UNIVERSITY OF GOTHENBURG

# Evolution of the brown algae *Fucus radicans* and *F. vesiculosus* in the Baltic Sea

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## Abstract

The aim of my thesis was to investigate neutral and adaptive evolution of a lineage of macroalga (*Fucus vesiculosus*) that entered the Baltic Sea about 6000 years ago, and later gave rise to a new endemic species, *F. radicans*. To examine whether the two species have adapted to local conditions of the Baltic Sea, or have been able to establish due to largely plastic phenotypes, we performed a reciprocal transplant experiment with *F. vesiculosus* from the North Sea, *F. radicans*, and *F. vesiculosus* from the Baltic Sea. The results show that both species have adapted to the brackish water conditions by evolving asexual reproduction and faster growth in low compared to high salinity. Noticeably, *Fucus radicans* was more extremely adapted than the Baltic Sea population of *F. vesiculosus*, which may be due to its endemism and lack of gene flow from populations outside the Baltic Sea. A population genetic survey unveiled that sexual and asexual reproduction are present in Baltic Sea populations of both species, although asexual reproduction is more common in *F. radicans* than in *F. vesiculosus*. We also found a complex population genetic pattern with partly geographic segregation of sexual and asexual reproduction. Furthermore, in *F. radicans*, a few clones were widespread and dominant, while most clones were rare and confined to single sites. Using a modelling approach we tested if such a complex population genetic structure can be the result of stochastic processes, as opposed to natural selection. We found that long-range dispersal in combination with asexual reproduction being successful also in the absence of other individuals, may result in the observed patterns of distribution of clones without invoking fitnesses-differences among clones. To test the alternative hypothesis, if the dominance of one clone may be due to differences in performance among clones, we compared three clones, and found inherited differences in traits that may affect fitness . The most widespread clone grew significantly faster than one of the other two clones, but did not show the highest capacity for asexual reproduction and thus did not show evidence of an overall higher fitness. Notably groups of individuals of the most widespread clone sampled in geographically separated areas, showed large differences in potential for sexual reproduction. We concluded that there were no clear evidence for selection among clones and thus we cannot reject a neutral explanation of the observed complex pattern. Finally, in an attempt to assess population aspects of the importance of interclonal variation we compared the performance of three monoclonal groups and a group with unique genotypes. We found variation in resistance to various stresses to be larger in the group of unique genotypes compared to the monoclonal groups. This suggests that genotypic diversity of a local population may affect its function and resilience. In this way, genotypic diversity may be critical for the adaptation to expected further changes in the Baltic Sea, although stochastic processes seems to have had major impact in structuring the early phase of establishment in the Baltic Sea.

**Keywords:** local adaptation, Baltic Sea, asexual reproduction, marginal environment