IBAM: Integrated Bayesian risk analysis of ecosystem management in the Gulf of Finland

1st year report (1.1.2009–31.12.2009, months 1–12)

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1. Work conducted in the project in 2009

1.1. WP 1: Geographical analysis of the spread of the common reed (Phragmites australis) *in the Gulf of Finland*

The general aim of WP 1 is to model the historical and future development of the common reed (*Phragmites australis*). The WP leader is Dr. Heikki Pitkänen from SYKE.

Task 1 concentrated on collection of the existing data. 7 datasets were found altogether. A satellite mapping data from 1997-2001 was received from Southwest Finland Regional Environment Centre. Also aerial photographs were moved to ArcGIS, and reed areas were digitized from them. There are four different aerial photo sets used in the study. Two are from 2003, one from 2006. These are presenting the present situation. One aerial photo set is from 1961, describing the situation several decades ago.

Two locations in the Gulf of Finland, Svartbäck and Espoonlahti, were chosen to be the study areas. These areas were used in the analysis of all seven datasets. One location, Svartbäck, is analyzed and delivered to TKK for geographical and historical modeling, but Espoonlahti is still under processing.

A thesis from Turku University (Geographic School) with reed analysis from inner, middle and outer archipelago areas was taken into the data pool. CORINE land cover 2000 was compared with the other data sets. From these two data sets a part of the original data was clipped for ArcGIS analysis.

Task 2, modeling the ecological effects of the productivity changes of the common reed on the littoral community, has been started with literature review. The selection of species and modeling the effects of reed on them will be carried out at the beginning of 2010.

Task 3, the spatial modeling of the common reed, can be broken down into three stages; studying the reed ecology, investigation of the factors related to the reed spread, and building a simulation model. Reed ecology was deeply investigated by literature reviews and meetings with experts. Upon this investigation, a number of factors were proposed to serve as "explanatory variables" of the phenomenon. These factors include water depth, proximity to main river mouths, openness and wave exposure index, distance to shore, bottom type, and water nutrient level. Based on the available datasets, some of these factors were statistically found to be strongly correlated with the current reed coverage density and, therefore, will be incorporated in the simulation model as explanatory variables. Factors which had strong correlation with reed coverage include proximity to main river mouths and distance to shore.

1.2. WP 2: Herring fisheries analysis by Bayesian quotas and by stakeholder specific risk models

WP 2 concentrates on developing an alternative for the current TAC policy in the EU. The WP leader is prof. Noél Holmgren from US. The following work has been conducted within WP 2 in 2009:

Task 1: Determining the production capacity of the Baltic Herring (US). Document Database has been compiled on the Baltic herring catches, fishing mortality, SSB, recruitment, weight-at-age

based on: 1) ICES Baltic Stock Assessment WG Reports for 1990–2009, 2) IBSFC Annual Meeting Proceedings – management measures related to the Baltic herring for 1990–2005, and 3) ICES Advice on the Baltic herring stocks – 1990–2009. Based on that information the main parameters of the recent fisheries management system for the Baltic herring are determined.

Based on ICES data and population viability analyses (PVA), there is a significant negative density-dependence of spawning stock biomass (SSB) on number of recruits in the following year. Hence, there is at least theoretically a SSB at which the population is at its maximum production. This should also be the target SSB for "maximum sustainable yield" (MSY) fisheries.

Task 2: Target population sizes (US and UT). We have obtained the target populations size for the Main Basin by building a population model of the Herring. The model is subsequently used for evaluating Bayesian Quota (Task 3). The population model is age structured from age 1 to 8+, in accordance with ICES data. Model parameters were obtained from statistical analyses of ICES data/ model results. Predation from Cod has a significant impact on natural mortality, and more so the younger the Herring. Growth in body mass was found to depend on age and body mass itself. There is a significant amount of inter-annual co-variation between age-classes related to a still unknown effect (will be studied later when the connections in the Bayesian net will be established). The year-effect also exhibits a negative trend, i.e. annual body mass growth has declined in the Baltic Herring from 1974 to 2006. This is alarming, because smaller Herring is found to produce smaller recruits. The production capacity in tonnes of the Herring (and as an eco-system service) has thus declined in the Baltic.

Task 5: The effect of the environmental trends of eutrophication and warming (=unknown trends). ArcGIS map layer presenting the bladder wrack *Fucus vesiculosus* (most essential spawning substrate of the herring) distribution along the Estonian coast of the Gulf of Finland is developed based on the data of UT.

Task 9: Participatory process (UT). Central modules of the web-based decision support system (DSS) for efficient participatory process of consensus building are developed and will be used in a course of the project realization. IBAM CONSENSUS DSS is allowing interactive reordering of individual priorities followed by immediate feedback from the system regarding how much a change in individual choices impacts the possible final decision. The system is allowing also interactive reordering of current consensus (ranking aggregation) to evaluate a) the minimal reordering of all individual priorities to reach the consensus, and b) the minimal reordering of priorities of defined stakeholder groups (e.g. coalitions) to reach the consensus.

1.3. WP 4: Development of the decision support system (DSS)

The main aim of WP4 is to develop a decision support system (DSS) that can be used to analyze the risk management of four themes: climate change, eutrophication, oil spills and harvesting. The WP leader is prof. Ari Jolma from TKK.

In WP 4.1, the first draft of the integrative model to be included in the DSS was developed (UH). This model includes four main risk factors and a group of random variables describing the relevant environmental factors. The most potential variables and interactions were studied by going through literature and by interviewing experts. Also the work concerning the submodels

that will be integrated to the final integrative model was started for the Common eider by building a model describing the population dynamics (UH).

In the original research plan, the tasks 1 (6 MM, SYKE) and 2 (2 MM, TKK) were planned to be done in WP 4 during year 2009. The task 1 concerns updating the current estimates of future eutrophication and uncertainties related to management actions, and the task 2 concerns identifying additional data needs for the DSS. Both tasks were postponed to year 2010 as work of SYKE and TKK concentrated on WP 1 and there were no immediate tasks depending on those tasks.

1.4. WP 5: Management and dissemination

The management of the project has been conducted successfully by the coordinator (UH). The following was performed in 2009:

UH has created the web-pages for the project and set up the wiki-system for the internal communication between the partners. The wiki is used regularly and it is found to be a useful tool for effective communication within the project. Also Skype – meetings have been carried out.

The following official project meetings were held in 2009:

- 1st meeting: Espoo, Finland, 12–13 January 2009
- 2nd meeting: Karlskrona, Sweden, 13–14 May 2009
- 3rd meeting: Tallinn, Estonia, 29–30 October 2009

In addition, regular skype-meetings were launched.

The presentations on the project held at international conferences/workshops in 2009 include:

- BONUS kick-off, Otaniemi, Espoo, 13 January 2009 / Sakari Kuikka (UH)
- "The marine ecosystem in changing climate" workshop, Norrköping, Sweden, 16 October 2009 / Inari Helle (UH)
- "Coping with Uncertainty" conference, Stockholm, Sweden, Nov 15–17, 2009 / Annukka Lehikoinen (UH)

Two manuscripts have been produced for publication (they will be submitted in 2010):

- A paper describing the dependency of coastal fish production on environmental variables, including nutrients, salinity and a proxy for temperature
- A paper describing the possibilities of oil combating methods to decrease the biological risks of oil on a group of species

Other relevant presentations and stakeholder meetings related to IBAM work include:

- Two presentations at the ICES Annual Science Conference, 21–25 September 2009, Berlin, Germany.
    - R. Aps & H. Lassen (2009) EU Common Fisheries Policy reform: co-production of science and policy. ICES CM 2009/R:10, 16 p.

    - R. Aps, H. Lassen & I. Liiv (2009) Baltic Sea Regional Advisory Council as facilitator between science, industry and policy. ICES CM 2009/O:25, 10 p.
- Participation and discussions on the objectives of IBAM (Bayesian quota) at the Baltic Fisheries Assessment Working Group meeting, April 2009, Copenhagen, Denmark.

The researchers of UH organized in co-operation with PROBAPS project a one-day workshop on Bayesian network methodology in December, in which several researchers working in IBAM participated. In addition, a PhD course on the same subject was planned to be held in August. However, as the funding was not received from the BONUS EEIG, the course had to be cancelled, but it can possibly be organized later on.

2. Comparison with the original research and financial plan

WP 1: Part of the work in Task 1 is still going on, but the financial plan is not changed. The data processing will be ready in February 2010. Task 2, modeling the ecological effects of the productivity changes of the common reed on the littoral community, is still going on and will be finalized in months 13–18. No need for financial plan is needed. The work for Task 3 was planned to start in the second year (2010). However, as the results of this work package will be used as an input for other tasks (namely T1.4 and T4.2), the work started earlier than scheduled and will continue for the coming period as planned.

WP 2: There are no major deviations from the original research plan by UT and US. A small delay has been in the way how oil spill impacts are estimated for herring, but this has no impact on project progress, because the only the final results will need this element.

The financial plan is slightly underutilized by UT and overutilized by US.

WP 4: Task 1 was originally planned for months 1–6 and it has now been postponed to months 13–18. Task 2 was planned for months 7–9 and it is now postponed for months 14–16. These changes are not major and do not have an effect on the schedule of other tasks.

WP 5: There are no deviations in the management plans. The financial plan is somewhat underutilized due to the maternity leave of Dr. Laura Uusitalo.

These minor differences between the original research plan and the realization have been acknowledged and the corresponding adjustments to the Gantt chart will be done.

3. Changes in research plan and/or deliverables

There are no major changes in the research plan or in the deliverables. However, the titles of the deliverables D1.1 and D1.2 were changed into more descriptive ones. The new names of deliverables are “The spatial reed simulation model with a geographical interface” and “Spatial probabilistic datasets of reed, its spread, and its estimated impacts on other biota and property values”, respectively. The adjustments were approved by EEIG Secretariat.

4. The influence of third parties on the working program

During the first year of work, some very interesting possibilities for co-operation with ongoing BONUS+-funded and other projects were recognized and partly carried out. These include:

ECOSUPPORT (Advanced tool for scenarios of the Baltic Sea ECOsystem to SUPPORT decision making), funded by BONUS+. The possibilities to include new results provided by ECOSUPPORT project regarding the future changes in salinity, SST and ice conditions in the Gulf of Finland were discussed. The discussions will continue in 2010.

Suomenlahden rehevöitymisen hallinta (SUHA) project ("Controlling the eutrophication in the Gulf of Finland"), funded by Ministry of the Environment, Finland. The project updated the SYKE-EIA 3D physical-biogeochemical model to a new five year period, which will be used to update the estimates on future eutrophication in IBAM. The project also concentrated in improving the description of sediment processes and nutrient fluxes in the model. The results of the project will benefit the IBAM project vitally.

5. Expected changes in the working plan or deliverables

There are no major changes to be expected in the work plan or in deliverables.