Källström, Björn (2006). Stress as an evolutionary force – causes, consequences and adaptations to extrinsic and intrinsic stresses. Department of Marine Ecology, Göteborg University, Tjärnö Marine Biological Laboratory, SE-452 96 Strömstad, Sweden

Abstract: The fitness of organisms in natural populations is affected by both extrinsic and intrinsic stresses that act as evolutionary forces. In this thesis five papers are presented that are aimed at investigating how stresses of both environmental and genetic basis affect organisms, and how populations can respond adaptively to these conditions.

In paper I, a simple model was used to test if populations of eelgrass, *Zostera marina*, from the low saline Baltic Sea show evidence of geographical as well as ecological marginality. Genotype data showed that Baltic populations, as compared to Skagerrak populations, had significantly lower genetic diversity and clonal diversity but larger clonal size. Significant population differentiation was found among the Baltic but not among the Skagerrak eelgrass populations. No support was found for lower stress tolerance in the Baltic populations, when exposed to an additional stress factor in a manipulative heat stress experiment. The results indicate that the Baltic Sea is both a geographically and an ecologically marginal habitat for eelgrass.

In paper II, observations, experiments and model simulations were used to investigate the possibility and range of long distance dispersal by seed rafting in eelgrass, *Zostera marina*, at the Swedish west coast. A field experiment showed that the breaking strength of post-flowering rhiphidia decreased significantly over a 30-day period, indicating that ontogenetic changes of the morphology facilitates dislodgement of the rhiphidia at the optimal time for dispersal. Data on positive buoyancy of detached post-flowering shoots together with field measurements of wind-driven surface transport velocities of floating shoots in combination with wind data allowed for a modelling a dispersal potential of up to 150 km along the Swedish west coast. The results in paper II indicate that rafting of seeds on floating reproductive shoots is an important dispersal strategy for eelgrass.

In paper III the effects of inducible stress responses were investigated using *Gammarus duebeni* juveniles that were pre-treated with a mild level of temperature or salinity stresses. When subsequently exposed to lethal levels of the stressors the pre-treated, or hardened, juveniles could better tolerate the stress and had significantly higher survival as compared to non-hardened juveniles. Harding with salinity also gave juveniles of *G. duebeni* a cross-tolerance to an otherwise lethal temperature stress.

In paper IV assembled populations of the amphipod *G. duebeni*, with varying levels of genetic diversity levels, were exposed to two different stress scenarios. The results, together with a simple model, showed that variance in the number of surviving individuals decreased with increasing genetic diversity.

In paper V, the effects of an interaction between environmental and genetic stresses were investigated. The results showed that neither the natural environment nor the inbreeding produced severe stress levels enough to cause reduced fitness for non-inbred juveniles in the field or inbred juveniles kept under stable conditions in the laboratory. However, for the juveniles experiencing both stresses at the same time, i.e. for the inbred under variable field conditions, there was a significant reduction in fitness. In other words, the results showed that it can be difficult to predict the outcome from multiple stress factors by studying the isolated effects they have on natural populations one by one.