern Ligurian Sea, 43°42'N, 10°16° E), following a Nested ANOVA design which factors were: Time (4 times in Authumn-Winter), Square (2 3.3×3.3 m quadrats for each time), Plot (2 quadrats 1×1 m each, nested in Square), Subplot (2 quadrats 10×10 cm each, nested in Plot). In each subplot 4 replicates (1 ml each) were collected and examined for their ciliate and thraustochytrid content following the procedures described elsewhere (Santangelo *et al.*, 2000).

The second analysis was carried out at Calafuria (Eastern Ligurian Sea 43°, 30' N. 10° 20' E) on 52 10×10 cm areas randomly chosen on a rocky cliff (30-40 m depth), on which red coral colonies were settleld and on 52 artificial substrates (marble tiles) of the same size. Both substrates were sampled by photograph in Autumn, after red coral reproduction (Bramanti *et al.,* 2005); new settled colonies were identified and their distribution was examined by Nearest-Neighbour Distances (NND) analysis and the Clark- Evans test (Ripley, 1981; Upton and Fingleton, 1985).

Results – On the basis of the nested ANOVA the density of ciliates varies significantly ($p<0.001$) at the smallest spatial scale examined (10×10 cm plots), while that of thraustochytrids varies significantly at the wider scale examined (3.3×3.3 m Squares; $p<0.018$). Moreover, ciliate density varies significantly ($p<0.015$) between different times, decreasing from Autumn to Winter, while Thraustochitrid density was statistically constant overtime. An high percentage of variance component was due to residual (69.9% for thraustochytrids and 39.7% for ciliates, respectively), suggesting a wide variability occurs also at the smallest scale examined (1 ml replicates).

On the basis of NND analysis performed on red coral settlers, there was a significant difference (Chi–Square=20; $p<0.0001$) in the frequency of clusters between natural and artificial substrates. In 60% of the former substrates a clustered distribution was found, while, in the latter substrates a clustered distribution was found only in 11% of cases. As the new settleld cohorts of recruits became older, their average NND increases and their aggregation reduces due to mortality; thus older, coeval colonies are not patched. Year after year different cohorts of recruits settled on the same tiles increasing overall density and aggregation and decreasing the average NNDs. The tendency of new individuals to settle in the proximity of older individuals is thus confirmed (Giannini *et al.,* 2003). Our results show that NND decrease with density increase up to a threshold above which new colonies cannot further settle.

Conclusions – The spatial scale at which the 2 interstitial protists examined show the maximal variability in density is completely different: while ciliates tend to form patches at a smaller (10×10 cm) spatial scale, reducing their patchiness from Autumn to Winter, thraustochytrids tend to colonise wider sandy areas showing a density constant overtime. These findings are consistent with the features of these protists (Bongiorni *et al.,* 2004).

Concerning the NND analysis of red coral recruits, a significantly higer frequency of patches on natural *vs* artificial substrates was found. This difference could be reasonably due to the homogeneity of the artificial, uncolonised substrate on which no competition with other encrusting organisms could occur. On natural substrate, on the contrary, planulae larvae can settle only on the limited portions of the examined areas which have not been previously colonised by other organisms, therefore forming patches. Larvae tend to settle in the proximity of adult colonies but there is a limit to their patchiness. Older cohorts tend to reduce their patchiness due to mortality.

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