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Environmental drivers of gelatinous zooplankton distribution

Mnemiopsis in the Baltic

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Akademisk avhandling för filosofie doktorsexamen i biologi, som med tillstånd från Naturvetenskapliga fakulteten kommer att offentligt försvaras fredagen den 27 september 2013 kl. 10:00 i hörsalen, Lovéncentret – Kristineberg, Fiskebäckskil, Institutionen för biologi och miljövetenskap, Kristineberg 566, 451 78 Fiskebäckskil.

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Abstract

Factors governing zooplankton distributions and dispersal have since long interested pelagic ecologists. This thesis presents studies of how the interaction between gelatinous zooplankton and the environment can shape their distributions, either by biophysical drivers (**papers I-III**), or through interactions with predators (**paper III & IV**) or competing species (**paper V**).

In **papers I & II** we followed the newly invaded ctenophore *Mnemiopsis leidyi* population in Kattegat, Skagerrak and Baltic Proper during a year, and showed strong environmental restrictions on the sampled population. Salinity and temperature clearly influenced the presence of adult *M. leidyi* (**paper I**), and low transitional-to-adult ratios in the low saline Baltic Proper indicated a failed reproduction (**paper II**). Advection from the higher saline Skagerrak and Kattegat area to the Baltic Proper seem to sustain the sporadic population in the Baltic Proper. One way in which plankton organisms can alter their spatial distribution is trough their vertical positioning. In **paper III** we investigated the fine scale vertical distribution in field by the use of video methods. We show how some life stages (e.g. size) of *M. leidyi* performs diel vertical migration, suggestively in response to light. The presence of *M. leidyi* was also tightly coupled to higher salinities, where lower salinities in combination with strong stratification seemed to prevent the vertical migration.

In **paper IV**, we experimentally investigate the potential predation control of *M. leidyi* by *Beroe gracilis*. Applying the determined clearance rates to *in situ* distributions (from **paper I**) showed that *B. gracilis* has limited ability to control the *M. leidyi* population in the field, partly due to a predatory size refuge. Finally in **paper V** we used a theoretical approach to investigate the competitive relationship between gelatinous plankton and zooplanktivorous fish, depending on eutrophication and water clarity. Tactile predation by jellyfish makes them less dependent on water clarity than are visually foraging fish. The model predicted a two sized effect of eutrophication for organisms utilizing vision (fish) with an optimal degree of eutrophication and water clarity. Above this threshold, tactile predators like jellyfish would be favored over visual predators like fish.

The results from this thesis contribute to the understanding of how the environment acts to shape gelatinous zooplankton populations, and may on a larger perspective help to understand future potential invasions.

Keywords: Gelatinous plankton, environmental forcing, salinity constrain, species interactions, light, visual and tactile predator