

Svensson, Carl Johan (2006) Matrix modelling of open and closed populations.

Abstract: Populations of many kinds have long been subjected to different type of studies. For marine populations, much emphasis has been put on the population dynamics of closed, semi-closed and open populations, trying to elude the major processes that govern each type of population. Though advances have been made in this aspect, much remains to be investigated. All studies in this thesis contained models of populations and, collectively, these models aimed to analyse and compare the population dynamics of open and closed populations in various environments. To achieve this aim, matrix model techniques were used to construct species-specific data-based models, using barnacles as test species for open populations and algae as a test species for closed populations. Thus the first section of the thesis (**Paper I, II & III**) is a gradual development of the application of spatially implicit matrix models for analysing open populations, using barnacles as test species while the last section (**Paper IV & V**) consists of a validation of matrix model methodology for stochastic models of closed populations and applications of this methodology to a number of species, primarily to the brown algae *Ascophyllum nodosum* (Le Jol). Secondary objectives were then to investigate and probe the population dynamics of the different study-species, which included testing for possible effects on populations from changes in the environment. Overall, results suggested that the open populations of barnacles fluctuate more than the closed populations of algae. It was also concluded that there is greater regional variability among barnacle populations. This showed that increased regional connectivity between populations does not necessarily mean increased homogeny. This could be explained by the large differences in life-history between the barnacles and algae, where barnacle demography is more susceptible to environmental conditions. If this is the case, barnacles could function as indicators of climate change, at least at higher latitudes. It could, however, also be that *A. nodosum* has a life-history strategy that is more robust than that for barnacles and therefore functions well in various environments. Further experiments and genetic analyses could perhaps help us answer this question. Results also showed that open populations had excellent buffering qualities against changes in vital rates induced by environmental change, meaning that barnacle density remained unaffected at relatively high perturbation levels. Though closed populations also were shown to be quite resistant in terms of viability, the effects on biomass were visible already at relatively small perturbation levels. In summary, results from this study did not compile with the general agreement that closed populations should be more heterogeneous than open populations but they did at least show that open and closed populations can be different. However, it is quite clear that ecosystems and populations may work in a number of different ways and that the relative effects of changes in the environment on populations will have to be decided in each instance.

Keywords: models, demography, barnacles, algae, recruitment, survival, fertility, elasticity, management, evolution, environmental change

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