Coastal Restoration

Shellfish on the move: predicting recovery of coastal habitats

__Carolyn Lundquist__ and __Conrad Pilditch__ have put juvenile cockles and wedge shells through their paces in the lab to learn more about how shellfish recolonise disturbed habitats.

Estuaries are affected by many disturbances that influence the animals that live both on and beneath the sediment surface. To manage these effects, and to optimise the success of any efforts to restore communities to their natural state, we need to understand the extent to which different locations within an estuary are linked. (This is termed 'connectivity'.) Restoration may focus on reducing negative effects within the estuary (such as reducing input of sediment, sewage, or other pollutants) and then allowing the area to recover naturally. Other restoration methods can be more direct. For example, when the disturbed area is too far from a source of larvae to expect natural colonisation, direct re-seeding of organisms (such as cockles or seagrass) may be necessary to restore a site. (See 'Giving our estuaries a helping hand', pp. 14–15.)

Restoration in estuaries

To determine which restoration measures are most effective for a particular species at a particular location, we need to know more about the life history of estuarine organisms, especially how likely they are to move into an area after disturbances have been removed. For example, if an area is very likely to receive colonists naturally, it may recover without active restoration measures. In contrast, if we can predict an area is unlikely to be recolonised – perhaps because water currents don't directly link a source population to the restored area – then we can initiate active restoration efforts, such as re-seeding.

Photo: Carolyn Lundquist

Conrad Pilditch collecting juvenile bivalves in Manukau Harbour.

Getting from A to B

- Some restored estuarine habitats will be repopulated naturally, and some need help with re-seeding.
- Locations of shellfish, their species' behaviour, and interconnecting currents all play a role.
- Laboratory studies of how shellfish move around show which species can go it alone and which need help.

Shellfish life history

Bivalves are important members of estuarine communities. In our study we investigated the behavioural ecology of two common New Zealand bivalves, the cockle *Austrovenus stutchburyi* (tuangi) and the wedge shell *Macomona liliana* (hanikura). Our goal was to better understand how these two species move within estuaries and which life stages (larvae, juvenile, adult) contribute to dispersal between areas. Cockles and wedge shells have very different life-history strategies. Adult wedge shells move very little, living at depths of up to 10 cm below the sediment surface and feeding at the surface of the sediment via a long siphon. The relatively low rates of movement of adult wedge shells mean that any recolonisation of new habitats is likely to happen during their larval and juvenile stages. In contrast, cockles are suspension feeders (filtering food particles directly from the water) that live very close to the sediment surface; they can move as much as 30 cm over a single tidal cycle as they burrow through surface sediments.

Prior NIWA studies have shown that juvenile shellfish emigrate from unsuitable habitats, and field experiments have found juveniles of both species well above the seafloor, implying that as juveniles they frequently move around the estuary with the tidal currents.

Dispersal in flow tanks

To determine how often and how far these juveniles are capable of moving, we used a laboratory flume (a flow tank that mimics water movement near the seafloor). We looked at how they moved and how flow speed influenced rate of movement. Some bivalves move by rolling along the sediment surface (known as bedload transport), while others can release mucus threads, allowing themselves to be lifted off the sediment and carried along in water currents – much like spiderlings in air currents. Knowing

Photo: Barry O'Brien

The laboratory flume, located at the University of Waikato, Department of Biological Sciences. The flume is 7.23 m long by 50 cm wide; the working area is 0.9 m long. Water is recirculated through the flume by a propeller located in a return pipe at the end of the channel.

Photo: Carolyn Lundquist

Sediment cores within the flume, showing juvenile wedge shells (left) and cockles (right) burrowing into the sediment. The inner diameter of the cores is 5.3 cm.

how flow speed influences movement behaviour can help predict the likelihood of recolonisation based on distances and the tidal currents between the areas to be restored and areas with good bivalve populations (that is, colonist source populations).

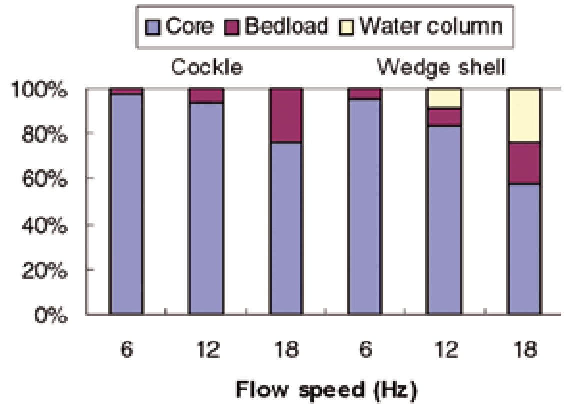
In our experiments, juvenile bivalves (less than 5 mm shell length) were allowed to bury in cores of sediment similar to that in which they would naturally be found in estuaries. Both bivalves and sediments were collected from Manukau Harbour. We ran experiments at three different flow speeds, none of which was strong enough to disturb the sediment surface; this meant that the experiments looked at movement initiated by the bivalves (active movement). Bivalves that moved away from the cores were collected either in bedload traps (these collected individuals that had crawled or rolled across the sediment surface) or in plankton nets (these collected individuals that had drifted in the water column).

We found that bivalves were more likely to disperse at higher flow speeds. Wedge shell juveniles moved using both bedload and water column transport, while cockle juveniles were transported only as bedload. What was particularly surprising was the large proportion of animals that actively moved – even from sediments that we deemed to be suitable for their growth.

Implications for restoration

These results are important, giving us an indication of flow speeds that result in 'active' transport, and the relative importance of bedload and water column dispersal to juveniles of these species. Differences in the mode of transport (bedload versus water column) allow us to predict that wedge shells are likely to travel farther than cockles, since travelling suspended in the water column exposes them to faster moving currents than the cockles which roll along the surface of the sediment.

This information allows us to predict the distances these two species are likely to move individually. The next step in this research is to combine our laboratory estimates of flow that results in bivalve transport with field estimates of how often these flows are exceeded, to calculate potential distances over which these bivalves can move to recolonise habitats. Then, we can answer whether or not a site is likely to receive a natural supply of colonists, or if the location would benefit from active restoration measures such as re-seeding projects. W&A



Percentage of juvenile bivalves moving in the bedload and in the water column. Juvenile bivalves found in the core had not moved. Flume motor settings of 6, 12, and 18 Hz correspond to flow speeds of 4.8, 11.0, and 16.6 cm/s in the centre of the flume.

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