THE MAKING OF MUDFLATS - INTERTIDAL MUD POOL ENHANCEMENTS LITTLEHAMPTON, WEST SUSSEX, UK

Bournemouth University, Environment Agency and Artecology

BIG Biodiversity Challenge Award Category: *Innovation Award*

Project overview

Chance discoveries lead to innovation! In 2018, nine Vertipools (artificial rockpools) were installed on new sheet piling on the River Arun, Littlehampton, promptly filling with mud. The mud was found to contain species typical of estuarine mudflats, providing a soft-sediment habitat – never before attempted in intertidal eco-engineering.

What were the biodiversity conditions on site, prior to the enhancement?

The existing river wall was in a very poor condition. Voids in the existing sea wall were surveyed for bats but as the voids were submerged at high tide they did not present viable habitats.

What were the reasons behind this project ?

The initial drivers behind this project were to gather case study data on existing Vertipool installations on the south coast of England. When Bournemouth University discovered the pools had filled with mud, it became crucial to determine how these enhancements could provide biodiversity value as soft-sediment habitat. This data also informed recommendations for optimising similar enhancements in the future to create vertical, eco-engineered mini mudflats.

Description: The site prior to a new flood defence. Image courtesy of Mackley.

Description: The site following installation of new sheet piling and Vertipools. Image courtesy of Mackley.

What were the biodiversity measures taken?

Nine Vertipools, commissioned by the Environment Agency from Artecology Ltd (300mm wide, pool ~60mm deep), were installed on a small sheet-piled addition hard-engineered estuary reach. This was completed using a custom stainless-steel bracket that would straddle the clutch on the sheet piling in-pan. Installation by Mackley within the in-pan minimised risk of contact with watercraft. Low carbon cement, resistant to salt-water attack, was used to reduce the carbon footprint of the enhancements. Artecology used form-liners made of reclaimed plastic from aggregate packaging, re-using form-liners across multiple pools, to create grooved textures on the exterior to mimic natural attachment opportunities for marine life. Each Vertipool interior was hand-finished to provide added texture. Once installed, the Vertipools created shade and complexity at different tidal exposures on an otherwise plain, vertical metal structure, enhancing colonisation.

Description: A column of three Vertipools in October 2019 (left) and September 2020 (right)

<u>Outcomes:</u>

After a year, it was found that the Vertipools had filled with mud. After ~2.5 years since installation, the mud in the Vertipools was cored and compared to core samples taken from two local mudflats ≤100m away. A total of 11 species was found in the Vertipool mud compared to 7-8 species found in the local mudflats.

To date, no research has demonstrated the efficacy of soft-sediment habitats within intertidal eco-engineering and these Vertipools represent the first known example of mudflat micro-habitat provision working in a heavily modified background. They show that not only do they retain mud, but they also support stable sediment and infaunal assemblages analogous to natural mudflats with evidence of reproducing populations. Additionally, it is the first known installation of this type of intervention on steel sheet piling, which is proof of concept that this enhancement is replicable, scalable, and may contribute valuable innovation and knowledge to the incremental improvement of WFD Good Ecological Status in Heavily Modified waterbodies.

Description: Surveying the mud in the Vertipools and the local mudflats.

Further information

Monitoring –Faunal composition, grain size and organic matter content of the Vertipool mud and both local mudflats was determined by taking sediment cores. Water content in Vertipools was relatively high, which allowed more species to survive compared to the species richness of a mudflat at an equivalent tidal height. Water retention mimics naturalised pockets in an unmodified river estuary environment and prevents the mud in the Vertipools from drying out as much during low tide.

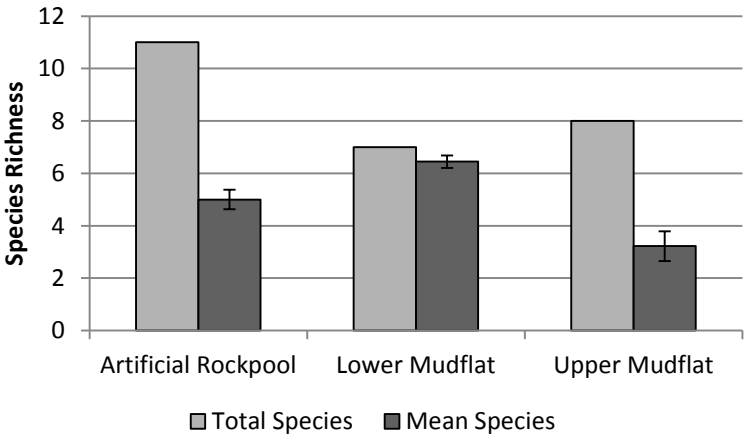
Lessons learnt – Although this intervention may be easily replicated on a similar structure, attention should be paid to the local sediment budgets to ensure it is a depositional environment, otherwise they may not retain sediment as expected. As evidenced by the Agency's installation, interventions should be placed in steppingstones from the bed upward, to allow vertical migration of organisms and tidal refreshment. Similarly, pools should not be placed above MHW.

And ongoing innovation! – Bournemouth University's findings demonstrate the Environment Agency enhancement has fulfilled another of the Agency's aims, in that they have strengthened, indirectly, green innovation. This evidence has supported the creation of MudFlats™ by Artecology Ltd - a new ecological enhancement specifically designed to retain sediment and estuarine infauna on sheet piling. This gives coastal engineers a greater range of choice for ecological enhancements on intertidal structures, allowing them to create bespoke habitats best suited to the local conditions and biological communities. Bournemouth University's findings from this research have been submitted for publication in a journal.

Project Team

- Client: Environment Agency
- Installed by Mackley Civil Engineering as part of Team Van Oord
- Created and manufactured by eco-engineering company Artecology Ltd.
- Coordination and access provided by Littlehampton Harbour Authority
- Survey and research by Bournemouth University.

Description: Cyathura carinata, an isopod found in the Vertipool mud and local mudflats.



Description: The total and mean species richness in the Vertipools and both local mudflats.

What was the motivation for carrying out the enhancement?

The additions were an enhancement above business as usual, recognising the capacity for a small change to support several wider outcomes: evidence of benefit to nature through habitat mimicry, Green Infrastructure (IGGI) visibility and thus affordability, change in delivery practice in hard engineering projects, partnership collaboration with enterprise and in driving green demand. The main motivation for carrying out enhancement is to optimise opportunities for intertidal marine life in the face of increasing sea and flood defences, ensuring that biodiversity is provided for in the built environment and to provide solutions to the challenges of sea level rise.