



MARINE ECOLOGY AND EVOLUTION

The department aims to obtain a mechanistic understanding of the structure and dynamic behaviour of marine macrobenthos populations and communities, whether they occur on the shelf margin or the intertidal. Taking up one of the great challenges in modern ecology, we try to understand the properties of populations and communities on the basis of characteristics of individual organisms. We focus on the role of bottom-up (food input and competition for food and other resources) as well as top-down (predation) processes in structuring benthic communities.

The work within the department covers three major themes: The structuring role of top-predators in marine ecosystems, Competition, life-history strategies and dynamic energy budgets, Recruitment and dispersal in relation to spatial and genetic structure of benthic invertebrate populations

In studies on the role of bottom-up and top-down processes in structuring marine benthic communities, the department uses a variety of research methods, including (1) field observations, along with long-term (and wide range) surveys; (2) manipulative field experiments; (3) laboratory experiments; and (4) modelling. Laboratory experiments are greatly facilitated by the possibilities within the experimental shorebird facility and the renovated aquarium building. Thus far it had been impossible to perform manipulative field experiments on the shelf sea floor, but our recently developed autonomous bottom landers enable *in situ* experiments lasting for periods of months. These landers are capable of sampling planktonic stages of benthos and simultaneously exposing substrates, while measuring a suit of environmental variables. Modelling builds on recent developments in Dynamic Energy Budgets (DEB) modelling. Another important development in marine benthic ecology is the incorporation of molecular genetics. Although the description of patterns of genetic variation within and among populations *per se* may not be very interesting, when placed in a general ecological setting these techniques are very promising. One example concerns the apparently open character of most marine benthic populations. Most marine benthic animals have dispersive propagules and usually, in studying a local population, it remains unclear how much authentic immigration occurs when settlement takes place. Both molecular techniques and marking methods are used within the department to unravel these problems of open marine systems.

One of our main hypotheses is that predation and other “top-down” processes have cascading effects through the benthic foodweb. This may work directly, with predators exhibiting a serious impact on the mortality of their prey and on the dynamics of the prey populations. The effect of predators may also work indirectly through the occurrence of predator-avoidance mechanisms. There is ample evidence of a widespread occurrence of such mechanisms in the marine environment, e.g. the deep-burying of bivalves. This work is mainly performed in intertidal areas (Wadden Sea), with the red knot *Calidris canutus* and its bivalve prey as the most important model system. Red knots mainly eat small bivalves and they are therefore strongly affected by spatial and temporal variation in bivalve recruitment. Other predators studied are crustaceans, juvenile flatfish and seabirds.

Intra- and interspecific competition for food and other resources may also play a major role in determining community processes. At the level of the individual, interest is directed towards performance (e.g. growth, age and size at maturity, fecundity, survival or, more generally, energy budgets) in response to food availability and other environmental conditions, and the consequences of choosing a specific strategy for competitive interactions and fitness. A phenomenon of increasing concern and potential (both as an adaptive trait and a tool to understand selection pressures) is phenotypic flexibility, which is studied in filter-feeding bivalves (sizes of gills and palps), in their avian predators (various parts of the digestive system) and in reef corals. At the level of communities, research is done in the Wadden Sea and in the North Sea, in both of which the effect of climate variability on macrobenthic communities is studied. On the Atlantic slope the effects of food pulses on metabolism and life history of key species and groups are studied in deep-sea coral and soft sediment communities. Finally, in tropical coral reefs the mechanisms determining dominance have our special attention.

At the population level, it has been observed that the period around the settlement of the recruits may be particularly important in the regulation of marine benthic populations. Henceforth the department focuses intensively on recruitment processes (e.g. intra- and interspecific adult-juvenile competition by means of settlement inhibition by adults, or the competition for food affecting the age and size at metamorphosis). Recruitment studies are performed in intertidal systems, shallow coastal seas and in coral reef communities in deep water and in the tropics.