



Ecotiles designed to mimic natural rocky shore biogeomorphic interactions: evidence of colonisation patterns after 12 and 18 months

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Natural rocky shore landforms show high habitat heterogeneity, as they have pools, crevices, groves and holes, which accommodate large variety of intertidal species. Urban coasts are often armed with smooth hard flood defences that lack the geomorphological features of natural rocky shores where biodiversity thrives. Hard coastal infrastructure can be 'greened' by improving habitats using ecotiles inspired by the natural coastal biogeomorphology to mimic geodiversity of rocky shores and support key species. The tiles for ecological enhancement were designed based on scientific evidence (ecology and biogeomorphology science) to support species richness, abundance and diversity. The highly and less textured tiles were deployed on City of Edinburgh's coastal protection assets, rock armour and seawalls, in 3 sites in 2020, enabling comparison between two tile types in two locations, as well as comparison to the rock armour and walls. Tiles on rock armour showed higher settlement than tiles on seawalls, which were positioned high in the intertidal zone but are expected to colonise with time, and will be especially important to prevent coastal squeeze with sea level rise. Our data suggest that there was no difference in settlement patterns based on time of deployment (March vs May) suggesting that timing in the settlement season has little ecological impact. The results show that highly textured tiles enhanced habitat on rock armour for seaweed species, notably furoids, which showed limited presence on rock armour prior to installation. The finer grooves and crevices and biomimicry features on the textured ecotile provided sites for sessile and mobile species, such as barnacles and littorinids, showing statistical differences between the two tile types tested. The less textured tiles on rock armour had colonised by seaweed species contrary to the hypothesis. This finding suggests that the selection of biogeomorphologically informed engineering materials is important for biodiversity enhancement. Active grazing of limpets was observed, which shows that the ecotiles provide foraging habitat for intertidal species that serve as food source for seabirds. The ecotile project represents a pioneer example of greening the grey to support biodiversity on urban coasts in Scotland; and one of the first known to be funded by nature conservation initiatives. This project shows that our understanding of the abiotic-biotic interactions can benefit in designing nature-based solutions to increase resilience and adapt to climate change-related coastal impacts.