

Sensitivity of selected gravel bed species to burial

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Changes in sedimentation regimes in the marine environment occur naturally (e.g. storms, wave and tidal action) and due to the increasing human activities (e.g. dredging, trawling, construction of marine renewable energy). Increases in sediment deposition can lead to burial of underlying organisms. Their survival following burial depends on their tolerance to sediment deposition and their ability to escape from burial. Sediment deposition may have substantial effects on hard substrate communities, such as those of gravel beds that are not used to such dramatic sediment fluctuations and host several sessile organisms.

This study aimed at understanding the sensitivity to burial of typical hard substrate species from gravel habitats. To do this, we first conducted laboratory experiments to investigate the effects of different levels (2, 5 and 7 cm) and different durations (2 and 10 days) of burial on four gravel bed species. We selected the species based on their conservation importance and representativeness of the variety of life forms found in the gravel bed habitat. At the same time, we focused on species for which quantitative information on tolerance to burial was missing.

Our results indicate that the common whelk *Buccinum undatum* and the plumose anemone *Metridium senile* were unaffected by sediment burial up to 7 cm. Their high survivorship is linked to their ability to escape burial: the former by using their foot to push upwards, and the latter by crawling out of the sediment. On contrary, the mortality of the common starfish *Asterias rubens* significantly increased with burial depth, while the mortality of the soft coral *Alcyonium digitatum* significantly increased after 10 days of burial. Their low tolerance to burial was related to their inability to vertically emerge from the deposited sediment, which may have resulted in suffocation and/or starvation. All the surviving individuals exhibited similar behaviour: in a very short period after burial, they re-established contact with the sediment surface followed by full emergence at a short/intermediate-term (depending on the species). Regaining contact with the sediment-water interface is important to maintain basic physiological needs, such as feeding and respiration.

To increase our understanding of gravel bed species responses to burial, we integrated our results with literature-based quantitative assessments of tolerance to burial of other gravel bed species reported from the North Sea. This integration indicates that tolerance to burial is species-specific and variable, but often related to the species ability to emerge from burial. We also show that permanently attached, sessile species are those most susceptible to complete burial by sediment. These findings can be used to assist in managing various human activities that result in increased sedimentation in the gravel bed habitat.

Keywords: Sedimentation; Hard substrates; Gravel; Behaviour; Vertical migration; *Alcyonium digitatum*; *Asterias rubens*; *Metridium senile*; *Buccinum undatum*