Sundelöf, Andreas. 2006. Modelling limpet dynamics in space and time. Department of Marine Ecology, Göteborg University, PO Box 461, SE 405 30 Göteborg, Sweden

Abstract: Fluctuations of populations in space and time have been observed and studied for centuries. Many different approaches have been used to interpret patterns and processes of these fluctuations. Still, much of the dynamics of marine benthic species are not understood.

Population change comes down to four processes governing population dynamics: births, deaths, immigration and emigration. This thesis studies these processes by covering the local demography, the production of larvae from local patches, the hydrodynamic forcing of spatially explicit dispersal and the local and regional population dynamics resulting from an open population structure.

For many marine invertebrates the prolonged pelagic larval stage of their life cycle complicates the assessment of births, since the production of larvae from a population will potentially be advected to distant populations for settlement. Here I extended a harmonic birth function to be dependent on population structure and size, and showed how the choice of birth function could affect population dynamics. Furthermore, the demographic rates that govern the reproductive output of open populations of limpets were investigated. In model simulations of the limpet *Patella vulgata* in the NE Atlantic, reproductive output was significantly cross-correlated to recruitment pulses. If there was variable recruitment into populations, there was also variable reproductive output. Temporal variation in supply and recruitment could may dynamic effects in connected sites, leading to complex interactions between local populations. Lower mean recruitment and higher coefficient of variation of recruitment produced stronger cross-correlations between recruitment and reproductive output.

With a spatiotemporal lag connecting distant populations through dispersal of larvae, advected by hydrodynamic forces, a stock-recruitment function is likely to occur at some scale. I predicted spatially explicit connectivity measures for a region of artificial reefs in the NW Adriatic Sea inhabited by the limpet *Patella caerulea*. I showed that behaviour of larvae influences dispersal kernels and that populations vary in their prospect of affecting their surrounding populations with supply of larvae. This variation led to a new consideration of sources and sinks in open populations. Variation in net export of larvae (source index) varies over time and may potentially cause regional fluctuations. However, many systems may be sufficiently interconnected to stabilise the supply signals into populations thus escaping this type of variability. Nonetheless, the understanding of the interplay between local dynamics and connectivity to produce pattern in space requires the development of new tools.

Keywords: Birth function, recruitment limitation, demography, hydrodynamic model, Lagrangian model, larval vertical migration, dispersal kernel, connectivity, source, sink, metapopulation, mesopopulation, meiopopulation

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