Abstract

An understanding of the processes causing patterns of organism distributions in time and space is fundamental in ecology. For sessile marine invertebrates, water motion is an important predictor of distribution patterns, affecting organisms all the way from dispersal to post-settlement recruitment. However, resolving the relative importance of flow effects on larval supply, contact rate with the substratum, possibilities for attachment and post-settlement survival still remains a major challenge. In addition, larval behavioural responses both before and after contact may affect the final recruitment patterns. In this thesis I examine the effects of flow on settlement and recruitment in the barnacle *Balanus improvisus.* I also study the flow and its associated forces from a biofouling perspective, investigating detachment of barnacles from fouling release coatings.

The effects of water flow on settlement, growth and survival were studied both in the field and under laboratory conditions. Mechanisms that may explain the changes in settlement and recruitment in response to flow were investigated and the role of both possible passive mechanisms and active larval responses was considered. Recruitment patterns on an archipelago scale were studied using PMMA-panels deployed in the water column and the pattern of temporal changes in the supply of barnacle cypris larvae indicated that large-scale phenomena controlled the transport of larvae in and out of coastal waters. However, there was a considerable variation in larval concentration on spatial scales of some kilometers, which was not easily explained. The rate at which cyprid larvae initially adhered to the panels decreased with increasing ambient flow speed despite an expected increase in the contact rate. Settlement rate was highly correlated with the probability of initial adhesion, which explained as much as 75 % of the total variation. The probabilities for initial adhesion and subsequent temporary attachment, with the antennulae, were further studied in a laboratory flume. Detailed studies of the flow within the boundary layer at free-stream velocities of 5-20 cm/s showed that also within the laminar viscous sublayer, where larvae attach, flow velocities and instantaneous stresses in the stream-wise direction vary substantially. Assuming that temporary adhesion only can take place during a stress lull, i.e. that successful attachment requires a minimum time interval under a certain threshold velocity or stress, we modelled the probabilities of attachment in various flow conditions. When modelled probabilities of temporary attachment were compared to empirical data of cyprid attachment the conclusion is that the threshold time needed is short, <0.5 s and probably as low as 0.1 s. The threshold velocity best fitting the data was close to the velocity of swimming cyprids It is suggested that cyprids can swim against the near-bed flow to maintain a fixed position and that this behaviour allows temporary attchment in flow.

Cyprids engaged in temporary attachment were found to spend less time exploring the substrate with increasing flow velocities. The time spent exploring is assumed an indicator of how attractive the surface is for permanent settlement and active rejection was observed at higher flow speeds. The adaptive significance of this behavioural response was further investigated by measuring growth and survival of juvenile barnacles as a function of flow speed. In velocities above ca 15 cm/s, growth and survival of the barnacles declined and laboratory studies revealed that the feeding rate decreased caused by deformation of the cirral fan, reduced retention efficiency and a decrease in time spent feeding. We conclude that cypris larvae actively reject flow environments that will be suboptimal for suspension feeding