

Patch monitoring as a field method to quantify natural disturbance in hard bottom communities

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Natural disturbance is usually considered one of the most important structuring agents of both marine and terrestrial communities (SOUSA, 1984a). According to SOUSA (1984a) disturbance is defined as "...a discrete, punctuated killing, displacement or damaging of one or more individuals (or colonies) that directly or indirectly creates an opportunity for new individuals (or colonies) to become established".

In shallow benthic communities, wave action and predation are two of the most important factors displacing sessile organisms from the substratum. These physical and biological processes may produce patches of bare space or of encrusting species (which are more resistant to dislodgement than erect organisms) within a given assemblage. The number and size distribution of such patches, generally monitored through time in fixed plots, have been used to quantify natural disturbance in intertidal communities (PAINE and LEVIN, 1981; FARRELL, 1989).

The method adopted to estimate the size of each single gap, was to measure the two principal axes of an elliptical or rectangular approximation to a patch (PAINE and LEVIN, 1981). However, no attempts have been made to verify how good these approximations are, and if the relationships between the measured and the true values vary with patch size and complexity.

Here we present the results of a correlative analysis comparing precise and approximated values of the perimeters and areas of 25 patches of encrusting corallines in *Cystoseira*-dominated littoral pools on the west coast of Italy (Ligurian Sea).

The two principal axes of each patch were measured in the field by treating them as rectangles or squares. Very irregular shaped gaps were decomposed in subpatches, more easily amenable as regular geometric figures. Approximate estimates of perimeters and areas were obtained by adding (and doubling) or multiplying the two major axes of each gap, respectively. The contour of each patch was also traced on a plexiglass sheet in the field and then on a drawing paper in the laboratory. Precise estimates of perimeters ($\pm 0.5\text{cm}$) were obtained by tracing again the contour of the drawings with a map measurer. Precise estimates of areas were obtained as follows: first the field maps were cut off from the drawing papers and weighed ($\pm 0.001\text{gr}$). Then the weight values were converted in areas using the equation obtained from the linear regression of paper size versus weight. This function was previously calculated by weighing squares of known size cut off from the same type of papers of those used to trace the patches.

The relationships between approximated and precise estimates of perimeters and areas are presented in Fig. 1. Both the correlation coefficients are highly significant, indicating that the field method usually adopted to estimate patch size and perimeter is a good approximation of the true values (at least for the range of sizes considered in this study).

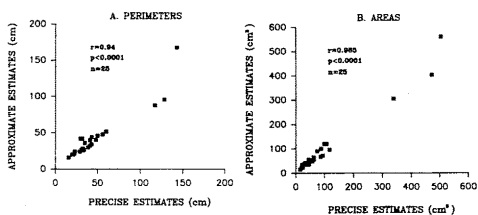


Fig. 1. Relationships between precise and approximate estimates of patch perimeters (A) and areas (B).

Knowledge of the disturbance rate to which a given assemblage is subjected may greatly improve our understanding of community structure and dynamics in hard bottom environments. The patterns of community recovery after damage are a product of the life histories of the species available to colonize a disturbed site and the severity and frequency of the disturbing force (SOUSA, 1984a). Factors such as gap size and shape, time of gap formation and the heterogeneity of its internal environment, may all affect the recolonization of a given patch and contribute to the spatial and temporal variability of species distribution (SOUSA, 1984a, 1984b; FARRELL, 1989). Most of these parameters (e.g. patch size, perimeter and shape, which is expressed as the ratio of the major axis on the minor one) are easily calculated once the two principal axes of a given patch are known.

Thus patch monitoring is a precise, inexpensive (although time consuming) and simple method to quantify the impact of disruptive forces on marine hard bottom assemblages. Moreover this information can be used to plan field experiments where artificially cleared patches of different size and shape (spanning the range of naturally formed gaps), are produced to test for the effects of these variables on patterns of patch recovery. Such kind of experiments are already in progress in *Cystoseira*-dominated littoral pools on the west coast of Italy.

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