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Coastal structure repairs can significantly disturb marine ecosystems

Renovating coastal structures, such as breakwaters, groynes, artificial reefs, quays and sea walls, can be destructive to marine ecosystems as it encourages opportunistic and invasive species, according to recent research. Repairs can be particularly damaging if conducted in spring or summer, so repair schedules should be recognised in marine planning strategies to minimise negative ecological effects, say the researchers.

More than 50% of the Mediterranean coastline around Spain, Italy and France is covered with artificial features that help protect against extreme weather, preserve beaches and add aesthetic value. However, instead of supporting marine life by mimicking natural hard-bottom habitats, as previously thought, scientists have found that repair work carried out over the lifetime of such features causes extreme ecological disturbances by removing, replacing and dislodging large portions of the structure on which biological communities have settled.

The team of researchers, funded under the EU THESEUS[1] and DELOS[2] projects, monitored the ecological effects of repair works to four breakwaters along Italy's North Adriatic coastline over a period of three years.

They found that one month after repair works, more than 80% of the landward (sheltered) sides of breakwaters were covered with either bare rock, where mussel and oyster beds had been lost, or biofilm, a thin coating formed by opportunistic marine microorganisms. This was relative to 30% cover for breakwaters that had undergone no repair work.

On the seaward (exposed) side, the effect was less pronounced with an increase in biofilm of just 10-20%. The scientists attribute the difference between the landward and the seaward sides to the level of exposure and differences in the structure of the mussel beds; smaller individuals in single-layer beds on the seaward side are far less susceptible to damage than larger ones in multi-layer beds on the landward side.

Macroalgae, including the invasive species *Codium fragile,* dominated the breakwaters after a year, reaching up to 50% cover on the seaward sides, compared to 20% on non-repaired breakwaters.

In a controlled experiment, the scientists simulated the destructive effects of repair work by removing the resident biological communities from sections of three breakwaters that had not been repaired in the last three years. They were removed at a different time of year for each section. They found that sections disturbed in January displayed no increase in macroalgae and recovered to their original state after only four months, while sections disturbed in April and August had significant macroalgae growth and still had not recovered a year later. This could be related to the time of year that both mussels and macroalgae reach maturity, according to the researchers.

As the need for coastal defence structures increases in response to a greater risk of storm surges and sea level rise with global climate change, the scientists recommend that repair works should be carried out in winter to reduce negative biological impacts. Reducing the spread of invasive species will also have indirect benefits for the fishery and aquaculture industries. Importantly, the higher cost of carrying out repairs in winter would be offset by a reduction in expensive clean-up procedures currently required to remove macroalgae washed up on tourist beaches.

1. THESEUS (Innovative technologies for safer European coasts in a changing climate) is supported by the European Commission under the Seventh Framework Programme. See: www.theseusproject.eu
2. DELOS (Environmental Design of Low Crested Coastal Defence Structures) was supported by the European Commission under the Fifth Framework Programme. See: www.delos.unibo.it

Source: Airoldi, L. & Bulleri, F. (2011). Anthropogenic disturbance can determine the magnitude of opportunistic species responses on marine urban infrastructures. *PLoS ONE*, 6(8); e22985. This study is free to view at:
www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0022985
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