GÖTEBORGS UNIVERSITET

Phenotypic Plasticity and Adaptation Potential to Salinity in Early Life Stages of the Tunicate, *Ciona intestinalis* spB

Elin Renborg

Institutionen för biologi och miljövetenskap
Naturvetenskapliga fakulteten

Akademisk avhandling för filosofie doktorsexamen i naturvetenskap med inriktning mot biologi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras tisdagen den 29 april kl. 14:00 i stora hörsalen, Institutionen för biologi och miljövetenskap – Tjärnö, Hättebäcksvägen 7, 452 96 Strömstad

ISBN: 91-89677-61-7

Abstract

Species respond to environmental heterogeneity through a variety of mechanisms such as plasticity, genetic adaptation and phenotypic buffering. Determining how gene flow, scale of environmental heterogeneity and trait heritability influence these responses is important for understanding how these different mechanisms arise, which is a central task in the field of evolutionary biology.

For many marine organisms salinity is an important driver of environmental heterogeneity and physiological stress. As with many stressors, salinity stress is often more severe for early life-history stages such as embryos and larvae. The main aim of this thesis was to investigate underlying mechanisms that allow species to cope with environmental heterogeneities in their natural environment. More specifically, I focused on strategies to manage salinity differences in early life-history stages of the tunicate *Ciona intestinalis*. This marine invertebrate has a large geographical distribution and is considered highly invasive in some parts of the world. Plasticity in important fitness related traits is generally considered to promote invasiveness even though there is evidence that local adaptation also could play an important role in range expansions of invasive species.

Through investigations of population differences in larval performance, I wanted to understand what mechanisms allowed existing populations to inhabit different salinity regimes, explicitly focusing on the role of transgenerational phenotypic plasticity. Adult acclimation had a predominant effect on tolerance ranges of developing embryos and larvae, but there were also small signs of population differences that could be related to local adaptation and/or persistent environmental effects.

To better understand the potential for adaptation of larval salinity tolerance I used quantitative genetic methods to assess the extent to which larval performance in different salinities is a heritable trait. Heritable variation proved to be extremely low, suggesting limited potential for local adaption in investigated populations. The potential for local adaptation can be strongly influenced by gene flow between populations that inhabit different environments. *C. intestinalis* has pelagic larvae, which could disperse over relatively large areas, thereby preventing local genetic differentiation. Through a population genetic study we found that gene flow at times was restricted at much smaller scales than suggested by the dispersal potential of larvae. Population structures implied that physical barriers, such as density differences between water masses, restricted larval dispersal.

The study of sexual selection is an important field in evolutionary biology. Traditionally, it was assumed that sexual selection could not operate in sessile marine invertebrates with external fertilization. Today, however, there are many examples of mechanisms governing gamete interactions that allow eggs to "select" sperm. Our understanding of the underlying selective pressures, and indeed how these mechanisms affect fertilization success between individuals within a species, is however limited. I examined causes of variation in fertilization success in populations of *C. intestinalis*. I found significant variability in compatibility between parental genotypes, which indicated that this may be a way for individuals to avoid the negative effects of inbreeding.