The Intertidal Zone

Benthic ecology and the effects of grain size

Michelle Wilkinson

Recent NIWA experiments have shown how a combination of habitat type and adult population level can affect settlement by juveniles of some shellfish species. The findings have important implications for the management of New Zealand's intertidal zone – the coastal strip which lies between high tide and low tide.

NEW ZEALAND's intertidal zone is many thousands of kilometres long and varies in width from several kilometres to less than a metre. Until recently it was affected by more than 30 Acts of Parliament (most of which have now been replaced by the Resource Management Act) covering subjects ranging from wildlife, sand drift, swamps, historical sites and marine mammals to fisheries, mining and forests. It may seem that this relatively narrow strip of land and water is over regulated. However, this interface helps to determine the condition of our harbours, estuaries and seas, so there is obviously a need for careful management.

Biological monitoring

Experiments can show that factors such as chemical contaminants, sediment grain-size changes and hydrodynamic changes may alter important ecological interactions in the intertidal zone.

However, in order to understand the subtle effects of gradual changes in physical and environmental factors on ecological communities, biological monitoring of the area is essential.

Monitoring programmes can provide valuable information on long-term trends and the natural variability of communities in terms of both species composition and abundance of individual populations. Biological monitoring allows us to detect changes in the environment that deviate from the common pattern, and helps us to identify possible problem areas worthy of more specific study. Through the interpretation of data from monitoring programmes, we can obtain a greater understanding of the interactions both within species and among species.

Biological monitoring is an important component of environmental assessment and prediction. It provides a link with specific laboratory tests (e.g., toxicity tests) and experiments (such as the one described in the accompanying article) which enables us to make predictions of community or population level responses to pollutants and disturbance.

The benefit of this "community level analysis", compared with tests on particular species, lies in the fact that species differ in their tolerance to pollution and disturbance. Some will decrease in abundance whilst others will benefit from the changes in environmental conditions.

One of NIWA's current research projects aims to improve our understanding of the effects of small changes in the physical environment on intertidal benthic (bottom-living) communities. Through experiments, we can demonstrate how changes in factors such as sediment grain size may influence important ecological interactions. Ultimately, this work will help us both to identify and to predict undesirable effects before they become catastrophic.

What influences intertidal communities?

Several factors are important in determining the structure of intertidal communities.

Biological factors

The main biological factors that act to structure sand flat communities are: species interactions (e.g., competition, predation); recruitment/settlement of juvenile organisms; food resources; and disturbance caused by, for example, burrowing activity.

Physical factors

One of the physical factors most important to the distribution and abundance of organisms is sediment grain size. Its significance rests with its effect on water retention and its suitability for burrowing. For example, fine sand tends to hold water in its interstitial spaces after the tide has retreated. Coarse sand and gravel, on the other hand, allow water to drain away quickly. Therefore, fine sand provides more protection against desiccation than coarse sand, making the latter less hospitable. Fine sand and mud are also more suitable for burrowing than coarser sediments.

Human and environmental factors

Environmental effects on the intertidal zone which are often caused by human activities fall broadly into four categories: sedimentation, nutrient input, contamination and habitat modification. Some impacts may be exaggerations of environmental conditions which occur naturally. One such case is increased sedimentation, the focus of this NIWA study.

Increases in both suspended sediments and sea floor sedimentation can have direct and adverse effects on plants and on suspension-feeding organisms such as bivalve molluscs and some polychaete worms. Suspension-feeding bivalves can have a major influence on energy flows and plankton population dynamics of coastal ecosystems, so any effect on these organisms may potentially affect the whole harbour ecosystem.