Stockholm, 090402

Report from the project "Uppdatering av födovävsmodell BNI" by Thorsten Blenckner, Baltic Nest Institute, Stockholm Resilience Centre, Stockholm Universitet funded by Naturvårdsverket (Kust och Hav)

Syfte/Objectives

The main objective of this project was the improvement and the upgrade of the BNI food-web model in order to support management decisions about nutrient reductions and utilisation of the biological resources in the Baltic Sea.

The more detailed objectives of this project were as follows:

- a) to technically upgrade the Ecopath with Ecosim software (from version 5 to version 6)
- b) to correct the bugs in the current software
- c) to prepare boxes/links of external forcing functions such as climate, nutrients, fishing activity

This work required expertise from the developers of the model software at the University of British Columbia (UBC), Canada.

The co-operation with the Ecopath group, lead by Villy Christensen (University of British Columbia, Canada), who developed the Ecopath with Ecosim software (www.ecopath.org), was very successful and helped us to further improve the BNI food web model. I will now structure the improvements according to the above-named objectives.

To a):

We improved the BNI model which was based on Harvey et al (2003, Fig. 1) by adding more functional zooplankton groups which have been shown to largely influence the re-structuring of the Baltic Sea food-web (see for example Möllmann et al 2008). In addition, we added a box for cyanobacteria, which is important from the management point of view. Most importantly, we included a cohort-like structure for the three main fish species, i.e. cod, sprat and herring. This is very important as now the recruitment and young fish is directly related to older fish, which was not possible before due to software limitations. This enables us to study directly the effect of, for example, bad recruitment conditions due to low cod reproductive volume on the entire cod cohorts. All this was partly possible because Chiara Piroddi from the Ecopath group worked for one week intensively here in Stockholm together with us, whereby the remaining tasks where done in Canada. The new model structure can be seen in Figure 2.

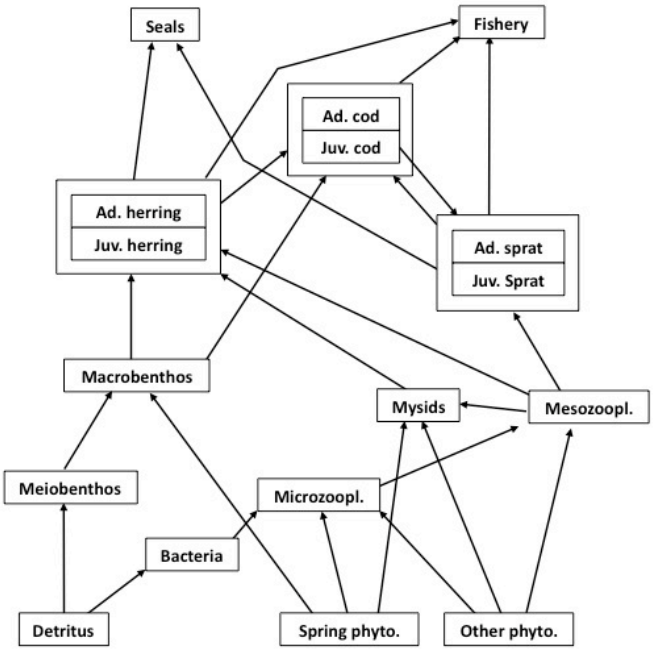

Figure 1. The old food-web model structure based on Harvey et al 2003.

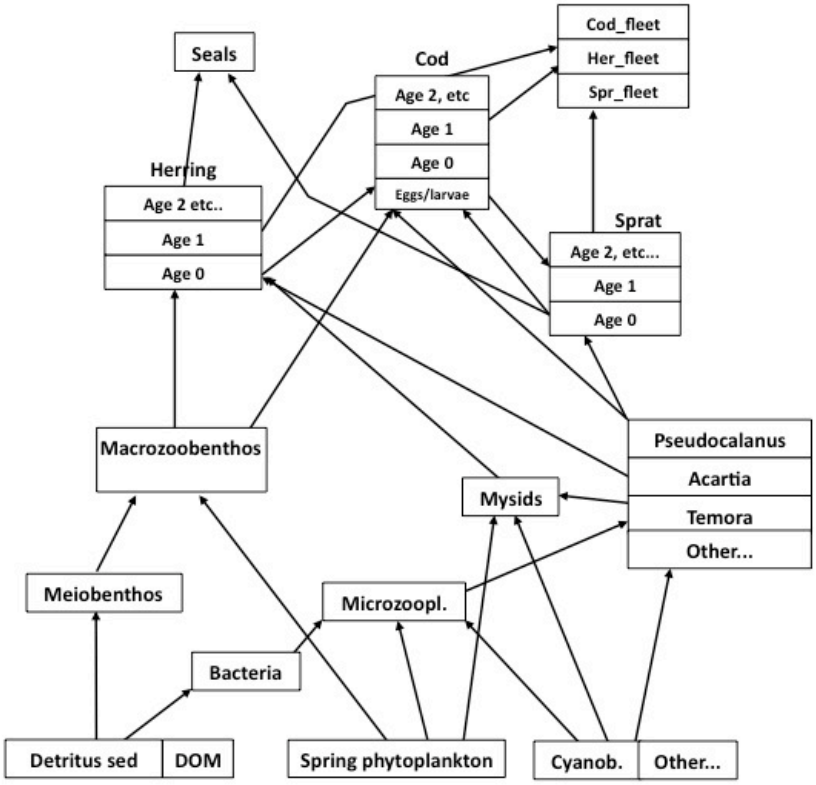

Figure 2: The new food-web model structure achieved during this project.

To b)
The programmers from the Ecopath group helped us intensively to fix the software bugs in the new software. We further got the source code of the whole Ecopath with Ecosim model (written in Microsoft .NET), so that we in the future will hopefully be able to work directly on the code. This is very essential as the interface of the software has still its limitations, whereby the code containing only the food-web model is very robust and adaptable.

To c)
We discussed intensively with the Ecopath group how to implement the link of the model variables to abiotic drivers, such as nutrient load, climatic variables, and fishery. In our new model, which has now been balanced and calibrated, we included the forcing functions of spring temperature on two zooplankton groups (*Acartia* and *Temora*), August temperature on sprat recruitment and cod reproductive volume on cod larvae. Further, we tested our new model within the ICES/HELCOM working group on integrated assessments of the Baltic Sea, together with seven other international models (ensemble modelling from single species, multiple species and very advanced models) and we found that overall the new Ecopath model provided suitable and comparable results. Further, within the working group we simulated different fishing and climate change scenarios. For example, we simulated the response of the zooplankton group *Temora* (important food source for young sprat) in relation to different sprat fishing and climate change scenarios (see Fig.3). The exercise within the working group will soon be available as a ICES report (http://www.ices.dk/workinggroups/ViewWorkingGroup.aspx?ID=199). These are of course preliminary tests, but we are a) confident that the model already now provides reasonable results and b) that the implementation of the external forcing functions was successful.

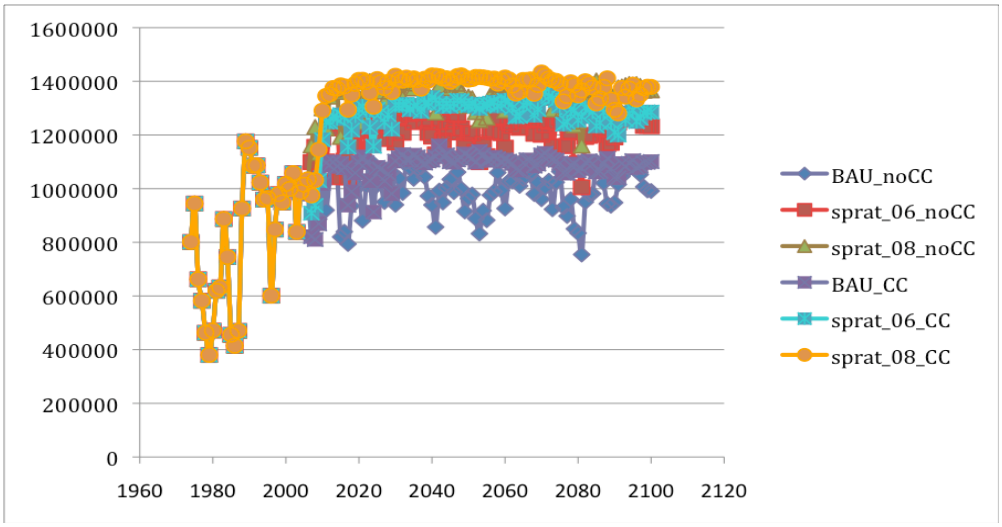

Figure 3: The biomass of the zooplankton Temora in relation to six scenarios. Two different sprat fishing scenarios (sprat_06 and sprat_08) with and without climate (CC, noCC) change and one business as usual scenario (BAU) with and without climate change (CC, noCC).

Conclusion

Overall, this small project funded by Naturvårdsverket was very important as it allowed us to further improve the BNI food web model by a new, more comprehensive structure, which includes now also several forcing functions. The next steps of the BNI food web model group will be to further test the model results, use the source code to run the model directly (and not via the current software) and to further test the coupling to the other NEST models.

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