Project information

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ECOAN WP IV Socio-economic consequences and management options
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Project leader
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Flagship
Ocean Acidification
Funding Source

Fram Centre, Ocean Acidification flagship

Summary of Results

As the project started in 2015, and is planned for 2015-17, there are no scientific results yet. We present here the work we have performed so far and the status on progress.

The aim of the project is to investigate if OA effects on lower trophic level organisms can lead to socio-economic consequences through impacts on commercial fish stocks, and explore relevant fisheries management options.

The work started in 2015 with the following tasks:

Task 1) BNM: Develop a Bayesian network model through a literature review and input from natural scientists in the ECOAN project.

Task 2) BEM: Choose and fit a bio-economic model suitable to assess socio-economic effects.

In the first part of the project period, the project group explored the possibility to integrate our approach with Bayesian network and bio-economic modelling into the comprehensive Atlantis-type ecosystem model for the Nordic and Barents Sea (NoBa) that IMR has established and is now refining. We also discussed the possibility to collaborate closely with the strategic institute project on ocean acidification at NIVA. This to avoid duplication of work and to utilise Norwegian research infrastructure and resources most efficiently. We had several video and physical meetings and workshops for this, including with people responsible for the NoBa model and the NIVA strategic institute project, and we have also worked on alternative approaches and designs on the Bayesian network model. We also participated and presented in a workshop arranged in Tromsø in June by the BioAcid project: Ocean acidification and warming in the Norwegian and Barents Seas: ecosystem changes and socio-economic impacts. Stakeholder workshop. 11th & 12th June 2015, Tromsø. Hosts: Prof. Dr. Stefan Goessling-Reisemann & Dipl.-Biol. Stefan Koenigstein, University of Bremen/Germany, Sustainability Research Center (artec).

In the second part of 2015 we planned and held a workshop (24/11-2015) to gather data/information relevant for the BN and NoBa models and scenarios from natural scientists in the Fram OA flagship. The aim of the workshop was to use expert knowledge i) to determine realistic values for future pH and temperature levels to use in scenarios up to year 2100; and ii) to investigate how the combination of key stressors OA (pH) and temperature might influence arctic zooplankton, specifically the impact on parameters in the NoBa model affecting the zooplankton population in the Barents Sea area. The data is meant to be used into a simple Bayesian Network Model, and also to be used in the NoBa model.

Seven persons participated in the workshop, in addition to the four persons arranging it. It included people with expertise on marine

biology and ecosystems (especially zooplankton and OA/climate change), chemical oceanographers, and ecological and marine bio-eco-chem-modellers. During the workshop the following issues were covered:

- General sensitivity of zooplankton to changes in pH and temperature;
- What are reasonable future pH and temperature scenarios towards year 2100;
- The functional zooplankton groups in the NoBa model and their "characteristic" species;
- General discussion on zooplankton reaction to pH and temperature changes;
- Range of changes in reaction of specific zooplankton functional groups of the NoBa model to pH & temperature changes.

Based on sensitivity analyses of how changes in the stocks of the different zooplankton functional groups affect the cod stock (the most valuable commercial fish stock) and discussion in the workshop it was decided to concentrate on the meso-zooplankton functional group (parameterized as *Calanus finmarchicus)*. It was also decided to consider the combined impacts of pH and temperature changes. As Calanus finmarchicus hibernate at rather great depths, the relevant temperature to consider for future impacts seems to be the summer temperature.

The first elicitation by the experts was on the likelihood of different pH and (summer) temperature conditions in year 2100 in the Barents Sea area. After the rest of the plenary discussions the experts did an individual expert elicitation on the likely impacts of pH and temperature changes on all the relevant zooplankton parameters for meso-zooplankton. The parameters that were considered were: a) Non-predator mortality; b) Final size (after growth); c) Ingestion rate; d) Nutritional content/value; e) Faster stage development. The experts indicated their best estimate/guesstimate of the probability of different states for each parameter: unchanged from today, and two different percentage changes from today's situation. This was done for different pH and temperature conditions.

The workshop was also to test out the format and design for expert elicitations, including the forms the experts used during it. After the individual elicitation we also attempted group expert elicitation. The timing, sequence and mix of plenary discussions, group elicitation, and individual expert elicitation seems to be important for getting answers that the experts are comfortable with are used for further analysis. The group exercise was seen as good, giving feedback/interaction between the experts on their reasoning and they think the quality of the estimates/guesses will improve.

The results from the workshop are now being analysed. We will identify where there are large differences in responses between the experts (individually or by groups). The results will be presented to the group of experts that took part, and discussed whether the results can be used for further analysis into the Bayesian network model and the NoBa model, or if there is need to refine/validate some of the results through repeated/additional expert elicitation or some other process.

In addition to the work with the expert elicitation workshop we are also considering how the NoBa model can be used for the assessment of the economic impacts on the commercial fisheries. The final output from the expert elicitation will be a comprehensive set of probability-assessed changes in pH and summer temperature for year 2100, and how the possible changes might affect the parameters impacting meso-zooplankton population. This will be used to run a relatively large number of simulations (100+) in the NoBa model, assessing the final impact on the zooplankton populations, and also the impact trough the ecosystem and especially onto commercial fish stocks. Given the format of the output from the expert elicitation the different simulations will also come with a probability assessment of their occurrence. The alternatives for investigating the economic impact on the commercial fisheries and possible management options include using the NoBa model directly, or using the output from the NoBa simulations to calibrate a simpler bio-economic model. The fishing fleet segment model of NoBa is still under development.

Published Results/Planned Publications

Not yet.

Communicated Results

At the workshop in June 2015 (see above) Eirik Mikkelsen gave a presentation titled: Ocean acidification and its socio-economic impacts in Norway.

Interdisciplinary Cooperation

The project group has competence in environmental and natural resource economics and management, bioeconomic modeling, ecology, fisheries management, identification and valuation of ccosystem services, environmental sciences, risk, ecological/environmental and Bayesian network modelling.

Budget in accordance to results

Funding from Fram centre.

Could results from the project be subject for any commercial utilization

No

Conclusions

Too early for conclusions.