“BioConnectEnce”

Final Scientific Report.

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Scientific progress:

This field-based marine ecological project had two main study elements. First, conducting a survey of the Ligurian rocky intertidal to define biodiversity over spatial scales of metres up to around 100 kilometre. Second, performing a multi-site disturbance-recovery experiment to assess the role of ecological connectivity in influencing recovery rates and thereby assess resilience. As well as the empirical study, a major review of ecological resilience, focused on trying to marry the current disparities between theoretical and empirical research, was also conducted.

The field work for phase one of this project, surveying 10 sites along the Ligurian coast, was completed in August 2008 (Fig. 1).

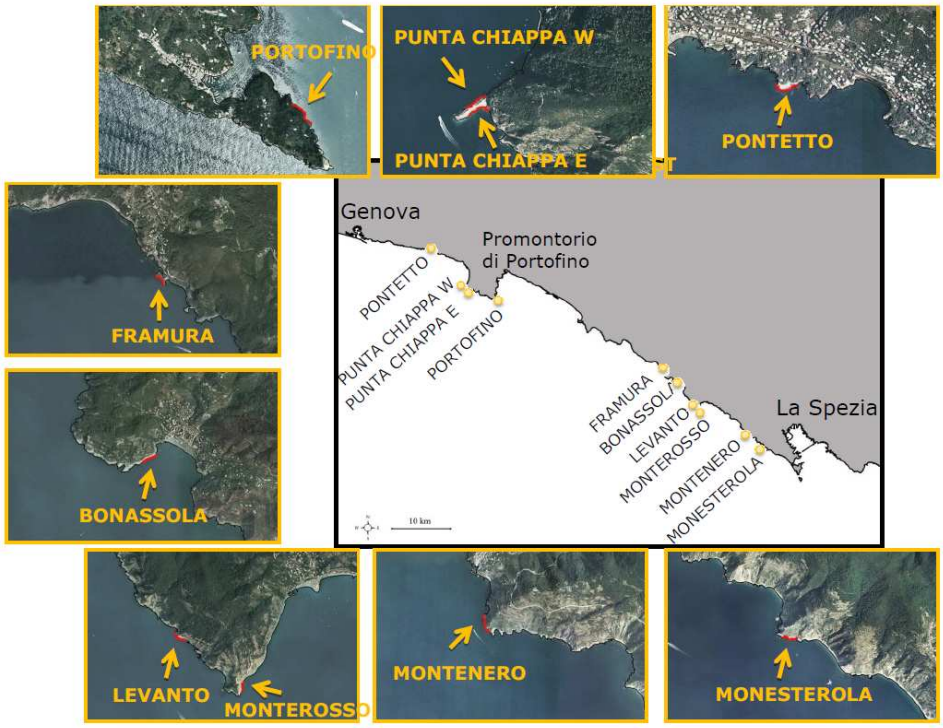

Fig. 1: Sampling sites

This provided us with important data on environmental conditions, as well as on the abundance and diversity of both large visible rocky shore plants (Fig. 2) and animals and the smaller turf dwelling organisms (Fig. 3).

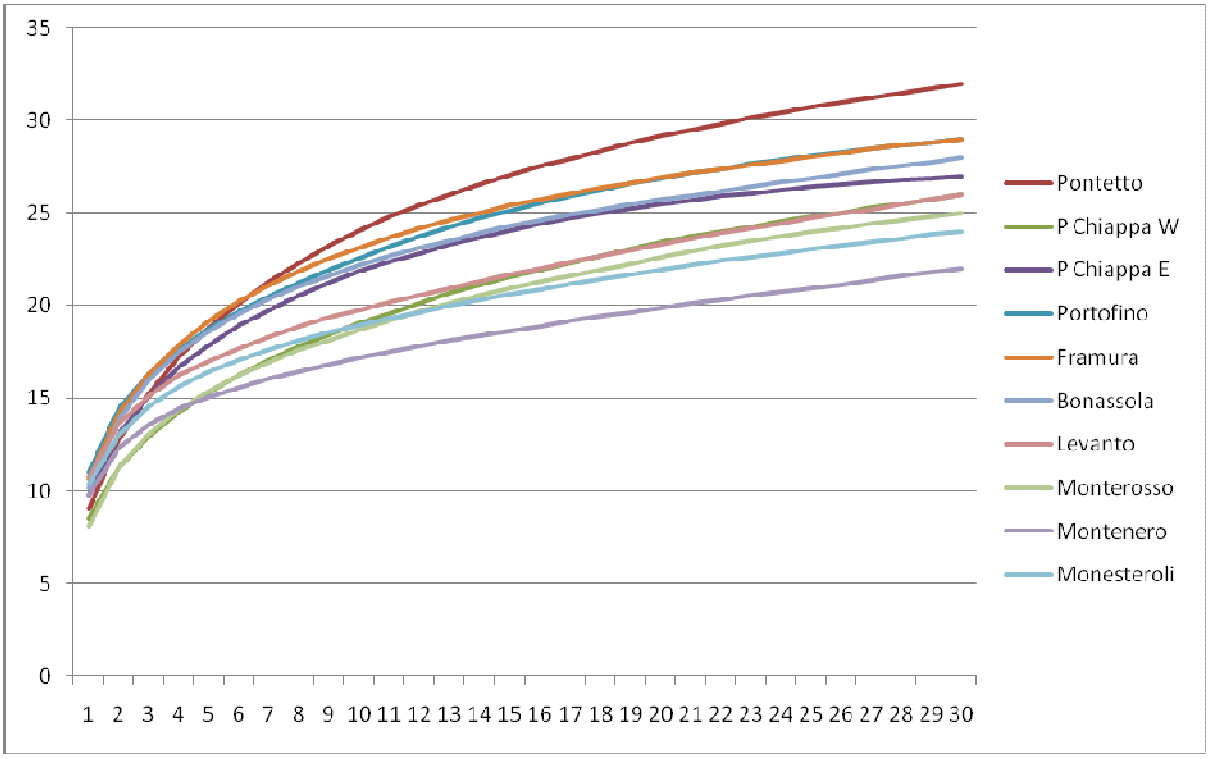

Fig. 2: Species accumulation curves on visual data (mainly macroalgae)

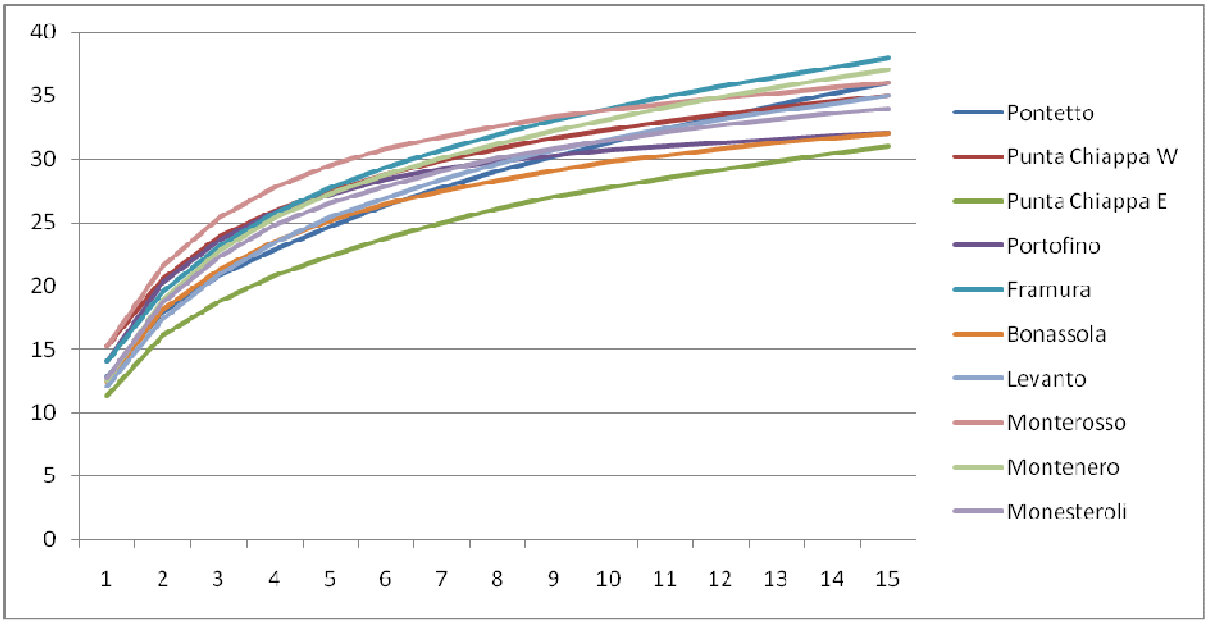

Fig. 3: Species accumulation curves on turf living fauna

The latter are a poorly studied part of the biodiversity of rocky shores worldwide that is dominated by difficult to identify groups of amphipods, and syllid and nereid polychaetes. This added an extra dimension to this project. However, these samples have required careful laboratory identification and enumeration, which has taken almost a year. This offered some unique opportunities to students to become involved in the project and provided projects for 3 bachelor level undergraduate students. The results of preliminary data analysis have been presented at one national Italian conference and an International conference in France (see below). We have a manuscript ready for submission based on this research which investigates the relationships between the structure and heterogeneity of the algal turf habitat on the shore and the abundance and diversity of the turf-dwelling infauna. Surprisingly, species richness contributed by turf dwelling fauna increased estimates of rocky shore diversity derived from traditonal visual quadrate sampling by over 100%. Analysis of turf community structure showed some local habitat features generated by the algal turf to be important, although high levels of unexplained variation remained. Along this coast, algal turfs do not facilitate high species richness of resident organisms by moderating the physically stressful characteristics of the rocky shore, a result that challenges current paradigms of the role of facilitation in stressful intertidal rockyshore environments.

Our sampling strategy for the survey was spatially structured (Fig. 4) to allow us to identify special patterns across a range of spatial scales and thus maximise information on the spatial scale of biodiversity change along the coast.

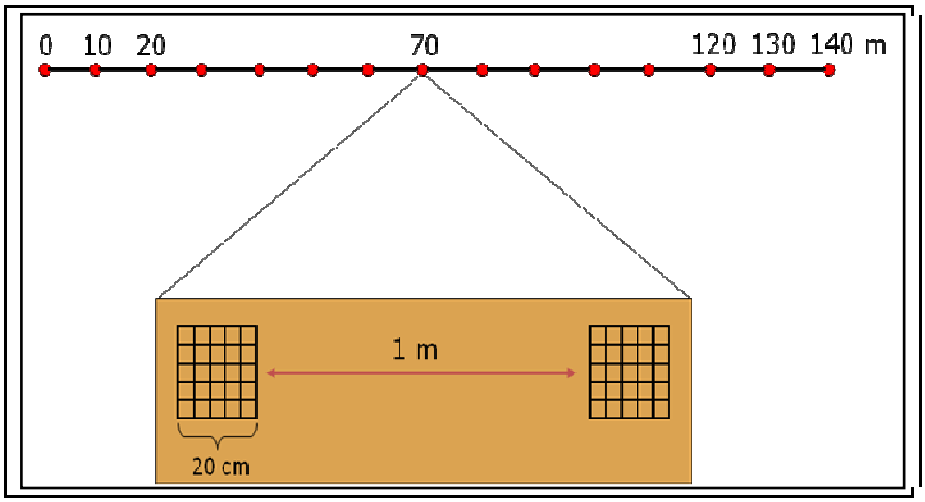

Fig. 4: Spatially structured sampling design

As well as the biological data, we also measured local habitat characteristics of each site (rock surface slope and rugosity, algal turf thickness, sediment and organic content). Thus, this survey has also provided a data resource to allow us to challenge the commonly held belief amongst many rocky shore ecologists that all the variability in the system is at small scales. This is actually an argument to justify the use of small-scale experimental studies conducted at few sites. But our analysis shows that, with sampling designs that are able to more precisely assess variability with scale, these beliefs, and thus justification for certain experimental designs, are unfounded. We are currently preparing another manuscript for publication on this theme.

The importance of the turf dwelling infauna in terms of biodiversity stimulated a new line of investigations concerning the utilisation of primary food resources and overall food \web structure. In particular we were interested in the relative importance of detrital resources generated within the turf habitat vs direct exploitation of autographs in Mediterranean, an oligotrophic sea. To investigate these factors, we have sampled organisms and primary food resources for stable isotope analysis from 3 of our study sites. We are now in the process of interpreting the results of the stable isotope analysis, but they seem to indicate a reasonably high proportion of reliance on detrital food resources – apparently an under estimated trophic link in rocky shore ecology. In the future, Dr Chiantore and colleagues plan to test the predictions of this preliminary survey with dope-and-trace experiments.

From our survey results we were able to define the difference between the diversity represented at each site (α-diversity) and that of the regional species pool (γ-diversity), highlighting significant variation in ecological connectivity between locations. This was a positive result for the establishment of the second experimental phase of our field work, the disturbance experiment.

The experiment was successfully established at 7 sites in May 2009. Considering previous small-scale disturbance-recovery experiments conducted in this system, we decided to disturb large plots (Fig. 5) for added experimental realism and to reduce artefacts associated with lateral migration (which is important for an adequate test of meta-community theory).

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