Biogeomorphic Species Interactions on Rocky Shores

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Background & Aims

A range of organisms contribute the geomorphological development of rock shores, particularly on limestone substrates that are more susceptible to organic sculpting (Coombes 2014). Cyanobacteria, micro-algae, rock-boring bivalves and worms, grazing molluscs, encrusting algae, barnacles, urchins, and macro-algae (seaweed) have all received attention from biogeomorphologists. At the same time, rocky shores are widely-used by ecologists to observe how species interact in positive ways (e.g., facilitation) and negative ways (e.g., predation and competition). Despite the significance of species interactions in controlling ecological dynamics, little has been done to examine the geomorphological significance of this on rocky shores.

This ECR grant from the BSG has been used to establish an on-going programme of field experiments (rock block exposure trials) that are examining how interaction between microorganisms and canopy-forming seaweeds mediate rock breakdown at the coast, focussing on bioerosion and bioweathering.

Methods

Samples of oolitic (Portland) limestone were attached to a shore platform in Cornwall in winter 2014, at mean tide level. Samples were secured to the rock in nylon mesh bags using epoxy putty (Figure 1); half the samples were attached under an existing canopy of algae (*Fucus* spp. Figure 2) and half to an adjacent area from which algae was removed. The mesh bags exclude grazing organisms and thereby the experiment focusses on algal canopy influences on microbial biofilms and their weathering roles. A network of data loggers was also established to provide continuous thermal data across the shore. Rock samples are periodically removed (6-monthly) from the covered and uncovered plots, and subsequent assessments of (a) microbiological growth and (b) weathering and erosion are undertaken using a range of laboratory- and microscope-based techniques (e.g., Coombes et al., 2011).

Figure 1 (left): limestone sample (5 x 4 x 1 cm) attached to rock platform.
Figure 2 (right): attached blocks covered by seaweed canopy at low tide.

Outcomes and Future Work

- The rate and abundance of microbial biofilm development has been strongly influenced by macro-algal canopies, but the extent to which this translates into differences in bioweathering and bioerosion is not yet clear. Such relationships will likely emerge as monitoring continues.
- New analysis techniques are being developed as a direct outcome of this grant, including protocols for rapid determination of rock microbial biomass using microtiter-based determination of chlorophyll. This forms part of an on-going programme of research on microbial geomorphology within the Oxford Rock Breakdown Laboratory (OxRBL).
- The field data-logger network is being used to better characterise rock-surface temperature dynamics on rocky shores, including across-shore variability and extremes associated with particular breakdown processes. These data will also be used to constrain future laboratory-based weathering experiments (e.g., Gowell et al., 2015).
- Findings and techniques from this grant will form part of peer-reviewed journal papers on rocky biogeomorphology, and will support future bids for Research Council funding by M. Coombes.

References:

Coombes et al. (2011) *ESPL* 36, p2114–2121.
Coombes (2014) *Geological Society of London Special Publications* 40, p57–76.
Gowell et al. (in press) *ESPL* DOI: 10.1002/esp.3736